APPENDIX D
Earthjustice References

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EARTHJUSTICE

June 21, 2024

VIA ELECTRONIC SUBMISSION

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Re: Public Participation for the Carbon TerraVault 1 (CTV 1) Carbon Capture and Storage Project

Dear Ms. Oviatt and Mr. Alvidrez:

We are writing to provide feedback and recommendations on the public participation process for the Carbon TerraVault 1 Project (the CTV I Project) for carbon capture and storage (CCS) in the Elk Hills oil field. Our organizations advocate on behalf of frontline communities throughout Kern County who have long been overburdened by the oil and gas operations and polluting industries that CTV I now threatens to prolong. As the County moves to the next stages of its CEQA review for the Project, we urge the County to build on the positive steps it has taken to facilitate public participation, address problems in the process thus far, and provide meaningful opportunities for community engagement going forward that takes residents' concerns and input seriously.

Indeed, this Project is expected to be the first facility-level deployment of CCS technology in California and involves a range of complex environmental and public health issues that could impact nearby community members, other Kern County residents, and the broader San Joaquin Valley for decades to come. The public, and frontline communities in particular, must be given sufficient time and space to fully review and vet this Project.

We want to acknowledge at the outset that the County's efforts to make its CEQA process for this Project more accessible are a step in the right direction. Namely, the County provided notices for the joint public workshops it convened with U.S. EPA in English and Spanish, along with separate instructions in both languages on how to participate virtually. The County also provided Spanish interpretation during the workshops, and the agencies' respective PowerPoint presentations were posted in both English and Spanish. Community members appreciated that the workshops were conducted in-person and virtually, and that the in-person workshops took place in the communities surrounding the Project.

These efforts go a long way toward making it easier for residents to access information and participate in the CEQA process. We hope to see the County adopt similar measures in other proposed projects to facilitate more effective and equitable public participation.

Despite these positive steps, the County's CEQA process has still presented obstacles that have impaired community members' full participation and engagement so far. Most critically, the County's collaboration with EPA during the joint workshops, while helpful in some respects, also created ongoing confusion for community members who wished to participate in the process. It was often unclear which agency was accepting public comments at each workshop, whether the County or EPA or both, and whether those comments would be accepted by the relevant agency in writing or verbally. For example, many residents intended to share verbal comments to the County regarding the Draft EIR for the Project during the joint workshop on February 28, 2024, but were confused to learn at the workshop that only EPA was accepting comments. To the extent the County and EPA intend to continue to coordinate going forward, we urge both agencies to clearly notify the public who will be taking public comments, when, and in what form.

Another obstacle to public access includes the fact that the County did not provide a Spanish-language version of any portion of the Draft EIR or Recirculated Draft EIR, which prevents many residents from meaningfully participating. This is critical for a project of this novelty and complexity. Kern County has a significant opportunity to rebuild trust with community members who would be impacted by CTV I and its associated polluting facilities via the CEQA process for this Project. Ensuring that environmental documents are accessible, and that residents feel safe and comfortable sharing their concerns and input throughout the process is a necessary baseline.

As a result, the County should take additional steps to address the flaws in its public participation process and ensure better community engagement going forward. Both the Draft EIR and Recirculated Draft EIR for the Project reveal the magnitude of impacts facing County residents. Indeed, in addition to "significant and unavoidable" impacts from the Project on Air Quality, Greenhouses Gases, and Mineral Resources in the County, the County found cumulatively significant impacts on Aesthetics and Visual Resources, Agricultural Resources, Air Quality, Biological Resources, Cultural Resources, Energy, Geology and Soils, Greenhouse Gases, Hydrology and Water Quality (Groundwater Supply), Mineral Resources, Noise, and Utilities and Service Systems (Groundwater Supply).[1]

In light of the scope, novelty, and highly technical nature of the Project, and the extensive public comments submitted on the Draft EIR, the County has decided to take additional time before it proceeds with its CEQA process. On June 4, 2024, the County also published a Recirculated Draft EIR, and announced a new comment period ending on July 18, 2024. It is our understanding that the County does not intend to conduct additional public workshops on the Recirculated Draft EIR, however, there are still concrete measures available to ensure local residents can engage meaningfully in the process moving forward. We urge the County to take the following steps as soon as possible to address the problems in its public participation thus far:

[1] CTV I RDEIR at 1-11 to 1-16.

- Publish in Spanish all notices related to the Project, including any notice of availability, notices of public workshops, meetings, and hearings, and any notices of determination (if applicable), in recognition of the significant number of linguistically isolated residents in Kern County and the fact that roughly 20% of County households are designated as Spanish speaking with limited English proficiency.[2]

- Translate into Spanish and post, at a minimum, the Executive Summary of the Recirculated Draft EIR and the text of all mitigation measures as soon as possible and at least 45 days before the Kern County Planning Commission hearing on the Project.

- Provide, at a minimum, a summary in Spanish of all the changes made in the Recirculated Draft EIR following the new comment period and publish the summary concurrently with the Final EIR.

- Ensure that any future workshops the County may schedule related to the Project are easily accessible to Spanish-speaking and low-income community members by: (a) inviting residents to ask questions or offer comments in Spanish; (b) providing two-way, simultaneous Spanish and English interpretation services for any oral presentations and all verbal comments; and (c) providing a Spanish-language version of any slides or other written materials.

- Postpone the Kern County Planning Commission hearing on the Project scheduled for August 22, 2024, and make the Final EIR publicly available well in advance of the hearing, so the public has an opportunity to review the document and provide comments before the Commission votes on it.

- Schedule the Kern County Board of Supervisors hearing for the Project a minimum of 28 days after the Planning Commission hearing, so that the County and the public will have sufficient time to respond and consider any issues and comments that arise during the Planning Commission hearing.

- Ensure that hearings before the Kern County Planning Commission and Board of Supervisors are easily accessible to Spanish-speaking and low-income community members by: (a) inviting residents to ask questions or offer comments in Spanish; (b) providing two-way, simultaneous Spanish and English interpretation services for any oral presentations and all verbal comments; (c) providing a Spanish-language version of any slides; and (d) allowing residents to join the hearings by phone, computer, or in person.

- Clarify for any County meetings, workshops, and hearings conducted jointly with other agencies which agencies will be accepting public comments, whether those comments will be accepted verbally and/or in writing, and which agency is in charge of receiving and responding to comments.

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[2] U.S. Census Bureau, *Limited English Speaking Households, Kern County, California*, https://data.census.gov/table/ACSST5Y2022.S1602?t=Language%20Spoken%20at%20Home&g=050XX00US06029 (as of May 30, 2024).

As our State's bedrock environmental protection and community right-to-know law, the California Environmental Quality Act was intended to allow the public to gain full information about proposed projects and to participate meaningfully in government decisions. Allowing sufficient time to review the EIR for this Project and taking steps to include Spanish-speaking residents would allow members of the public to provide relevant input to the County on this important matter and can lead to better, more equitable results.

Thank you for considering this request. We welcome the opportunity to work with you moving forward.

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Via Email
July 18, 2024

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Re: Comments on the Recirculated Draft Environmental Impact Report for Carbon TerraVault I

Dear Mr. Alvidrez:

On behalf of Center for Biological Diversity, Center on Race, Poverty & the Environment, Central California Environmental Justice Network, Central Valley Air Quality Coalition, and Sierra Club, we are writing to submit the following comments regarding the Recirculated Draft Environmental Impact Report (the Recirculated Draft EIR) for the Carbon TerraVault I Project (the CTV I Project) for carbon capture and storage (CCS) in the Elk Hills oil field. These comments are offered to ensure that Kern County (the County) complies with the California Environmental Quality Act (CEQA)[1] and CEQA Guidelines[2] in its consideration of the CTV I Project.

In addition, we submit technical expert analyses prepared by Ron Sahu, PhD, QEP, CEM (Attachment A); Dominic DiGiulio, PhD (Attachment B); and Richard Kuprewicz (Attachment C). We refer the County to these reports, both here and throughout these comments, for further discussion of the Recirculated Draft EIR's inadequacies.

These comments build upon previous comments we submitted on March 1, 2024 in response to the original December 19, 2023 Draft EIR for the CTV I Project. The Recirculated Draft EIR fails to remedy the legal deficiencies noted in our previous comments, and for those reasons and others it is inadequate under CEQA. This letter supplements and expands upon the arguments in our prior letter, but it is not intended to be exhaustive and incorporates by reference arguments made previously.

Because the County's approach to the CTV I Project has not materially changed, our requests remain the same. As in our previous letter, we urge the County not to double down on a CCS project that is designed to facilitate continued fossil fuel extraction and combustion in the County for years longer than necessary. By extending the life of the Elk Hills oil field and the existing gas plant and power plant supporting the field, and justifying the build-out of multiple new polluting facilities as future CO_2 sources, the CTV I Project will ultimately exacerbate pollution and ongoing harms to the County's frontline communities. Rather than further locking

[1] Pub. Resources Code, § 21000 *et seq*.
[2] Cal. Code Regs., tit. 14, § 15000 *et seq*. (CEQA Guidelines).

in its dependence on the fossil fuel industry, the County should adopt measures that improve health and safety protections for local communities already threatened by oil and gas operations, and invest in the transition to renewable clean energy solutions.

We also continue to urge the County to conduct a genuinely inclusive public process for the CTV I Project, which should allow for the County's many Spanish speakers to participate meaningfully. Issuing a Recirculated Draft EIR without a detailed summary of revisions made to the original draft,[3] and without notations or other clear indications of changes made to the text (e.g. underlined or italicized text), has the opposite effect and creates burdens for the public to participate in the County's decisionmaking process. Given the magnitude of the industrial activities authorized by the Project and the long-term threat these activities pose to community members' health and safety, the County's already overburdened residents deserve a reasonable opportunity to provide input on a decision that will disproportionately affect them. To that end, our organizations submitted a letter on June 21, 2024 outlining additional steps the County must take to address the flaws in its public participation process for this Project and ensure better community engagement going forward.[4] We have not received a response to that letter to date.

As with the original Draft EIR, the Recirculated Draft EIR is missing critical details about the CTV I Project and is vague throughout, making it impossible to sufficiently analyze the range of impacts due to the Project and to adopt adequate mitigation measures. The Recirculated Draft EIR therefore fails in its basic purpose of being an informational document "to provide public agencies and the public in general with detailed information about the effect that a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project."[5]

After carefully reviewing the Recirculated Draft EIR, we have nonetheless concluded that it suffers from the same flaws as the original Draft EIR and similarly fails in numerous respects to comply with CEQA. As explained below, the Recirculated Draft EIR violates CEQA because it fails to: (1) properly define the project description and the scope of the CTV I Project's foreseeable impacts; (2) adequately analyze and mitigate growth-inducing impacts; (3) employ appropriate Project objectives; (4) properly consider alternatives to the Project; and (5) adequately analyze and mitigate numerous foreseeable environmental impacts and cumulative impacts. As the first CCS project of its kind to undergo environmental review in California, the Recirculated Draft EIR for CTV I falls far short of establishing appropriate standards and safeguards should more of these projects move forward in the future.

For these and the additional reasons expressed below, we strongly urge the County to reject the Recirculated Draft EIR as an informational document, and to prepare and circulate a revised version that complies with CEQA.

We include a table of contents on the next page to facilitate review.

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[3] CEQA Guidelines, § 15088.5(g).
[4] Letter from undersigned groups to Kern County Planning & Natural Resources Dept., *Re: Public Participation for the Carbon TerraVault 1 (CTV 1) Carbon Capture and Storage Project* (June 21, 2024).
[5] See Pub. Resources Code, § 21061.

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I. THE RECIRCULATED DRAFT EIR'S ANALYSIS AND MITIGATION ARE BASED ON AN IMPROPER PROJECT DESCRIPTION

CEQA aims to foster greater transparency in order to ensure that decisionmakers and stakeholders are informed of potentially harmful environmental consequences of proposed projects, receive a clear and robust analysis of those consequences, and are assured that feasible mitigation is implemented. This level of transparency requires a complete understanding of the project and an analysis that encompasses the project's full scope. "Only through an accurate view of the project may outsiders and public decision-makers balance the proposal's benefits against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal . . . and weigh other alternatives in the balance."[6] Here, the County does not achieve the level of transparency required by CEQA because of an inappropriately narrow project description.

Under CEQA, a "project" is defined as the whole of an action that has the potential to cause direct or indirect physical changes to the environment.[7] A project description that omits integral components of the full project may result in an EIR that fails to disclose all the impacts of the project.[8] EIR project descriptions have been rejected as inadequate when, as is the case here, the EIR limited the scope of environmental review by artificially narrowing the project description, thus minimizing the project's impacts and undermining public review.[9]

A proper description and analysis must include "future action" that is "a reasonably foreseeable consequence of the initial project" and would "be significant in that it will likely change the scope or nature of the initial project or its environmental effects."[10] As explained below, the Recirculated Draft EIR fails to include the whole of the action in its analysis, and to analyze reasonably foreseeable and significant consequences of the CTV I Project.

The Recirculated Draft EIR's scope is too narrow because it fails to address critical components of the CTV I Project, including the Project's effect on the development of industries in Kern County that will send CO_2 for sequestration to the Elk Hills oil field, and the effect of the Project on the development of CO_2 transportation infrastructure. The narrow and vague

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[6] *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 192.
[7] CEQA Guidelines, § 15378(a); see *Habitat Watershed Caretakers v. City of Santa Cruz* (2013) Cal.App.4th 1277, 1297.
[8] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829 (project description for sand and gravel mine omitted water pipelines serving project); *City of Santee v. County of San Diego* (1989) 214 Cal.App.3d 1438, 1454 (concluding that complete project description is necessary to ensure that environmental impacts of entire project are considered).
[9] See, e.g., *Rural Landowners Assn. v. City Council* (1983) 143 Cal.App.3d 1013, 1024 (EIR for city general plan amendment and rezoning that failed to describe or analyze the impacts of development that would follow annexation to the city); *County of Inyo, supra*, 71 Cal.App.3d at 193 (EIR for groundwater pumping and water export project that failed to describe or analyze groundwater exports and instead improperly sought to characterize expanding groundwater exports as a separate, ongoing project).
[10] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal* (1988) 47 Cal.3d 376, 396, as modified on denial of reh'g (Jan. 26, 1989).

description of the Project and its scope also renders the Recirculated Draft EIR informationally inadequate.

The project description states that CTV I includes "the construction and operation of an approximately 9,104-acre carbon capture and storage (CCS) facility with related capture facilities and pipeline for the initial source."[11] That "initial source," according to the Recirculated Draft EIR, would be the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility and used at the Elk Hills power plant. The Recirculated Draft EIR goes on to say that "[n]o additional sources of CO_2 (from outside Elk Hills) or other new development are proposed for the CCS Surface Land Area or injection into the project."[12]

However, as the Recirculated Draft EIR makes clear, the "initial source" it analyzes is only the first among several sources that will inevitably send CO_2 for storage in the Project:

> Only one source has been identified and is analyzed in this EIR: existing Elk Hills field gas streams in specific locations. That operation, which is related to oilfield operations, will not provide enough captured CO_2 to produce the maximum injection capacity […] *Additional existing and new CO_2 sources, completely outside the CCS boundary of 9,104 acres, will need to be permitted and conveyed to CTV I for permanent underground storage*.[13]

The Recirculated Draft EIR also makes clear the initial source is a minor source: the storage reservoirs have the capacity to store almost 50 million metric tons (MMT) of CO_2, and the Project proponent is seeking to approve *the whole project's storage capacity* in the Recirculated Draft EIR.[14] At the same time, the Recirculated Draft EIR's analysis discloses that at a maximum, the initial source's CO_2 will add up to 203,485 tons per year (tpy) of captured CO_2.[15] Even this number is hypothetical and might in fact be much lower, as it assumes continuous operations of the power plant into the year 2045, while the Recirculated Draft EIR admits that the plant "may be forced to close sooner" due to California's fossil fuels policies.[16] Assuming a continuous injection from the initial source over the next 20 years, that source will at most provide about 4 million tons total of CO_2 for injection, leaving a minimum of about 45 million tons to be sent from other sources.[17]

It is also evident that the Project has no financial or practical viability without its future sources, beyond the initial source. The Recirculated Draft EIR explicitly admits that "[t]he life of the project is dependent on the sources permitted for injection into the storage" and on "the

[11] RDEIR, Vol. 1 at 3-1.
[12] RDEIR, Vol. 1 at 3-1.
[13] RDEIR, Vol. 1 at 3-13 (emphasis added).
[14] RDEIR, Vol. 1 at 4.8-19.
[15] RDEIR, Vol. 1 at 3-2.
[16] RDEIR, Vol. 1 at 4.8-24.
[17] Of course, as discussed in the cumulative impacts section of this comment letter below, a scenario where the vast majority of CO_2 over the life of the Project comes from the initial source is impossible, given the projections of CO_2 sourcing in the initial years of the Project and the disclosures made in the EPA Class VI permit applications as well as the California Air Resources Board (CARB) CCS Protocol certification.

ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[18] That financial dependency is also stressed in the Recirculated Draft EIR appendix titled "Envisioning a Carbon Management Park." This report states, regarding a potential carbon sequestration project, that "[f]or those wells to be cost effective, there will need to be a significant source of CO_2 – on the scale of millions of metric tons annually – available for injection."[19]

While the Recirculated Draft EIR acknowledges that other sources could be sending CO_2 to the Project, it fails to disclose all the meaningful information regarding these sources and, most importantly, it fails to disclose and analyze the sources' potential impacts.

In response to the comments that were submitted regarding the original Draft EIR for the CTV I Project released in December 2023, the County added to the Recirculated Draft EIR a new short section titled "Future Sources – Identification."[20] In this section, the County briefly describes companies that "have announced contractual relationships or interest in locating on [California Resources Corporation (CRC)] properties outside CTV I project boundary or sending CO_2 for injection at CTV I."[21] The Recirculated Draft EIR lists six broad potential sources and describes their purpose and status in a few lines. Out of the six, the Recirculated Draft EIR states that four have entered into a Carbon Dioxide Management Agreement (CDMA) with the Project's applicant CRC. The Recirculated Draft EIR notes that one of the two other potential sources is in "preliminary commercial discussions with the applicant" (the Avnos direct air capture (DAC) project). For the last one, the Elk Hills Power Plant, the Recirculated Draft EIR states that the "CalCapture project would explore capturing CO_2 emissions" from the CTV I Project's operations.[22]

In addition, the "Future Sources – Identification" section states that future sources of CO_2 will be "limited" to specific "industries" within Kern County. These "industries" include "hydrogen — green and blue," biomass carbon removal and storage (BiCRS), cement production, green steel production, oilfield field gas streams, power plants, DAC, and alternative fuel production.[23]

The Recirculated Draft EIR also includes an updated list of "cumulative projects." The list includes seven other CCS projects, two "Carbon Capture and Transport for Storage" projects, five oil and gas extraction projects (as well as the County's oil and gas ordinance), two DAC projects, and five other projects that can be potential CO_2 sources, including hydrogen and alternative fuels, and the "CTV Clean Energy Park" that is described as "multiple projects."[24]

Just as in the original Draft EIR, the Recirculated Draft EIR provides nothing more than the name, location, type, acreage, and status of each project. Most projects' status is described in the Recirculated Draft EIR as "Not submitted – media PR," some as "Application incomplete"

[18] RDEIR, Vol. 1 at 4.8-24.
[19] RDEIR, Vol. 2, App'x K.2, Envisioning A Carbon Management Business Park at 3.
[20] RDEIR, Vol. 1 at 3-13 to 3-15.
[21] RDEIR, Vol. 1 at 3-14.
[22] RDEIR, Vol. 1 at 3-15.
[23] RDEIR, Vol. 1 at 3-13.
[24] RDEIR, Vol. 1 at 3-45 to 3-47.

and some as "EIR in process."[25] The Recirculated Draft EIR does not provide any useful information on the reason why these projects are listed as cumulative, and whether they are potential CO_2 sources for the Project, or whether they are expected to have cumulative impacts for other reasons.

The Recirculated Draft EIR explains that all information regarding potential CO_2 sources has been provided by the applicant and, "if and when" any of them advances further, it will require a new environmental review process. Therefore, the Recirculated Draft EIR concludes:

> [T]hese projects are not required to be analyzed further in this EIR as approval of the project does not compel approval, nor presume completion, of any other of the contemplated projects, no applications of these other projects are pending before the county, and there is not otherwise sufficient information available to allow for meaningful environmental review of the other projects at this time.[26]

This project description violates CEQA for several reasons: first, it fails to analyze the whole of the action and presents a partial and misleading picture of the proposed development. Second, it contradicts the Recirculated Draft EIR's analysis of greenhouse gas impacts, and finally, it omits important project elements.

A. The Project Description Fails to Analyze the Whole of the Action That Has Potential to Cause Changes to the Environment.

A proper project description and analysis must include "future action" that is "a reasonably foreseeable consequence of the initial project" and would "be significant in that it will likely change the scope or nature of the initial project or its environmental effects."[27] The Recirculated Draft EIR's project description fails in both aspects.

1. The future CO_2 sources are a reasonably foreseeable consequence of the initial Project.

The Recirculated Draft EIR's representation of future sources is both lacking and misleading, leaving the document inadequate as an informational document under CEQA.

First, the new "Future Sources – Identification" section downplays the financial dependency of the Project on its CO_2 sources, and in particular the financial relationships between the Project proponent and those sources. The County inappropriately hides behind the argument that all information is provided by the applicant, and that the County is "not party" to financial agreements.[28]

The County's argument ignores the fact that the applicant *is* a party to these agreements, however, and can shed more light on the financial connections between the CTV I Project and its

[25] RDEIR, Vol. 1 at 3-45 to 3-47.
[26] RDEIR, Vol. 1 at 3-14 to 3-15.
[27] *Laurel Heights*, *supra*, 47 Cal.3d at 396.
[28] RDEIR, Vol. 1 at 3-14.

future sources. More importantly, this argument ignores publicly available information showing that the financial ties between CRC and its sources go beyond carbon management agreements. In fact, several of these projects contemplate CRC, CTV, or affiliated or subsidiary companies possessing an "equity stake" in the CO_2-sending facilities.[29] As CRC has noted publicly, these projects "play an important role within Carbon TerraVault's strategy" in developing the Project.[30] It is the County's responsibility to ensure it obtains all relevant information from CRC in order to disclose, assess, and mitigate Project impacts.

As explained above, the Recirculated Draft EIR admits that the Project is financially and practically dependent on future sources permitted for injection into the storage reservoirs.[31] The Recirculated Draft EIR's argument that "approval of the project does not […] presume completion […] of any other of the contemplated projects"[32] is thus misleading. This statement downplays the fact that the Project has no practical or financial justification without its CO_2-sending sources. These sources are not just a reasonably foreseeable consequence of the initial Project, but also an inseparable part of it, and must be properly disclosed and analyzed in the Recirculated Draft EIR.[33]

2. The future CO_2 sources are significant because they will likely change the scope or nature of the initial Project or its environmental effects, and the Recirculated Draft EIR must be revised to disclose and analyze these impacts.

An accurate and stable project description is necessary so that the lead agency and the public have enough information to "ascertain the project's environmentally significant effects,

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[29] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* (July 31, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Provides-Second-Quarter-2023-Update/default.aspx ("CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake") (accessed Mar. 1, 2024); CRC, *Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA* (May 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Announces-Two-New-Storage-Only-Carbon-Dioxide-Management-Agreements-and-Submission-of-Another-Class-VI-Permit-to-the-EPA/default.aspx ("CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake").

[30] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* ("This project highlights the value proposition of our CTV Clean Energy Park and its important role within Carbon TerraVault's strategy . . . . We welcome NLCE as a trusted partner in developing and furthering California's decarbonization efforts and supporting Kern county's ambitions to become the leading carbon sequestration area in the state.").

[31] RDEIR, Vol. 1 at 4.8-24.

[32] RDEIR, Vol. 1 at 3-14 to 3-15.

[33] See also James Temple, MIT Technology Review, *The World's on the Verge of a Carbon Storage Boom* (June 12, 2024), https://www.technologyreview.com/2024/06/12/1093477/the-worlds-on-the-verge-of-a-carbon-storage-boom/ ("Carbon sequestration projects can qualify for 12 years of U.S. subsidies. If Carbon TerraVault injects half a million tons of carbon dioxide into each of the 31 wells it has applied for over that time period, the projects could secure tax credits worth more than $15.8 billion.").

assess ways of mitigating them, and consider project alternatives."[34] Information about and analysis of the sources for the CO_2 that will be injected into the CTV I Project's storage facility is crucial for this very reason. The industrial processes that will emit the CO_2, the capture technology, the CO_2 properties, and the mode of transportation to the Project all have major implications for the CTV I Project's impacts on air pollution, greenhouse gas emissions, hazardous materials, and public health, among other issues.

As just one example, whether CO_2 will be transported to the Project by trucks or pipelines, and the routes of such trucks or the locations of the pipelines, are all critical pieces of information necessary to assess the Project's potential impacts. Courts have held that an EIR for a mining operation failed as an informational document because it failed to include a "description of the facilities that will have to be constructed to deliver water to the mining operation."[35] In the same way, the Recirculated Draft EIR fails to describe the methods and facilities that will be used to send CO_2 into the CTV I Project. As discussed below, the expert Kuprewicz Report attached to these comments also finds that important information regarding pipelines is missing from the Recirculated Draft EIR.

While the Recirculated Draft EIR provides no information on the methods of CO_2 transportation from its potential sources, its project description section states that "[i]t is anticipated that diesel heavy heavy [sic] duty trucks would make 40 trips per day following the access routes designated for travel"[36] as part of the Project's operational traffic. The Recirculated Draft EIR fails to include *any* explanation as to the reason for these heavy-duty truck trips. Moreover, these trips are not mentioned or analyzed in the transportation analysis section or in the air quality section.

The "Future Sources – Identification" section added to the Recirculated Draft EIR, listing the specific "industries" that will be allowed to send CO_2 to the Project and the applicable rules, only exacerbates the serious concerns around the Project's impacts that are left undisclosed and unanalyzed.

First, it appears that instead of reducing emissions, the CTV I Project will instead incentivize new CO_2-emitting and other criteria pollutant-emitting industries, as the list is extremely broad and includes multiple industries and processes, some of which will be new to the area, some of which could be built, permitted, and operated only with a commitment to store the resulting CO_2, and all of which may create both greenhouse gas and criteria pollutant emissions.

The fact that CO_2 source facilities will now be limited to Kern County exacerbates this problem.[37] As shown above, the Project's financial viability is wholly dependent on its CO_2-sending industries. Under this new condition, existing industries that could send CO_2 but are outside the County will not be allowed to do so, thus creating an incentive for new potentially polluting development where it is not actually needed.

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[34] *Sierra Club v. City of Orange* (2008) 163 Cal.App.4th 523, 533.
[35] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829.
[36] RDEIR, Vol. 1 at 3-38.
[37] RDEIR, Vol. 1 at 4.11-53.

In this context, it should be noted that the new appendix added to the Recirculated Draft EIR, titled "Source Identification Memo," includes in its discussion of "Source Limitations" the following statement:

> Any additional CO_2-emitting facilities added to the CTV I carbon hub would be limited to sources that are capable of mitigating criteria pollutants from the CO_2 capture and transportation process with no net increase for existing operations.[38]

This statement limits itself to carbon capture and transportation emissions only, not addressing operational or construction emissions. Tellingly, even this limited statement, or *any* guarantee that future sources would mitigate at least part of their criteria pollutant emissions, is nowhere to be found in the project description. It is also nowhere to be found in Mitigation Measure 4.11-7, the new Measure added to the Recirculated Draft EIR that sets rules for future sources.[39] There is no guarantee that the Project will not incentivize more pollution and more CO_2 emissions. The project description must therefore disclose and analyze these potential impacts.

Second, the list of sources in the Recirculated Draft EIR highlights the risk that the Project will serve to extend the life of fossil fuel sources that will continue to operate under the guise of "zero emission" when they would have been phased out but for the Project: the sources list includes both oil field gas streams and power plants—a fossil fuel and a fossil fuel operated facility—as potential sources.[40] The recirculated cumulative projects list now includes multiple oil and gas operations as well as two existing gas power plants (in an "unknown" location).[41] The Project description fails to provide any details on the potential life extension of these heavy emitters that the Project may cause, or include any measure to safeguard against such impacts.

B. The Recirculated Draft EIR Improperly Piecemeals the Project.

The Recirculated Draft EIR engages in impermissible piecemealing under CEQA by failing to analyze, at the very least, two projects that should be analyzed as part of the CTV I Project: the Avnos DAC Project and the Hydrogen Project, which will serve as CO_2 sources.

The new "Future Sources – identification" section of the Recirculated Draft EIR lists the sources allowed to send CO_2 to the Project. The list includes both blue hydrogen and DAC projects.[42]

Both the DAC project and the blue hydrogen project were included in CRC's application to the U.S. EPA for a Class VI injection well permit: "CTV plans to source carbon dioxide initially from Lone Cypress, a proposed hydrogen plant, Elk Hills pre-combustion gas treatment, and the proposed Avnos direct air capture facility."[43] Following the application, EPA issued

[38] RDEIR, Vol. 2, App'x K.4 at 1.
[39] RDEIR, Vol. 1 at 4.11-53.
[40] RDEIR, Vol. 1 at 3-13.
[41] RDEIR, Vol. 1 at 3-45 to 3-47.
[42] RDEIR, Vol. 1 at 3-13.
[43] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* (Dec. 2023) at 1.

draft permits that included both sources, stating the drafts were issued following "a thorough technical review of all information submitted by CTV in its permit application, as well as the operational standards, monitoring requirements, and existing geologic setting", that was sufficient for the EPA to make a determination under the Safe Drinking Water Act.[44]

Recently, the EPA issued revised draft permits that do not include the DAC and hydrogen sources. However, CRC and CTV make clear in their letter to EPA that this removal of sources is happening in the "short-term," and that "even if the Lone Cypress and/or Avnos project does not proceed, CRC expects that over time sources of CO_2 for the 26R UIC permits will likely include hydrogen and direct air capture facilities (among other potential future sources of CO_2)."[45]

Both projects are not only a reasonably foreseeable consequence of the initial CTV I Project, but they are also dependent on the Project.[46] A DAC project, by definition, must be tied to a carbon sequestration reservoir to operate. In the same way, the blue hydrogen project relies on the CTV I Project's sequestration for its operations.[47]

At the same time, the CTV I Project is dependent on these sources. As discussed above, the Recirculated Draft EIR admits the Project's financial and functional viability is dependent on its CO_2 sources.[48] It is also evident that the Project relies on sources beyond the initial source to provide CO_2 for sequestration almost immediately after it begins operations: The Recirculated Draft EIR discloses that at a maximum, the oil field's CO_2 will add up to 203,485 tons per year (tpy) of captured CO_2.[49] But its greenhouse gas analysis projects over 300,000 tons of CO_2 to be injected by its second year—which must come from approved sources beyond the initial source.[50]

Both the DAC and Lone Cypress Hydrogen projects come with their own sets of environmental impacts related to both construction and operations, which will likely affect the CTV I Project's environmental effects. Both projects must therefore be included in the Recirculated Draft EIR, and their potential impacts must be disclosed and analyzed.

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[44] EPA, *Public Notice of Intent to Issue a Class VI Underground Injection Control Permit for Carbon TerraVault JV Storage Company Sub 1, LLC* (Dec. 2023) at 1.
[45] Letter from Travis Hurst, CRC and CTV, to David Albright, EPA Groundwater Protection Section (June 17, 2024) at 1–2.
[46] *Paulek v. Dept. of Water Res.* (2014) 231 Cal.App.4th 35.
[47] The fact that the Lone Cypress application was recently withdrawn does not change the fact that a blue hydrogen project was analyzed as a likely CO_2 source for the CTV I Project by EPA.
[48] RDEIR, Vol. 1 at 4.8-24.
[49] RDEIR, Vol. 1 at 3-2.
[50] To add sources beyond these permitted sources, the CTV I Project's proponent will have to go through a process of further application, review, and approval by EPA. RDEIR, Vol. 2, App'x E.3 – 26R Storage Project Draft Permits.

C. The Recirculated Draft EIR Contains Contradictory Statements Regarding the Project Description.

The "Future Sources – identification" list in the project description section also contradicts other sections of the Recirculated Draft EIR, particularly its greenhouse gas (GHG) analysis: The GHG analysis claims that future CO_2 sources will come from "essential but hard to decarbonize" industries.[51] As discussed in detail in our comments below on the Recirculated Draft EIR's GHG analysis, several sources in the new list cannot be categorized as "essential but hard to decarbonize" industries by any stretch of the term.[52]

As discussed more fully below in the GHG analysis section of these comments, some of the sources are not considered appropriate industries for GHG reduction purposes, as they do not have an end product or service. The term "hard to decarbonize" is also completely irrelevant to fossil fuels (like oil field gas) or to fossil fuel-based plants (like gas power plants) that appear in the list. These fuels and facilities are not "hard to decarbonize"—they are the very source of CO_2 that decarbonization efforts aim to eliminate. The Recirculated Draft EIR must be revised to provide a coherent and consistent description and analysis of future CO_2 sources.

D. The Recirculated Draft EIR's Project Description Fails to Disclose Important Project Elements.

The Recirculated Draft EIR is missing important project description information. The original Draft EIR included aerial photos and drawings showing the site layout and the potential locations for the Project's amine units. In the Recirculated Draft, the County inexplicably removed three figures: Figure 3-5 that showed Phase 1 Amine Unit and Possible Relocation Sites for Phase 2 Amine Unit, and Figures 3-6 and 3-7 that showed the existing and new components of each of the two sites in the 26R reservoir. The project description is now missing important information on the location and layout of its components that must be included in a revised draft to properly serve as an informational document and provide the public with sufficient details.[53]

E. The Recirculated Draft EIR Fails to Disclose or Address the Impacts of CRC's Merger with Aera Energy.

As is clear from public statements from CRC and other significant media coverage throughout 2024,[54] the CTV I Project proponent has now successfully facilitated a merger that has resulted in the combination of CRC and Aera Energy LLC (Aera).[55] CRC now owns Aera

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[51] RDEIR, Vol. 1 at 4.8-26.
[52] See section V.B.1.b of this comment letter.
[53] *Laurel Heights, supra*, 47 Cal.3d at 405.
[54] See, e.g., Fassler, Joe, DeSmog, *As CRC Prepares to Buy Aera, New Law to Stem Orphan Wells Faces its First Test* (Mar. 18, 2024), https://www.desmog.com/2024/03/18/california-resources-corporation-aera-energy-merger-orphan-idle-wells-ab-1167/; Cantu, Aaron, Capital & Main, *Will California's Largest Oil Well Owner Get a Pass on Paying to Clean Up Its Mess?* (June 18, 2024), https://capitalandmain.com/will-californias-largest-oil-well-owner-get-a-pass-on-paying-to-clean-up-its-mess.
[55] Securities and Exchange Com., CRC, Form 8-K (June 28, 2024), Ex. 10.2, Agreement and Plan of Merger (Feb. 7, 2024).

and its significant number of wells and pore space in California, making the combined entity the largest oil and gas company in the state.[56]

This merger is clearly "significant in that it will likely change the scope or nature of the initial project or its environmental effects."[57] As CRC publicly states, the acquisition of Aera "doubles CRC's premium CO_2 pore space in the San Joaquin Basin."[58] According to a news release, CRC is expecting to expand its carbon management business "through the addition of surface acreage and rights, and significant new carbon dioxide (CO) pore space to enable future carbon capture and sequestration (CCS) development."[59] This new storage potential at the Project site is clearly viewed by CRC as a financial opportunity that can generate significant profits.[60] CRC further states it expects to obtain a pending EPA Class VI permit and apply for additional similar projects in oil fields around CTV I.[61] CRC thus appears to view CTV I as part of a larger project, stating that it "will have the potential to nearly double its injection rate capacity near CTV I, creating a premier 'decarbonization hub' for CO_2 storage."[62]

The County's failure to address the merger and its impacts on CTV I in this Recirculated Draft EIR, despite information being publicly available regarding the merger throughout 2024, violates CEQA and renders the document deficient. The Recirculated Draft EIR should disclose and analyze this potential expansion of the Project's scope and its impacts, particularly as part of the project description analysis.

II. THE RECIRCULATED DRAFT EIR FAILS TO ANALYZE GROWTH-INDUCING IMPACTS

CEQA requires the Recirculated Draft EIR to describe growth-inducing impacts of the CTV I Project,[63] including ways in which the Project could directly or indirectly foster economic growth that could lead to an adverse physical change to the environment.[64]

In a one-paragraph discussion, the Recirculated Draft EIR explains that because Project operation would include five regular full-time employees, with five potential additional maintenance employees, the Project "would not result in a substantial influx of people" and "is not likely to induce any growth within Kern County."[65]

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[56] CRC, Press Release, *California Resources Corporation to Combine with Aera Energy* (Feb. 7, 2024), https://www.crc.com/news/news-details/2024/California-Resources-Corporation-to-Combine-with-Aera-Energy/default.aspx.
[57] *Laurel Heights, supra*, 47 Cal.3d at 396.
[58] CRC and Aera, Press Release, *Expanding Our Leading Energy Platform* (Feb. 24, 2023) at 6.
[59] CRC and Aera, Press Release, *California Resources Corporation to Combine with Aera Energy* at 2.
[60] *Id.* at 6 ("Incremental pore space has the potential to generate significant EBITDA, ranging from $70MM to $180MM.").
[61] *Id.*
[62] *Id.*
[63] Pub. Resources Code, § 21100(b)(5); CEQA Guidelines, § 15126(d).
[64] CEQA Guidelines, §§ 15126.2(d), 15064(e); *Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) 124 Cal.App.4th 1184, 1205.
[65] RDEIR, Vol. 1 at 5-8.

By focusing on the projected number of employees in the CTV I Project alone, the Recirculated Draft EIR ignores the requirement to discuss the ways in which a proposed project could foster *economic growth*, not only population growth, directly or indirectly.[66] Clearly, as described above, the CTV I Project is just the first step in a much larger development for which CTV has already signed multiple CDMAs. In addition, the storage capacity proposed for approval can accommodate many more metric tons of CO_2 than the Recirculated Draft EIR analyzes. Further economic growth from the Project is clearly what the Project proponents and the County envision, and it should be analyzed.

Moreover, a report prepared for the County to analyze the potential fiscal and economic benefits of a carbon management park found significant economic growth from such a park development: The potential volume ("output") associated with the carbon management park and related offsite activities is projected in the report to range from $4.5 billion to $6.9 billion per year. Regarding employment, the report finds that, at full buildout, the park and related offsite activities would directly and indirectly support 13,500 to 22,000 permanent jobs.[67] While this report does not directly analyze the specific projects envisioned for the Elk Hills oil field, it shows the potential economic growth that needs to be discussed under a proper growth-inducing analysis.

III. THE RECIRCULATED DRAFT EIR FAILS TO PROVIDE ADEQUATE PROJECT OBJECTIVES

The Recirculated Draft EIR does not provide an adequate set of project objectives. The document articulates no purpose, need, or objectives for the CTV I Project independent of a list of "the applicant's objectives" for the Project.[68] Because, as discussed below, the integrity and validity of an alternatives analysis depends in significant part on the articulation and assessment of the lead agency's project objectives, an EIR that lacks an adequate statement of those objectives will not be in compliance with CEQA. This deficiency is compounded by the likelihood that the Project will both attract and incentivize the construction of new CO_2-generating facilities instead of focusing on reducing and sequestering CO_2 emissions from existing facilities, and also be used as a rationale to extend the life of existing fossil-fuel infrastructure whose utility otherwise may cease sooner.

Here, the Recirculated Draft EIR states:

The following are the applicant's project objectives:

- Construct and operate a permanent underground storage facility to develop and use existing CO_2 storage capacity at Elk Hills in an economically feasible manner.

[66] CEQA Guidelines, § 15126.2(e).
[67] The Natelson Dale Group Inc., *Analysis of Potential Fiscal and Economic Benefits of Kern County Carbon Management Industry* (Apr. 4, 2023) at 6, https://psbweb.kerncounty.com/planning pdfs/cmbp/CMBP_Potential_Fiscal_Economic_Benefit_Analysis.pdf.
[68] RDEIR, Vol. 1 at 1-5, 3-7, 6-7 to 6-8.

- Contribute to CRC's adopted goals of Full-Scope Net Zero emissions for Scope 1 (direct greenhouse gas emissions), Scope 2 (indirect greenhouse gas emissions associated with the purchase of electricity/steam/heat/cooling) and Scope 3 (all other indirect greenhouse gas emissions resulting from the company's business operations) emissions by 2045 by capturing and storing CO_2 emissions from CRC's Elk Hills field gas operations.
- Support California's Executive Order B-55-18, for California to achieve carbon neutrality by 2045 and net negative emissions thereafter.
- Site and design the project in an environmentally responsible manner consistent with current Kern County and California guidelines.
- Promote economic development and bring living-wage jobs to Kern County.[69]

The Recirculated Draft EIR articulates no purpose, need, or objectives for the CTV I Project independent of this list of "the applicant's objectives" for the Project. But without a purpose, need, and objectives adopted by the lead agency, the Recirculated Draft EIR cannot meaningfully assess impacts and develop or compare a reasonable range of alternatives to the proposed Project.[70]

Finally, the Project's objectives were revised in the Recirculated Draft EIR such that the Project's goal of contributing to CRC's "adopted goals of Full-Scope Net Zero emissions" is now qualified by the sentence "by capturing and storing CO_2 emissions from CRC's Elk Hills field gas operations."[71] This suggests that the Project will intentionally serve to extend the life of fossil fuels—making that a specific objective of the project, in tension with objectives that support carbon emissions reduction. Because the applicant operates the oil field that will be a major source of CO_2 for the storage facility, and this facility appears to be designed at least in part to enable the oil field operations to continue to emit Scope 1, 2, and 3 emissions and to facilitate the development and operation of new GHG-emitting facilities, working against state carbon neutrality goals, it is particularly important to scrutinize the project objectives and ensure they reflect public agency goals.

IV. THE RECIRCULATED DRAFT EIR FAILS TO ANALYZE ADEQUATE ALTERNATIVES

The Recirculated Draft EIR is also unlawful for failing to properly put forward, describe, and analyze a reasonable range of alternatives. Under CEQA, a proper analysis of alternatives is essential to comply with the Act's mandate that significant environmental impacts be avoided or

[69] RDEIR, Vol. 1 at 1-5, 3-7, 6-7 to 6-8.
[70] *North Coast Rivers Alliance v. Kawamura* (2015) 243 Cal.App.4th 647, 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)) ("[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency"); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).
[71] RDEIR, Vol. 1 at 3-7.

substantially lessened where feasible.[72] The analysis of alternatives lies at the "core of an EIR,"[73] and an EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[74]

The purpose of the requirement to contemplate alternatives is to identify ways to mitigate or avoid the significant effects of a project.[75] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental effects."[76] The alternatives discussion must be "meaningful" and must "contain analysis sufficient to allow informed decision making."[77] The alternatives analysis is critical to the integrity of an EIR.[78] An EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[79] An alternatives analysis under CEQA must focus on potentially feasible alternatives to the project, even if these alternatives would impede to some degree the attainment of project objectives, or would be more costly.[80]

As explained below, the Recirculated Draft EIR's alternatives discussion fails to comply with CEQA. The alternatives discussion is flawed for at least seven reasons: (1) it relies on an inadequate project description; (2) it relies on an inadequate set of project objectives; (3) it relies on an inadequate understanding of the Project's own impacts; (4) it fails to consider a reasonable range of alternatives; (5) it fails to properly or coherently discuss the "no project" alternative and compare it to the Project; (6) it fails to meaningfully describe or analyze the action alternatives it considers; and (7) it fails to provide substantial evidence to support its comparisons of alternatives to the proposed Project. The Recirculated Draft EIR must be revised to properly analyze project alternatives, as required by CEQA.

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[72] Pub. Resources Code, § 21002; CEQA Guidelines, §§ 15002(a)(3), 15021(a)(2), 15126(d); *Citizens for Quality Growth v. City of Mount Shasta* (1988) 198 Cal.App.3d 433, 443–45.
[73] *Citizens of Goleta Valley v. Bd. of Supervisors* (1990) 52 Cal.3d 553, 564.
[74] *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 735; see also Pub. Resources Code, § 21002.1(a).
[75] Pub. Resources Code, § 21002.1.
[76] *Save Panoche Valley v. San Benito County* (2013) 217 Cal.App.4th 503, 52 (citations omitted); see also Pub. Resources Code, §21081(a); CEQA Guidelines, §15091(a)(3); *Cal. Native Plant Society v. City of Santa Cruz* (2009) 177 Cal.App.4th 957, 1002.
[77] *Laurel Heights*, *supra*, 47 Cal.3d at 403–04.
[78] *In re Bay-Delta Programmatic Envtl. Impact Report Coordinated Proceedings*, 43 Cal.4th 1143, 1162 (2008) ("The EIR is the heart of CEQA, and the mitigation and alternatives discussion forms the core of the EIR.").
[79] *San Joaquin Raptor/Wildlife Rescue Center*, *supra*, 27 Cal.App.4th at 735; see also Pub. Resources Code, § 21002.1(a).
[80] CEQA Guidelines, § 15126.6(b), (f); see also Pub. Resources Code, § 21102.1(a) ("The purpose of an environmental impact report is to identify the significant effects on the environment of a project, to identify alternatives to the project, and to indicate the manner in which those significant effects can be mitigated or avoided.").

A. The Recirculated Draft EIR Cannot Properly Consider Alternatives Without an Adequate Project Description, Adequate Description of the Lead Agency's Project Objectives, and Adequate Analysis of Project Impacts.

The Recirculated Draft EIR's alternatives analysis fails in three threshold ways: it is not based on an adequate project description, it does not articulate a public purpose and need for the Project, and it does not describe, assess, or analyze impacts properly. These deficiencies render the alternatives analysis inadequate.

First, the Recirculated Draft EIR's alternatives analysis is flawed because it is not based on a stable, accurate project description. As demonstrated above, the Recirculated Draft EIR's analysis and mitigation are based on an improper project description that understates and misstates the CTV I Project's scope, and omits integral components of the full Project. Without a proper project description, it is not possible to effectively develop alternatives or compare Project impacts with alternatives in a way that is coherent and supported by substantial evidence.

Second, without a proper description of the Project's purpose and need and a set of project objectives adopted by the lead agency, it is impossible to adequately assess alternatives to the Project in a way that complies with CEQA.

A proper statement of the lead agency's project objectives is essential to the development of an adequate alternatives analysis. This principle is apparent throughout the Guidelines and case law. For example, "[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency."[81] The Recirculated Draft EIR must include "[a] clearly written statement of objectives," as this will guide the County in developing a reasonable range of alternatives.[82] CEQA Guidelines section 15124(b) notes that a "clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[83] That statement of the *lead agency's* objectives, in informing the *lead agency's* reasonable range of alternatives to a proposed project, cannot simply be delegated to a project proponent.

Moreover, "[a] lead agency may not give a project's purpose an artificially narrow definition. An agency 'may structure its EIR alternative analysis around a reasonable definition of underlying purpose and need not study alternatives that cannot achieve that basic goal. For example, if the purpose of the project is to build an oceanfront resort hotel or a waterfront aquarium [citation], a lead agency need not consider inland locations.'"[84] This principle requires, again, that the lead agency take responsibility for articulating the project purpose and need as well as the project objectives.

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[81] *North Coast Rivers Alliance*, *supra*, 243 Cal. App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).
[82] CEQA Guidelines, § 15124(b).
[83] CEQA Guidelines, § 15124(b).
[84] *North Coast Rivers Alliance*, *supra*, 243 Cal.App.4th at 668 (citing *Bay–Delta*, *supra*, 43 Cal.4th at 1166 [internal citations omitted]).

Here, as noted above, the Recirculated Draft EIR articulates no purpose, need, or objectives for the Project independent of a list of "the applicant's objectives" for the Project.[85] The Recirculated Draft EIR contains no further discussion of purpose, need, or objectives beyond this list. But, as reflected in the case law and Guidelines,[86] it is not possible for a lead agency to meaningfully undertake an independent evaluation of alternatives if the agency uncritically uses an applicant's objectives as the benchmark for evaluation, and fails to include its own statement of purpose and objectives. A range of alternatives that is based exclusively on "the applicant's project objectives," and not incorporating any public purpose, need, or objectives that have been adopted by the lead agency, thus cannot comply with CEQA. Moreover, reliance exclusively on applicant project objectives is particularly inappropriate where there are unmitigable significant impacts that will require the County to find overriding considerations, given the need for the objectives to "aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[87]

Third, without a proper analysis of the Project's impacts, any alternatives analysis is necessarily flawed because the comparison of Project impacts to the anticipated impacts of alternatives will be unsupported by substantial evidence. Here, the significant deficiencies in the Recirculated Draft EIR's analysis of Project impacts make any comparison of those impacts with the impacts of proposed alternatives meaningless.

This deficiency in the Recirculated Draft EIR—flawed impact analysis leading to flawed alternatives analysis—is apparent across multiple impact areas, discussed throughout these comments. Any comparison of the impacts of the Project with the impacts of alternatives will fail if the Project impacts are misstated or improperly analyzed. But the deficiency is most glaring in the context of GHG impacts, where the Recirculated Draft EIR's alternatives analysis asks its readers to accept a paradox: first, the Project will have significant unmitigable impacts on GHG emissions.[88] Second, the no-project alternative will have less-than-significant impacts on GHG emissions.[89] And third, at the same time, according to the Recirculated Draft EIR, the no-project

[85] RDEIR, Vol. 1 at 3-7, 6-7 to 6-8.
[86] *North Coast Rivers Alliance*, *supra,* 243 Cal.App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b).
[87] CEQA Guidelines, § 15124(b); see *Preservation Action v. San Jose* (2006) 141 Cal.App.4th 1336, 1351–52 ("Since CEQA charges the agency, not the applicant, with the task of determining whether alternatives are feasible, the circumstances that led the applicant in the planning stage to select the project for which approval is sought and to reject alternatives cannot be determinative of their feasibility. The lead agency must *independently* participate, review, analyze and discuss the alternatives in good faith." [citing *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 736]).
[88] RDEIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 to 6-6 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"), 6-22 (Project GHG impacts "significant and unavoidable").
[89] RDEIR, Vol. 1 at 6-14 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]").

alternative's impacts are "greater than project" impacts.[90] On its face, this analysis cannot stand scrutiny, since it is internally inconsistent. This internal inconsistency, in turn, is a consequence of a fundamental failure in the underlying Project GHG analysis and conclusions, as discussed below.

These analytical failures render the Recirculated Draft EIR's alternatives analysis deficient. And beyond that, the failures also constitute fundamental informational deficiencies in the document. It is not possible for the public or a decisionmaker to compare the alternatives meaningfully if the conclusions being compared are incoherent or internally inconsistent, as is the case here.

B. The Recirculated Draft EIR Fails to Adequately Consider a Reasonable Range of Alternatives.

An EIR must consider a reasonable range of alternatives which "offer substantial environmental advantages over the project proposal."[91] The Public Resources Code makes it clear that proper alternatives need to "substantially lessen" the significant environmental effects of a project.[92] Here, the Recirculated Draft EIR rejects without analysis several alternatives that meet that criterion and satisfy at least some project objectives. This improper failure to consider alternatives appears to have occurred, at least in part, because the applicant's project objectives are drawn too narrowly,[93] and the applicant's conception of "feasibility" is improperly constrained.[94]

The lead agency, not the applicant, bears the responsibility to evaluate alternatives based on project objectives, as demonstrated above.[95] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental effects."[96] The lead agency also must evaluate feasibility based on objective criteria. "Feasible" means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors."[97]

Here, the Recirculated Draft EIR should have considered a wider range of alternatives that minimize or avoid impacts from the proposed Project. Alternatives that involve eliminating or reducing oil extraction from CRC's oil fields, for example, satisfy most of even the applicant's project objectives, including contributing to CRC's adopted goals of Full-Scope Net

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[90] RDEIR, Vol. 1 at 6-22 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-24 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

[91] *Citizens of Goleta Valley*, *supra*, 52 Cal.3d at 566.

[92] Pub. Resources Code, § 21002; see also CEQA Guidelines, § 15126.6(a).

[93] *North Coast Rivers Alliance*, *supra*, 243 Cal.App.4th at 668.

[94] *Preservation Action*, *supra*, 141 Cal.App.4th at 1351–52.

[95] *Kings County Farm Bureau*, *supra*, 221 Cal.App.3d at 736; *Preservation Action*, *supra*, 141 Cal.App.4th at 1351–52.

[96] CEQA Guidelines, § 21081; *Mountain Lion Foundation v. Fish Game Com.* (1997) 16 Cal.4th 105, 134.

[97] Pub. Resources Code, § 21061.1; *Cal. Native Plant Society*, *supra*, 177 Cal.App.4th at 960.

Zero emissions by 2045, supporting California's Executive Order B-55-18, and siting and designing the Project in an environmentally responsible manner. If the goal is to keep oil field-generated CO_2 out of the atmosphere, there are alternative ways to accomplish this that the Recirculated Draft EIR fails to consider.

The Recirculated Draft EIR should be revised to consider these and other reasonable alternatives, as required under CEQA.

C. The Recirculated Draft EIR's Discussion of Alternative 1, the "No Project" Alternative, is Inadequate Under CEQA.

The Recirculated Draft EIR's "no project" alternative discussion provides a brief examination, unsupported by evidence or analysis, of the environmental consequences of not permitting the Project or any alternative. This summary discussion of Alternative 1 is inadequate under CEQA because it fails to include basic information about the no-project alternative.

The CEQA Guidelines require that the no project analysis discuss "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services."[98] Here, however, the discussion lacks "adequate information regarding the no-project alternative" that would allow the decisionmakers to make "an informed, reasoned decision on whether this Project should go forward."[99] In *Save the Hill Group v. City of Livermore*, the court found that a "no-project" alternative that failed to provide adequate information as to what would be reasonably expected to occur if a project would not go forward was in violation of CEQA, and set the EIR approval aside.[100]

The same reasoning applies here. The Recirculated Draft EIR should contrast the impacts of the proposed Project with the impacts of the no-project alternative, with specificity and, where possible, quantification, across all impact categories. It should provide a "factually based forecast of the environmental impacts of preserving the status quo."[101] Instead, the Recirculated Draft EIR includes a cursory narrative discussion, with no supporting evidence or analysis, articulating only what the applicant asserts the consequences of the no-project alternative would be. The Recirculated Draft EIR then bases its comparison with the proposed Project on this thin, non-evidence-based discussion.

This missing information is, in the words of the *Save the Hill Group* court, "just the sort of information CEQA intended to provide those charged with making important, often irreversible, environmental choices on the public's behalf."[102] The alternatives analysis must be revised to provide a robust discussion of the "no-project" reasonable consequences.

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[98] CEQA Guidelines, § 15126.6(e)(2).
[99] *Save the Hill Grp. v. City of Livermore* (2022) 76 Cal.App.5th 1092, 1113, review denied (July 13, 2022).
[100] *Id.* at 1113.
[101] *Ctr. for Biological Diversity v. Dept. of Fish & Wildlife* (2015) 234 Cal.App.4th 214, 253.
[102] *Save the Hill Grp.*, *supra*, 76 Cal.App.5th at 1113.

Additionally, as discussed above, the analysis of the no-project alternative is inadequate because the comparison between the no-project alternative and the proposed Project is misleading, inconsistent, and incoherent. The Recirculated Draft EIR's characterization of Alternative 1 as having greater GHG impacts than the Project, in particular, reflects a failure to adequately and coherently describe and analyze this alternative as well as a failure to coherently analyze the Project's impacts.[103]

Finally, an adequate analysis of Alternative 1 would also address the failures, highlighted elsewhere in these comments, in framing project objectives and in neglecting to analyze the fact that the Project is designed to facilitate and justify the continued extraction of oil and burning of fossil fuels for energy. An adequate comparative analysis between the impacts of Alternative 1 and the Project would require analysis of the Project's sources of CO_2 and of the Project's facilitation of fossil fuel extraction and combustion.

D. The Recirculated Draft EIR Fails to Adequately Describe or Analyze Alternatives 2 and 3.

The Recirculated Draft EIR's discussion of the two "action" alternatives, DAC (Alternative 2) and nature-based carbon storage (Alternative 3), is cursory and lacking in specificity, evidence, and support.[104] The Recirculated Draft EIR not only fails to describe either alternative with specificity, but also fails to disclose or even meaningfully attempt to discuss the projected impacts of either alternative. As a consequence, the document fails to support its conclusions—where it compares alternatives' impacts with the Project's impacts—with substantial evidence.

First, Alternative 2, the DAC Alternative, fails to specify any of the major features of the hypothetical DAC facility that forms the basis of the alternative. The Recirculated Draft EIR does not even attempt to explain, for example, what technology would be used, the size and throughput of the facility, what infrastructure would be built and where, or what resources it would take to build and maintain that infrastructure and operate the facility. Instead, the document presents only a discussion of the generalized features of DAC technology and facilities, with not one word about how those features might or might not appear in the application of DAC as an alternative to the proposed Project, as discussed earlier in these comments.[105] The Recirculated Draft EIR then fails even to make a serious attempt to assess the

[103] Compare RDEIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"); 6-22 (Project GHG impacts "significant and unavoidable"), 6-14 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]") with Draft EIR, Vol. 1 at 6-22 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-24 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

[104] RDEIR, Vol. 1 at 6-17 to 6-21 (containing the Draft EIR's entire discussion of these two alternatives).

[105] RDEIR, Vol. 1 at 6-17 to 6-20 (containing the Draft EIR's discussion of Alternative 2, in full).

impacts of the DAC alternative in each impact category[106]—a task that would have been fruitless, given the lack of specificity about the alternative's basic features. Correspondingly, the Recirculated Draft EIR and appendices do not contain evidence, methodology, modeling, or calculations regarding any such impacts. And following from this, there is no substantial evidence—indeed, no evidence at all—supporting the Recirculated Draft EIR's comparison of Project impacts with the purely speculative conclusions about the DAC alternative's impacts. Nor is the brief discussion of whether Alternative 2 meets project objectives[107] supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed. The lead agency is required to meaningfully develop and analyze this alternative, and has failed entirely to do that.

Second, Alternative 3, the "Nature Based Carbon Storage" alternative, also fails to meaningfully specify any of the features of the alternative. While the Recirculated Draft EIR sets forth some general ideas about what types of features this potential alternative might include, the alternative remains completely unformed and unanalyzed.[108]

This text, with the "example" of "planting of trees," comes closest to articulating the features of Alternative 3:

> The most applicable nature-based carbon storage alternative for the area of the project site would be regenerative agriculture, as it coincides with the current zoning. Planting of trees would be one example of regenerative nature-based carbon storage for the highest ability to store atmospheric carbon.[109]

It is clear on its face that this statement does not present a specific alternative to the proposed Project. As with Alternative 2, the Recirculated Draft EIR lacks any discussion, beyond the speculation above, of what technology will be used, much less how the alternative would be configured, or what, specifically, it would entail.[110] And the closest the Recirculated Draft EIR comes to articulating the scope or size of this alternative is in a purely conditional, hypothetical statement: "If 9,000 acres of the project site were remediated of all oil and gas facilities and prepared for planting, an estimated 400 to 1,000 trees per acre could be planted, resulting in a new forest area of 3.6 million to 9 million trees."[111] Notably, even all these hypothetical statements in the Recirculated Draft EIR lack any evidence or foundation in the document or appendices, but instead just appear as assertions, without any references or citations to articulate or support any methodology, analysis, or conclusions.

Accordingly, there is no meaningful analysis of either the features or impacts of the alternative, making it impossible to compare the Project's impacts with the alternative's impacts, and making the conclusions in that attempted comparison lacking in substantial evidence for support. Nor is the brief discussion of whether Alternative 3 meets project objectives[112]

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[106] *Id.*
[107] *Id.*
[108] RDEIR, Vol. 1 at 6-20 to 6-21 (containing discussion of Alternative 3, in full).
[109] RDEIR, Vol. 1 at 6-20.
[110] RDEIR, Vol. 1 at 6-19 to 6-21.
[111] RDEIR, Vol. 1 at 6-20.
[112] RDEIR, Vol. 1 at 6-21.

supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed.

V. THE RECIRCULATED DRAFT EIR FAILS TO ANALYZE AND MITIGATE SIGNIFICANT IMPACTS

The discussion of a proposed project's environmental impacts is an essential component of an EIR.[113] The fundamental purpose of CEQA is to "inform the public and its responsible officials of the environmental consequences of their decisions *before* they are made."[114] To do so, an EIR must contain facts *and* analysis, not just an agency's bare conclusions.[115]

As explained in detail below, the Recirculated Draft EIR's environmental impacts analysis is deficient under CEQA because it fails to provide the necessary facts and analysis to allow the County and the public to make informed decisions about the CTV I Project.

CEQA also requires an EIR to describe and adopt all feasible mitigation measures to address a project's significant environmental impacts.[116] Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[117]

Generally, the "[f]ormulation of mitigation measures should not be deferred until some future time."[118] As an exception, "measures may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way."[119] Crucially, there is a "distinction between stating a generalized goal and adopting specific performance criteria," and "[s]imply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[120] Further, even where the deferred formulation of mitigation might be allowable, there is a point beyond which delayed implementation is not allowed: "[o]nce the project reaches the point where activity will have a significant adverse effect on the environment, the mitigation measures must be in place."[121]

"Where several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified."[122]

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[113] See CEQA Guidelines, § 15126.2(a) ("An EIR *shall* identify and focus on the significant effects of the proposed project on the environment.") (emphasis added).
[114] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal.*, 6 Cal.4th 1112, 1123.
[115] *Citizens of Goleta Valley*, *supra*, 52 Cal.3d at 568.
[116] Pub. Resources Code, § 21002; CEQA Guidelines, § 15126.4(a)(1).
[117] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).
[118] CEQA Guidelines, § 15126.4(a)(1)(B).
[119] *King & Gardiner Farms, LLC v. County of Kern* (2020) 45 Cal.App.5th 814, 856.
[120] *Id.* at 856.
[121] *Id.* at 860, quoting *POET, LLC v. Cal. Air Resources Bd.* (2013) 218 Cal.App.4th 681, 738.
[122] CEQA Guidelines, § 15126.4(a)(1)(B).

As discussed below, throughout the Recirculated Draft EIR, the County's proffered mitigation measures are insufficient, riddled with inconsistencies, and ultimately not adequate to satisfy CEQA's legal requirements.

A. The Recirculated Draft EIR's Analysis and Mitigation of Air Quality Impacts is Inadequate.

1. The Recirculated Draft EIR states heavy-duty truck traffic is expected for Project operations but does not describe or analyze the impacts of such traffic.

Within the chapter on project description, in the section for "Operational and Maintenance Activities," the Recirculated Draft EIR describes five full-time employees who will be onsite at all times and another five employes who may need to be onsite when repairs or other maintenance is required.[123] The Recirculated Draft EIR calculates "Operational Traffic" for these employees, who are expected to collectively make 20 daily trips in "Passenger Vehicles."[124]

Separately, the discussion of "Operational Traffic" includes a heading for "Truck Traffic," which is followed by one sentence that states: "It is anticipated that diesel heavy heavy-duty trucks would make 40 trips per day following the access routes designated for travel."[125] No further information on the nature, purpose, or impacts of this operational heavy-duty truck traffic is provided in the project description chapter. Nor is there any further discussion anywhere else in the Recirculated Draft EIR.

As noted above, the Recirculated Draft EIR must be revised to thoroughly explain this aspect of the CTV I Project. Based on the County's previous statement in the Notice of Preparation/Initial Study that "[t]he proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project,"[126] it seems likely these trucks will be carrying CO_2 from offsite industrial sources

In addition to fully explaining the nature and purpose of the operational heavy-duty truck trips in the project description, the impacts of such heavy-duty truck traffic during Project operation must be analyzed and mitigated consistent with CEQA's requirements. As acknowledged in the Notice of Preparation/Initial Study, truck and other vehicle traffic threatens significant direct and cumulative impacts in at least the following categories: air quality, energy demand and consumption, greenhouse gas emissions, hazards and hazardous materials, noise, and transportation and traffic.[127] Depending on the nature and purpose of the operational heavy-duty truck traffic, additional significant impacts are possible.

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[123] RDEIR, Vol. 1 at 3-38.
[124] RDEIR, Vol. 1 at 3-35 to 3-38.
[125] RDEIR, Vol. 1 at 3-38.
[126] *Notice of Preparation/Initial Study* at 4.
[127] *Notice of Preparation/Initial Study* at 24–25, 29, 32, 34–35, 40, 44–45.

2. The Recirculated Draft EIR must be updated to address the revised national ambient air quality standard for $PM_{2.5}$.

The Air Quality section of the Recirculated Draft EIR must be updated to reflect the U.S. EPA's issuance of a new national ambient air quality standard (NAAQS) for fine particulate matter, also known as $PM_{2.5}$. On February 7, 2024, U.S. EPA strengthened the annual health-based NAAQS for $PM_{2.5}$ from a level of 12 micrograms per cubic meter to 9 micrograms per cubic meter.[128]

Beyond just acknowledging the new standard, the Recirculated Draft EIR should also address the implications of the new annual $PM_{2.5}$ NAAQS: air quality in Kern County currently does not meet the new standard[129] and is not expected to meet it in 2032,[130] meaning the San Joaquin Valley Air Pollution Control District (Air District) will have to institute further restrictions on polluting projects and activities through the San Joaquin Valley airshed, including in Kern County.[131]

3. The Recirculated Draft EIR must be updated to make clear the full danger posed by increased $PM_{2.5}$ emissions.

a. The Recirculated Draft EIR should disclose that there is no safe level of exposure to $PM_{2.5}$.

Along with U.S. EPA's issuance of its revised $PM_{2.5}$ NAAQS, the agency also summarized the latest scientific studies on the health effects of $PM_{2.5}$.

The Recirculated Draft EIR should update its discussion of the health effects of $PM_{2.5}$ to reflect the latest science summarized by U.S. EPA in its standard-setting decision. Such an

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[128] See generally EPA, *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter*, 89 Fed. Reg. 16202 (Mar. 6, 2024), https://www.federalregister.gov/documents/2024/03/06/2024-02637/reconsideration-of-the-national-ambient-air-quality-standards-for-particulate-matter; accord, EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* (Feb. 7, 2024), https://www.epa.gov/newsreleases/epa-finalizes-stronger-standards-harmful-soot-pollution-significantly-increasing.

[129] See EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* at Figure 1; accord EPA, *Fine Particle Concentrations for Counties with Monitors Based on Air Quality Data from 2020 – 2022* at 1, https://www.epa.gov/system/files/documents/2024-02/table_annual-pm25-county-design-values-2020-2022-for-web.pdf (last accessed Mar. 1, 2024).

[130] EPA, *EPA Projects More than 99% of Counties Would Meet the Revised Fine Particle Pollution Standard* (Feb. 7, 2024), https://www.epa.gov/system/files/documents/2024-02/2024-pm-naaqs-final-2032-projections-map.pdf.

[131] Lazo, *California's Pursuit of Clean Air Just Got Much Harder: New Soot Standards Set*, Cal Matters (Feb. 7, 2024) ("Achieving the new target will take wide-ranging new state and local regulations aimed at cutting emissions"), https://calmatters.org/environment/2024/02/california-new-soot-standards.

update is necessary because CEQA requires that an EIR conduct "an analysis that connect[s] the air quality effects to human health consequences."[132]

Of key importance to disclose to Kern County residents and decisionmakers: currently available evidence indicates there is no safe level of exposure to $PM_{2.5}$.[133] Consequently, it is essential that the County adopt all feasible mitigation for increased $PM_{2.5}$ emissions.

b. The Recirculated Draft EIR should better address the relationship between $PM_{2.5}$ and DPM.

The Recirculated Draft EIR's description of air pollutants and health effects discusses "Particulate Matter (PM_{10} and $PM_{2.5}$)" separately from "Diesel Particulate Matter."[134]

The discussion of $PM_{2.5}$ notes that "$PM_{2.5}$ constitutes a large portion of combustion particulates, including diesel particulate matter (DPM)," (p. 4.3-14) but does not direct the reader to the separate, further discussion of the dangers of DPM.

To prevent confusion and to convey the full extent of the health risks posed by $PM_{2.5}$, the Recirculated Draft EIR's discussion of $PM_{2.5}$ should include a cross reference to the more detailed discussion of DPM in the section that addresses "Health Effects and Risks of Toxic Air Contaminants."

Confusingly, the Recirculated Draft EIR's discussion of $PM_{2.5}$ currently includes an erroneous cross reference. At Volume 1, page 4.3-15, the text states: "The section below entitled 'Oil and Gas Operations and Health Effects' further discusses potential health effects of $PM_{2.5}$ emissions, among other things." But no such section with that title exists.

c. The Recirculated Draft EIR should address how $PM_{2.5}$ exacerbates illness and death from COVID-19.

The Recirculated Draft EIR's discussion of the health effects of $PM_{2.5}$ fails to adequately address "the nature and magnitude"[135] of the CTV I Project's increased emissions because it does not acknowledge the studies that demonstrate that exposure to $PM_{2.5}$ has been found to lead to an increase in the death rate for COVID-19, especially for people of color.[136] Indeed, one

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[132] *Sierra Club v. County of Fresno* (2018) 6 Cal.5th 502, 522.
[133] According to EPA: "[t]he currently available evidence does not identify particular PM2.5 concentrations that do not elicit health effects. Rather, health effects can occur over the entire distribution of ambient PM2.5 concentrations evaluated, and epidemiologic studies conducted to date do not identify a population-level threshold below which it can be concluded with confidence that PM2.5-related effects do not occur." 89 Fed. Reg. 16249.
[134] Compare RDEIR, Vol. 1 at 4.3-13 to 4.3-15 with *id.* at 4.3-25 to 4.3-26.
[135] *Sierra Club*, *supra*, 6 Cal.5th at 522.
[136] See Cal. Dept. of Public Health, *State Officials Announce Latest COVID-19 Facts* (News Release No. NR20-111) (June 3, 2020), https://www.cdph.ca.gov/Programs/OPA/Pages/NR20-111.aspx;

recent study determined that thousands of COVID-19 deaths could have been prevented during the first year of the COVID-19 pandemic in California, especially in the San Joaquin Valley, if ambient levels of $PM_{2.5}$ pollution were lower.[137]

The Recirculated Draft EIR therefore should be updated with a discussion of the health risks posed by COVID-19 generally, along with a further discussion of the COVID-19 morbidity and mortality increased by exposure to $PM_{2.5}$.

Notably, the Recirculated Draft EIR includes a proposed mitigation measure (MM 4.3-7) that addresses COVID-19, stating that: "Owner/operators shall implement all orders related to the COVID-19 pandemic or any other pandemic mandated by Kern County Public Health on well sites and related to worker safety."[138] To provide context for this mitigation measure, the Recirculated Draft EIR should be revised as recommended above to make clear why COVID-19 is a health concern, particularly for a project that is expected to significantly increase $PM_{2.5}$ emissions.

4. The Recirculated Draft EIR contradicts earlier statements about the nearest sensitive receptor.

The Recirculated Draft EIR states: "The closest sensitive receptor to the project site is McKittrick Elementary School, which is 4.47 miles southwest of the facility pipeline and injection well 357-7R. The nearest residence is approximately 4.4 miles southeast of the injection line and 4.4 miles from injection well 345-36R."[139] In contrast, the Initial Study/Notice of Preparation states: "The sensitive receptor closest to the project site is the rural residence approximately 1 mile to the south of the project site."[140]

It is important for purposes of both impact analysis and mitigation that the Recirculated Draft EIR correctly identifies the nearest sensitive receptor. The County must explain the

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Chow, D.S. et al., *The Disproportionate Rise in COVID-19 Cases Among Hispanic/Latinx in Disadvantaged Communities of Orange County, California: A Socioeconomic Case-Series*, Johns Hopkins Bloomberg School of Public Health (2020), https://www.medrxiv.org/content/10.1101/2020.05.04.20090878v1.full.pdf; Goyal, M.K. et al., *Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children*, Pediatrics (2020), https://pediatrics.aappublications.org/content/pediatrics/early/2020/08/03/peds.2020-009951.full.pdf; Petroni, M., et al., *Hazardous Air Pollutant Exposure As a Contributing Factor to COVID-19 Mortality in the United States*, Environ. Res. Lett., Vol. 15, no. 9 (Sept. 11, 2020), https://iopscience.iop.org/article/10.1088/1748-9326/abaf86; Tian, H. et al., *Risk of COVID-19 is Associated with Long-term Exposure to Air Pollution*, medRxiv (Apr. 24, 2020), https://doi.org/10.1101/2020.04.21.20073700; Wu, X. et al., *Exposure to Air Pollution and COVID-19 Mortality in the United States: A Nationwide Cross-Sectional Study* (updated Nov. 4, 2020), https://projects.iq.harvard.edu/covid-pm/home; Zhu, Y., *Association Between Short-Term Exposure to Air Pollution and COVID-19 Infection: Evidence from China*, 727 Science of the Total Environment (Apr. 2020), https://doi.org/10.1016/j.scitotenv.2020.138704.

[137] English, P.B. et al., *Association Between Long-Term Exposure to Particulate Air Pollution with SARS-CoV-2 Infections and COVID-19 Deaths in California, U.S.A.*, Environmental Advances 9 (2022) 100270, https://doi.org/10.1016/j.envadv.2022.100270.

[138] RDEIR, Vol. 1 at 1-31, 4.3-74.

[139] RDEIR, Vol. 1 at 1-5.

[140] *Notice of Preparation/Initial Study* at 3.

discrepancy between the Recirculated Draft EIR and the Initial Study/Notice of Preparation and, if the nearest sensitive receptor is actually only one mile away, revise its impacts analysis and mitigation measures accordingly.

5. The Recirculated Draft EIR's air quality impact analysis is premised on unexplained and/or faulty assumptions.

As set forth in the attached Sahu Report, the Recirculated Draft EIR's assessment of impacts and formulation of mitigation measures is inadequate because it is premised on assumptions that are unexplained if not faulty.[141] For example:

- The data provided on "Existing Air Quality" is dated—covering 2019 to 2021—and therefore may not be representative of current air quality in Kern County.
- Nowhere does the Recirculated Draft EIR or accompanying report prepared by Trinity Consultants explain the assumptions upon which the emissions estimates are made. It is unclear how the various emissions factors were selected and whether they are representative of expected activities and equipment for the CTV I Project.
- Further, assumptions about the expected project activities are unexplained despite their uncanny precision (e.g., well pad construction is expected to take 11 days; every well to be drilled is identified with a specific and unique depth; five hydrocranes are expected to operate exactly 1968.75 hours).
- The Recirculated Draft EIR suggests false precision by failing to disclose quantitative error ranges and/or to qualitatively explain the uncertainty inherent in the emission estimates.
- Additionally, page 4-6 of the Trinity Consultants' report is completely blank. It is unclear whether this was intentional, or perhaps a formatting issue. To the extent information is missing—it should be provided to the public with appropriate time for review.

6. The Recirculated Draft EIR fails to adequately address cumulative air quality impacts.

The Recirculated Draft EIR acknowledges that the CTV I Project will contribute to cumulatively significant air quality impacts. It states: "Because the project's specific emissions would contribute to Kern County's 2020 emissions inventory and to the 2025 projected

[141] Dr. Sahu's report addresses the original Draft EIR, but his assessment of the County's flawed air quality emissions estimates and inadequate mitigation measures applies fully to the Recirculated Draft EIR. The text of Section 4.3 ("Air Quality") of the Recirculated Draft EIR is nearly word-for-word identical to the original Draft EIR, with no substantive changes made to the County's analysis, emissions estimates, or mitigation measures. Compare, e.g., RDEIR, Vol. 1 at 4.3-60 to 4.3-81 with DEIR, Vol. 1 at 4.3-60 to 4.3-81. Further, Section 4.3 of the Recirculated Draft EIR continues to rely on the same "AIR QUALITY IMPACT ANALYSIS" prepared by Trinity Consultants, dated May 2023 and revised November 2023.

emissions of Kern County, *the project's incremental effects on air quality would be cumulatively considerable* and, even with mitigation, this potentially significant cumulative impact would be cumulatively significant and unavoidable."[142]

Although the Recirculated Draft EIR acknowledges a significant cumulative impact on air quality, it does not evaluate or explain the severity of the impact or its consequences for local residents. The Recirculated Draft EIR's bare conclusion—without further analysis—violates CEQA because "a sufficient discussion of significant impacts requires not merely a determination of whether an impact is significant, but some effort to explain the nature and magnitude of the impact."[143] Further, the Recirculated Draft EIR is inadequate because, for an analysis of air quality impacts, an EIR must explain the "connection . . . between the two segments of information presented in the EIR—potential project emissions and human health impacts."[144]

To adequately address the CTV I Project's cumulative air quality impacts, the Recirculated Draft EIR should address "how the environmental and public health burdens of a project might specially affect certain communities."[145] As part of this analysis, the document should account for increased emissions from the Project "together with any pollution burdens [nearby] communities already are bearing, or may bear from probable future projects."[146]

A thorough analysis of cumulative air quality impacts is crucial because Kern County already experiences some of the worst and unhealthiest air quality in the country.[147] Not only will the Project itself generate increased air pollution, but it will incentivize the development of other dirty industrial sources that necessarily will be concentrated nearby and will contribute to worse overall air quality owing to the Project's requirement that it will only accept CO_2 from local sources in Kern County.[148]

Such poor air quality is particularly burdensome because "Kern County has a higher percentage of Hispanic, linguistically isolated, and pollution burdened populations than do other areas of California."[149] Indeed the majority-Hispanic residents (63.9 percent) nearest to the proposed CTV I Project are particularly overburdened already: the Project has been proposed for a census tract that already faces one of the highest pollution burdens in the state (96th percentile)

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[142] RDEIR, Vol. 1 at 1-12, 5-3 (emphasis added).
[143] *Sierra Club*, *supra*, 6 Cal.5th at 519.
[144] *Id.* at 520.
[145] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* (2012) at 3, https://oag.ca.gov/sites/all/files/agweb/pdfs/environment/ej_fact_sheet.pdf.
[146] *Id.* at 4.
[147] American Lung Assn., *State of the Air* (2024) at 15–21 (listing Bakersfield, CA as the most polluted city in U.S. for daily and annual particulate matter and the third-most polluted city for ozone), https://www.lung.org/getmedia/dabac59e-963b-4e9b-bf0f-73615b07bfd8/State-of-the-Air-2024.
[148] RDEIR, Vol. 1 at 4.11-53 to 4.11-54 (stating in MM 4.11-7 that "Source[s] of CO_2 must be from an industry within Kern County").
[149] Kern County Planning & Natural Resources Dept., *Final Supplemental Recirculated Environmental Impact Report (October 2020) for Revisions to Title 19-Kern County Zoning Ordinance–(2020 A), Focused on Oil and Gas Local Permitting* (Jan. 2021), section 7.2.6 (Response to Comments of Interested Parties), response to comment 0010-3.

as well as challenges posed by unemployment (89th percentile), poverty (86th percentile), and linguistic isolation (83rd percentile).[150]

Notably, in addition to thoroughly addressing the existing air pollution burden in the Project area, the Recirculated Draft EIR must also address "probable future projects."[151] As discussed elsewhere in these comments, the CTV I Project represents merely one component of extensive further industrial development that is expected in the area.

In addition to adequately analyzing cumulative effects of the CTV I Project in the context of the existing pollution burden on frontline communities and expected future projects, the County must then reassess the Recirculated Draft EIR's evaluation of alternatives and identification of all feasible mitigation measures. As explained by the Office of the Attorney General, "[w]here a local agency has determined that a project may cause significant impacts to a particular community or sensitive subgroup, the alternative and mitigation analyses should address ways to reduce or eliminate the project's impacts to that community or subgroup."[152] Pursuant to CEQA's requirements and consistent with the Office of the Attorney General's guidance, the County should work with the public and affected communities to develop mitigation measures that will adequately address the CTV I Project's cumulative impacts.

7. The Recirculated Draft EIR fails to adopt all feasible mitigation to control fugitive dust.

The Recirculated Draft EIR acknowledges that PM_{10} is largely emitted as fugitive dust, often generated by construction, demolition, excavation, extraction, and/or other earthmoving activities.[153] Such activities—as well as vehicle traffic, another source of PM_{10}—will occur at the CTV I Project site, and the Recirculated Draft EIR concludes that the Project's construction and operational activities will cause a significant increase in PM_{10} emissions.[154] Consequently, all feasible mitigation for PM_{10} must be adopted.

Mitigation Measure (MM) 4.3-2 specifies that "The Owner/operator shall develop and implement a Fugitive Dust Control Plan in compliance with San Joaquin Valley Air Pollution Control District fugitive dust suppression regulations."[155] The Measure further specifies 14 specific "dust control measures [that] shall be implemented."[156]

The prescribed specific measures set forth in MM 4.3-2 are inadequate and do not represent all feasible mitigation for fugitive dust at the Project site. Inexplicably, MM 4.3-2 does not include all feasible measures identified by the San Joaquin Valley Air Pollution Control

[150] Office of Environmental Health Hazard Assessment (OEHHA), *CalEnviroScreen 4.0*, results for 6029003700, https://oehha.ca.gov/calenviroscreen/maps-data (last visited Feb. 26, 2024).
[151] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* at 4.
[152] *Id.* at 4.
[153] RDEIR, Vol. 1 at 4.3-14, 4.3-38 to 4.3-39.
[154] RDEIR, Vol. 1 at 4.3-63 to 4.3-68.
[155] RDEIR, Vol. 1 at 4.3-58.
[156] RDEIR, Vol. 1 at 4.3-58 to 4.3-59.

District in its most recent Guidance for Assessing and Mitigating Air Quality Impacts.[157] Nor does MM 4.3-2 institute all measures contemplated by the Air District's Regulation VIII.[158] Indeed, some of the measures set forth in MM 4.3-2 contradict stricter requirements set forth in Regulation VIII.

Consistent with CEQA's requirement to adopt all feasible mitigation, MM 4.3-2 should be revised to reflect stronger and/or additional mitigation to control fugitive dust.

MM 4.3-2 must be strengthened not only to comply with CEQA, but to abide by the legislative directive that CCUS projects like CTV I "include . . . [s]trategies to minimize, to the maximum extent technologically feasible, copollutant emissions from facilities where CCUS or CDR technology is deployed to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."[159]

Consequently, MM 4.3-2 should be revised to include the following:

- Work should be phased to reduce the amount of disturbed surface area at any one time.[160] The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.
- At all times, for all activities (i.e., *not* just excavated soil piles, construction activities on unpaved surfaces, and grading), visible dust emissions should be limited to 20% opacity.[161]
- Wind barriers should be constructed and maintained to limit visible dust emissions to 20% opacity.[162] The Owner/operator should be required to describe where and how it will construct and maintain wind barriers in the required Fugitive Dust Control Plan.
- Traffic speeds on unpaved roads should be limited to 15 miles per hour (*not* 25), with speed limit signs posted.[163]
- Construction activities should be discontinued whenever visible dust emissions exceed 20% opacity, even if ambient wind speeds do not exceed 25 miles per hour.[164]

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[157] See San Joaquin Valley Air Pollution Control District (SJVAPCD), *Guidance for Assessing and Mitigating Air Quality Impacts* (Mar. 19, 2015) at 77–78, https://www.valleyair.org/transportation/GAMAQI.pdf.
[158] The Air District's Regulation VIII and its constituent rules are described in the Recirculated Draft EIR in Volume 1 at 4.3-38 to 4.3-39. Further, it is available on the Air District's website at https://ww2.valleyair.org/rules-and-planning/current-district-rules-and-regulations/regulation-viii-fugitive-pm10-prohibitions/.
[159] Health & Safety Code, § 39741.1(a)(3)(A).
[160] Rule 8021, section 5.2 and table 8021-1.
[161] Rule 8021, sections 5.0, 5.2, 5.4.1, and table 8021-1; Rule 8051, section 5.0.
[162] Rule 8021, section 5.2 and Table 8021-1.
[163] Rule 8021, section 5.3.
[164] Rule 8021, section 5.4.1.

- Track out should be prevented by one of the following: a grizzly with rails, pipes or grates to dislodge debris off exiting vehicles; a layer of washed gravel at one inch or larger in diameter, three inches deep; extension of paved road at least 100 feet from publicly maintained road; or installation of a wheel washer.[165]
- All visible carryout and trackout on paved public roads or the paved shoulders of a paved public road should be removed at the end of each workday;[166] it is not sufficient to isolate carryout or trackout behind a locked gate.
- For empty haul trucks, the interior of the cargo compartment must be cleaned or covered before the empty truck leaves the site.[167]

Additionally, MM 4.3-2 must specify that no construction or grading permits shall be issued, and no activities expected to cause fugitive dust emissions may otherwise commence, unless and until the Air District approves a Fugitive Dust Control Plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[168]

8. The Recirculated Draft EIR does not provide adequate mitigation to protect sensitive receptors.

a. MM 4.3-6 is inadequate and does not constitute all feasible mitigation.

To protect sensitive receptors, MM 4.3-6 states: "No Class VI or Class II well shall be located within 4000 feet of any sensitive receptor."[169] According to the Recirculated Draft EIR, this measure is intended to mitigate an "escape" of CO_2 "into the atmosphere," which "could result in health impacts to humans and wildlife."[170]

While MM 4.3-6 appropriately establishes a sizeable setback from the CTV I Project's injection wells, it is unclear if the setback distance provides adequate mitigation because the Recirculated Draft EIR does not explain how the distance of 4,000 feet was selected. The Recirculated Draft EIR must be updated to substantiate that MM 4.3-6's setback distance is adequate to protect sensitive receptors, reflecting an assessment of site-specific factors.

Notably, as described in the "Failure Investigation Report" for the CO_2 pipeline rupture that occurred not far from Satartia, Mississippi, emissions from the rupture affected community

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[165] See Rule 8041, sections 5.8 and 5.9; see also Kern County Planning & Natural Resources Dept., *Recirculated Draft Environmental Impact Report for 99 Houghton Industrial Park Project* (Oct. 2019) (hereinafter "99 Houghton Recirculated Draft EIR") at 4.3-43, https://psbweb.kerncounty.com/UtilityPages/Planning/EIRS/99_Houghton/DEIR/_99_Houghton_RDEIR_Vol%201.pdf.
[166] Rule 8041, section 5.1.
[167] Rule 8031, table 8031-1.
[168] *King & Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET, supra,* 218 Cal.App.4th at 738.
[169] RDEIR, Vol. 1 at 1-31, 4.3-74.
[170] RDEIR, Vol. 1 at 4.3-73.

members located "approximately one mile" away.[171] As a consequence of the rupture and the significant leak of CO_2, 45 people were taken to the hospital and all 200 residents of Satartia had to be evacuated.[172] The threat posed by CO_2 emissions from an injection well—particularly in the event of a blowout—would seem to be equal if not greater than the threat posed by a pipeline rupture.

Beyond the need to substantiate MM 4.3-6's setback distance for injection wells, the stated rationale for the measure makes plain the measure's inadequacy. As the Recirculated Draft EIR aptly notes, the escape of CO_2 "via either well failure *or pipeline rupture* . . . could result in health impacts to humans and wildlife."[173] Indeed, the incident near Satartia demonstrates that it is not only injection wells that pose a threat to public health, but also pipelines and presumably any other equipment or structure that could leak significant quantities of CO_2. Consequently, MM 4.3-6 should be revised to require a protective setback from not only the injection wells, but also the Project's pipelines and any other structures or equipment containing or conveying CO_2.

b. MM 4.3-8 constitutes inadequate and unlawfully deferred mitigation.

As a further measure to address air quality impacts on sensitive receptors, MM 4.3-8 sets forth the following monitoring requirements:

> Prior to issuance of any construction or grading permits, the Owner/operator shall consult with the San Joaquin Valley Air Pollution Control District and develop a draft Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project including but not limited to: criteria pollutants, CO_2, and H_2S. The plan shall be reviewed and approved by both the San Joaquin Valley Air District and the California Air Resources Board, with a draft copy to the EPA UIC Program and Kern County Planning and Natural Resources, and implemented before any construction on the CCS facilities can occur. The final approved plan shall be provided to the EPA UIC Program and Kern County Planning and Natural Resources.[174]

Given the CTV I Project's potential to expose nearby community members to substantial concentrations of air pollution, both criteria air pollutants and toxic air contaminants, the County can and should insist on a robust monitoring plan to detect elevated pollution levels.

Unfortunately, MM 4.3-8 does nothing more than generically require development and approval of a future plan. The mitigation measure fails to identify any performance standards to be used to develop the monitoring plan and, equally important, neglects to identify performance standards for the mitigation to be instituted when the monitoring identifies significant impacts.

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[171] RDEIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC (May 26, 2022) at 3.
[172] RDEIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC at 2.
[173] RDEIR, Vol. 1 at 4.3-73 (emphasis added).
[174] RDEIR, Vol. 1 at 1-31 to 1-32, 4.3-74.

This open-ended and therefore potentially meaningless promise of a mitigation measure to be developed sometime in the future violates CEQA's requirements for deferred mitigation.

In *Gray v. County of Madera* (2008) 167 Cal.App.4th 1099, the court rejected—for lack of any performance standards—a mitigation measure that required monitoring private wells near a quarry and, if an impact was found, specified that the project must replace the lost water from existing wells on the proponent's property. Even though the respondent county in *Gray* had "committed itself to a specific mitigation goal—the replacement of water lost by neighboring landowners because of mine operations," the court concluded the goal was not a specific performance standard that complied with CEQA.[175]

MM 4.3-8 is even more deficient than the mitigation measure rejected in *Gray*, as the Recirculated Draft EIR does not identify any performance standards for the monitoring plan to be established beyond the pollutants to be addressed, let alone any performance standards for the mitigation to be implemented upon the identification of impacts. To meet CEQA's requirements, MM 4.3-8 should identify:

- Specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters;
- Requirements for reporting monitoring results to the County and responsible agencies and/or performance standards to be used to develop such reporting requirements;
- Requirements for reporting monitoring results to affected communities, regional community-based organizations, and to the public online and/or performance standards to be used to develop such meaningful public disclosure;
- Threshold level(s) and requirements for notification of nearby residents, other affected communities, and schools when a threshold is exceeded and/or performance standards to be used to develop such public notification requirements;
- Threshold levels of air pollution that, if detected at the fenceline, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation;
- Mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

To adequately protect community members, monitoring parameters for the plan to be developed pursuant to MM 4.3-8 should be developed with input from nearby residents and affected communities. Community input is particularly valuable and important for determining the locations of monitors (including, but not limited to, near sensitive receptors and along the

[175] *Gray, supra,* 167 Cal.App.4th at 1119.

project fenceline), the number of monitors, and the thresholds that will trigger community notification and response requirements.

9. The Recirculated Draft EIR fails to adopt all feasible mitigation to address Valley Fever.

The Recirculated Draft EIR institutes one mitigation measure, MM 4.3-7, to address Valley Fever.[176] MM 4.3-7 is inadequate and does not incorporate all feasible mitigation to address Valley Fever.

MM 4.3-7 should be revised to include the fuller protections that the County previously devised for the 99 Houghton Industrial Park Project, as set forth in MM 4.3-1 of the recirculated Draft EIR for the project:[177]

- The Owner/operator should be directed to thoroughly clean equipment, vehicles, and other items of dust before they are moved offsite to other work locations.
- Grading and trenching work should be phased so that earthmoving equipment is working ahead or down-wind of workers on the ground. The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.
- The area immediately behind grading or trenching equipment should be sprayed with water before ground workers move into the area.
- In the event that a water truck runs out of water before dust is sufficiently dampened, any ground workers that otherwise would be exposed to dust should be directed to leave the area until a full truck resumes water spraying.
- All heavy-duty earth-moving vehicles should be closed-cab and equipped with a HEPA-filtered air system.
- Evidence of required training on how to spot and report the symptoms of Valley Fever and how to properly use personal protective equipment should be provided by the Owner/operator to the Kern County Planning and Natural Resources Department within 24 hours of the training session.

10. The Recirculated Draft EIR fails to adopt all feasible mitigation for cumulatively significant net increases in nonattainment air pollutants, including $PM_{2.5}$.

The Recirculated Draft EIR acknowledges that the CTV I Project will result in a cumulatively considerable net increase of criteria air pollutants for which the San Joaquin Valley has been designated a "nonattainment" area pursuant to applicable state and federal ambient air quality standards. In particular, the Recirculated Draft EIR states that "[t]he project's total emissions would exceed the San Joaquin Valley Air Pollution Control District thresholds for

[176] RDEIR, Vol. 1 at 1-31, 4.3-74.
[177] See 99 Houghton Recirculated Draft EIR at 1-27, 4.3-48 to 4.3-49.

nitrogen oxides (NOx), particulate matter with a diameter of 10 micrometers or less (PM_{10}), and particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), for which the project region is nonattainment under an applicable federal or State ambient air quality standard."[178]

To address the CTV I Project's significant criteria air pollutant emissions, the Recirculated Draft EIR includes MM 4.3-5, which "requires the execution of a Developer Mitigation Agreement (DMA)" with the Air District.[179] According to the Recirculated Draft EIR: "[t]he implementation of a DMA (MM 4.3-5) to reduce criteria pollutants of NO_X, ROGs, and PM net incremental emissions generated by a project has been incorporated into development projects in the county since 2008."[180]

In several respects, MM 4.3-5 does not meet CEQA's requirement that the County adopt all feasible mitigation, nor does it comply with the requirement of Health and Safety Code section 39741.1(a)(3)(A) that CCS projects "minimize, to the maximum extent technologically feasible, copollutant emissions . . . to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."

a. The County must approve the DMA and institute other requirements to ensure MM 4.3-5 is enforceable and enforced.

While MM 4.3-5 appropriately requires the Owner/Operator enter into the DMA and pay associated fees due to the Air District prior to the approval of any grading or construction activity, the Measure fails to specify that the agreement must be approved by the County as well, subject to public review and comment. In litigation over Kern County's Oil and Gas Ordinance, courts have found that the specific terms of such an implementing agreement are consequential and must provide for "particular" and "enforceable" mitigation.[181] Further, in correspondence between the County and Air District concerning such agreements, the County has confirmed that it—as lead agency—is ultimately "responsible for the implementation of all mitigation measures."[182] For these reasons, the County must itself review and approve the DMA, subject to the additional steps for community input and public review discussed below.

The County should withhold its approval of the DMA unless and until the California Air Resources Board (CARB) confirms in writing that the DMA meets the requirements of section 39471.1 of the California Health and Safety Code. MM 4.3-5 currently specifies that the DMA

[178] RDEIR, Vol. 1 at 1-12.
[179] RDEIR, Vol. 1 at 4.3-70.
[180] RDEIR, Vol. 1 at 4.3-68.
[181] *King & Gardiner Farms, LLC v. County of Kern* (Fifth District Court of Appeal Case No. F077656, Feb. 25, 2020), Slip Opinion at 67-74; *Vaquero Energy Inc., et al. v. County of Kern, et al.* (Kern County Superior Case No. BCV-15-101645-GP, June 7, 2022), Ruling on Petitions for (Third) Writ of Mandate at 21–23.
[182] Letter from Kern County Planning & Natural Resources Dept. to SJVAPCD (Sept. 15, 2020) at 2; accord Letter from SJVAPCD to County of Kern Planning & Natural Resources Dept. (Oct. 30, 2020) at 2 (stating the Air District "is not responsible for making whole any shortfalls for emission reductions that the District is not able to achieve with the mitigation funds it receives from the County" pursuant to an emissions reduction agreement because "as the lead agency under CEQA," it is the County's "obligation to ensure implementation of all mitigation measures included in the Environmental Impact Report").

"shall be reviewed by the California Air Resources Board for compliance with" section 39741.1 "before execution and adoption,"[183] but does not specify if or how compliance will be confirmed. MM 4.3-9 should be revised to specify that written confirmation of compliance is required.

To ensure that MM 4.3-5 and all the other mitigation measures set forth in the Recirculated Draft EIR are implemented and fully enforceable, the County should specify in the CUPs required by the CTV I Project that compliance is required, with construction as well as subsequent operational activities conditioned upon initial and ongoing compliance.

Further, MM 4.3-5 should be revised to require: (a) reporting by the Owner/operator to verify that actual CTV I Project emissions are consistent with the Recirculated Draft EIR's emissions estimates and the fee paid; (b) reporting by the Air District to confirm that funding by the Owner/operator is sufficient to fund local pollution-reducing projects that, in fact, offset the Project's actual emissions; and (c) a mechanism that requires the Owner/operator to pay a supplemental fee or fees if actual Project emissions exceed the Recirculated Draft EIR's estimates and/or the initial fee proves to be insufficient.

b. MM 4.3-5 is ambiguous about exactly what mitigation is required.

The Recirculated Draft EIR and MM 4.3-5 are not clear about precisely what mitigation will be required under the mitigation measure. MM 4.3-5 states:

> The Owner/operator shall pay fees to fully offset Project emissions of NOx (oxides of nitrogen), ROG (reactive organic gases), PM10 (particulate matter of 10 microns or less in diameter), and PM2.5 (particulate matter of 2.5 microns or less in diameter) (including as applicable mitigating for reactive organic gases by additive reductions of particulate matter of 10 microns or less in diameter) (collectively, "designated criteria emissions") to avoid any net increase in these pollutants.[184]

MM 4.3-5's requirement to "fully offset Project emissions . . . to avoid any net increase in these pollutants" is ambiguous. It is unclear if the County is mandating that, for each air pollutant emitted by the CTV I Project, the DMA will require an equivalent, offsetting reduction in the same air pollutant. Conversely, the County may intend to treat all the criteria air pollutants collectively and interchangeably, with the DMA only required to ensure that the combined sum of all increased criteria air pollutant emissions will be offset by an equivalent reduction in criteria air pollutants—no matter the particular air pollutant reductions achieved. Either way, the Recirculated Draft EIR should be revised to clarify what the terms in the mitigation measure mean. For example, if it is the County's intention to allow reductions in PM_{10} to be credited as mitigation for $PM_{2.5}$ under MM 4.3-5, the Recirculated Draft EIR should clearly say as much so that the public and decisionmakers fully understand how MM 4.3-5 will operate.

[183] RDEIR, Vol. 1 at 4.3-71.
[184] RDEIR, Vol. 1 at 4.3-70.

c. The County must require that increases in $PM_{2.5}$ emissions be offset with commensurate reduction in $PM_{2.5}$.

To the extent the County intends to treat all the criteria air pollutants interchangeably for purposes of mitigation, such an approach fails to ensure that significant increases in particular air pollutants will be reduced, as CEQA requires. In this regard, the conflation of $PM_{2.5}$ and PM_{10} is especially problematic.

In reviewing mitigation for the Kern County Oil and Gas Ordinance, the courts have twice found that treating $PM_{2.5}$ and PM_{10} interchangeably for purposes of mitigation is unlawful. In 2020, the Fifth District Court of Appeal agreed with petitioners that the County's 2015 EIR failed to adequately mitigate $PM_{2.5}$ pollution. Reviewing the issue as a matter of law, the court observed that $PM_{2.5}$ and PM_{10} "are not the same" and faulted the County's mitigation measure and a related emissions reduction agreement for "[l]umping them together."[185] According to the appellate court, absent a finding that it would be infeasible, the County was required to adopt "fully enforceable" mitigation in the form of a "particular requirement" for $PM_{2.5}$.[186]

More recently, in 2022, the Kern County Superior Court again agreed with petitioners that the County unlawfully failed to adopt all feasible mitigation for $PM_{2.5}$ and to make such mitigation enforceable. In its ruling, the court faulted the County for continuing to "conflat[e] … PM2.5 and PM10."[187]

Although MM 4.3-5 mentions both $PM_{2.5}$ and PM_{10} separately, that is insufficient. Instead, MM 4.3-5 should specify that the Project's $PM_{2.5}$ emissions will be mitigated by funding projects that result in an equivalent quantity of $PM_{2.5}$ reductions. Absent such an explicit requirement in MM 4.3-5, significant increases in $PM_{2.5}$ may, in fact, evade mitigation. In its 2020 opinion, the Fifth District explained how this could happen in a detailed hypothetical:

> Suppose that during a proposed project's first year of operation it was estimated to emit 16 tons of PM2.5 and to emit 17 tons of PM10 that was larger than PM2.5. If the project proponent were to enter into offset agreements that reduced PM10 that was larger than PM2.5 by 30 tons in the first year, then the net particulate matter emissions for the first year would be three tons, which is below the standard of significance for both PM10 and PM2.5. However, the 16 tons of PM2.5 emissions would not have been offset and, under Air District's 15-ton per year threshold of significance for that air pollutant, one would conclude that the project would have a significant adverse effect on air quality despite the offsets of PM10.[188]

[185] *King & Gardiner Farms* Slip Opinion at 70–72.
[186] *King & Gardiner Farms* Slip Opinion at 70–73; accord *King & Gardiner Farms*, 45 Cal.App.5th at 830.
[187] *Vaquero Energy*, Ruling on Petitions for (Third) Writ of Mandate at 22.
[188] *King & Gardiner Farms* Slip Opinion at 71.

d. Additional changes are required to ensure that MM 4.3-5 will effectively reduce air quality impacts to the extent feasible.

MM 4.3-5 recognizes the importance of addressing air quality impacts where the CTV I Project's increased air pollution emissions will be experienced most acutely—i.e., in the communities nearest to the proposed Project. MM 4.3-5 therefore appropriately requires that monies collected pursuant to the DMA will be used to fund pollution-reducing mitigation projects within a 20-mile radius.[189]

MM 4.3-5 also responds to the need for outreach to local community members to ensure effective operation of the DMA, requiring the Owner/operator to pay an annual fee "for the creation of a county managed community liaison position to provide technical support to the Eligible CCS Air Funding Communities and coordination with the San Joaquin Valley Air Pollution Control District to expedite use of the funding for air mitigation projects."[190] This likewise is a welcome and appropriate requirement.

Nonetheless, further steps can and should be taken to ensure the DMA effectively reduces air quality impacts. Specifically:

- MM 4.3- should require the Owner/operator and the Air District to establish a community-led steering committee made up of affected residents that live within Eligible CCS Air Funding Communities. The purpose of this steering committee would be to provide input to the Owner/operator and the Air District as the terms of the DMA are developed, and to advise the Air District on its funding decisions once the DMA is executed.
- MM 4.3-5 should also specify that, with the support of the DMA-funded community liaison, the steering committee will hold periodic public meetings and/or workshops to hear residents' concerns and to provide information about the availability of DMA funds.
- In addition to requiring funding for the community liaison position, MM 4.3-5 should also require additional funding to ensure that the public liaison and steering committee can conduct outreach in English as well as Spanish—with an ability to provide written materials in both languages as well as interpretation at meetings and/or workshops.

B. The Recirculated Draft EIR's Analysis and Mitigation of Climate Impacts is Inadequate.

The Recirculated Draft EIR's GHG emissions analysis is unsupported, self-contradicting, and violates CEQA's requirements for proper analysis.

First, the Recirculated Draft EIR's GHG analysis relies on contradictory and false premises: it purports to analyze GHG impacts from future CO_2 sources it also argues are

[189] RDEIR, Vol. 1 at 4.3-71.
[190] RDEIR, Vol. 1 at 4.3-71.

impossible to analyze. Moreover, it claims that these sources will be "hard to decarbonize" while this claim is contradicted by the Recirculated Draft EIR's own evidence.

The analysis is also missing crucial information: it fails to account for all elements of the CTV I Project, fails to analyze the whole Project's lifespan, fails to account for potential life extension of fossil fuel facilities, and does not disclose potential offset credit generation. Finally, the analysis of CO_2 retention in the ground is not supported by the evidence, as the attached DiGiulio Report shows, because it fails to identify permanence standards and ignores crucial leakage risk factors that contradict the claim that CO_2 will remain permanently in the ground.

Second, the GHG analysis reveals a contradiction at the heart of the premise of this Project: the Recirculated Draft EIR's analysis of GHG impacts concludes that even though permanent CO_2 sequestration and reductions in CO_2 emissions are CTV I Project's main objectives, the Project has a potentially significant impact from GHG emissions. Even worse, the Recirculated Draft EIR reaches this conclusion in part based on the assertion that it cannot guarantee that the CO_2 it proposes to inject underground will actually remain underground permanently without release or leakage. No meaningful analysis or evidence supports any of these conclusions in the Recirculated Draft EIR.

Third, the analysis does not adequately assess consistency with plans and policies relating to GHGs, including California's leading plan for GHG emissions reduction, the 2022 Scoping Plan.

Fourth, the Recirculated Draft EIR's cumulative impacts analysis is wholly inadequate, self-contradicting, and fails to address any cumulative projects, which is the essence of a cumulative impacts analysis.

Finally, the Recirculated Draft EIR's mitigation measures are inadequate under CEQA. They are ineffective, unenforceable, and impermissibly deferred without any standards, as required under CEQA. Moreover, some measures rely on offset credits, revealing a fundamental failure in the CTV I Project's ability to meet its objectives.

1. The Recirculated Draft EIR's GHG analysis is inadequate under CEQA.

a. The GHG analysis relies on data it claims does not exist.

One of the basic flaws at the heart of the GHG analysis is that it purports to present data that, according to the same analysis, does not exist. Table 4.8-6 presents "Projected Injection 2026-2045" and claims that total GHG injected in the CTV I Project is projected to be 31,217,430 MT CO2e.[191] This number, however, represents CO_2 injected from many sources beyond the initial sources the Recirculated Draft EIR describes and analyzes—the Elk Hills field gas streams. The GHG analysis does not only provide a total volume of CO_2 injected underground over twenty years. The analysis goes as far as projecting the exact volume of CO_2 that will be injected in each year of the Project's first 20 years of operation.

[191] RDEIR, Vol. 1 at 4.8-26.

At the same time, the same analysis states clearly that because these sources "have not been permitted or completed CEQA, information cannot be provided on the total amount of GHG emissions they produce, how much will be captured, how much stored, how much additional created or how much will still be released to the atmosphere."[192] Both parts of the analysis cannot be true at the same time.

b. The GHG analysis relies on a false premise.

The GHG analysis relies on a premise that is not only vague and unsupported by evidence but is, in fact, contradicted by the Recirculated Draft EIR's own information in a way that renders the whole GHG analysis unsupported and inadequate under CEQA.

Specifically, the Recirculated Draft EIR argues that "[t]he capture of the GHG from the initial source and other sources will reduce the amount of CO_2 in the atmosphere emitted by industries that are essential but hard to decarbonize, such as concrete and hydrogen transportation fuels" and therefore, "[a]ccounting for the GHG emissions reductions from CCS, the project's impacts related to GHG emissions would be less than significant."[193]

The GHG analysis's premise is that if the Project's CO_2 sources are "essential but hard to decarbonize" industries, the Project would be beneficial from a climate perspective and will have a less than significant impact on GHG. This premise is contradicted by the Recirculated Draft EIR's own information and mitigation measures.

The analysis fails to define what are "essential but hard to decarbonize" industries. At the same time, MM 4.11-7 limits future Project sources to a list of sectors and industries. These sectors and industries include "hydrogen—green and blue," biomass carbon removal and storage (BiCRS), cement production, green steel production, oilfield field gas streams, power plants, DAC, and alternative fuel production.[194]

Several sources on this list cannot be categorized as "essential but hard to decarbonize" under any reasonable definition. First, some of them are not industries at all. As explained below, industries in the climate context are usually defined by the end-product or service, like cement or steel. But oil field gas streams, blue hydrogen, and alternative fuels are energy sources, not industries with an essential end-product.

Moreover, the term "hard to decarbonize" is completely irrelevant to fossil fuels (like oil field gas) or fossil fuel-based plants (like gas power plants). These fuels and facilities are not "hard to decarbonize"—they are the very source of CO_2 that decarbonization efforts are aimed at eliminating. CARB's Scoping Plan, which lays out the path to achieve California's climate goals, and which the Recirculated Draft EIR claims to be consistent with,[195] states that the "transition away from fossil combustion" is the plan's overriding goal.[196]

[192] RDEIR, Vol. 1 at 4.8-25.
[193] RDEIR, Vol. 1 at 4.8-26.
[194] RDEIR, Vol. 1 at 4.11-53 to 4.11-54.
[195] RDEIR, Vol. 1 at 4.8-30.
[196] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 183.

The CARB Scoping Plan also includes a discussion of key sectors that it covers, contradicting any suggestion that the full range of industries, fuels, and processes listed as potential CO_2 sources might be considered "hard to decarbonize." Under "Industry," the Scoping Plan's discussion makes a clear distinction between industries and their energy sources and explains that different fossil fuels "provide energy to meet three broad industry needs: electricity, steam, and process heat."[197] It then explains that "[e]lectrification and solar thermal heat are best-suited to industrial processes that have relatively low heat requirements,"[198] but that "[t]here are fewer commercially available and economically viable electrification options to replace industrial processes that require higher-temperature heat."[199] The Scoping Plan goes on to say that "[i]ndustries in California with high heat needs include *steel forging, glass manufacturing*, and industries with calcination processes, such as *manufacturing lime and cement*."[200] It is clear that oil field gas, gas power plants, blue hydrogen, and alternative fuels cannot be treated as "essential but hard to decarbonize" industries under the Scoping Plan, and the premise of the GHG analysis is therefore contradicted by the Recirculated Draft EIR's own mitigation measures.

This contradiction is apparent even in the Recirculated Draft EIR's discussion of potential CO_2 sources. The "Source Identification Memo" ("Source Memo") added to the Recirculated Draft EIR explains that "[d]ue to the high heat required, cement plants are one of a few industries that are hard to decarbonize."[201] When discussing steel plants as potential sources, the Source Memo again explains that "[s]teel forging requires high heat and onsite combustion, with few electrification options to replace fossil gas for high heat requirements, and as such is among the industries hard to decarbonize." The Source Memo makes clear that "hard to decarbonize" industries are those where electrification options are hard to come by to produce the end product. Tellingly, the Source Memo does not use the term "hard to decarbonize" when discussing any other potential sources for the Project, such as gas power plants and hydrogen plants. Any conclusion based on the assertion that the listed sources are "hard to decarbonize" is erroneous and unsupported by substantial evidence.

The "hard to decarbonize industry" definition is also irrelevant to DAC, which is not an industry, but a process aimed at pulling CO_2 from the atmosphere, and to green hydrogen which, as the Source Memo explains, generates no GHG byproducts.[202]

The erroneous use of the "hard to decarbonize" concept in listing potential CO_2 source industries underscores the failure at the heart of the Recirculated Draft EIR's process—in which the County attempts to certify a major carbon injection and storage operation without accounting for its sources and their impacts. The Recirculated Draft EIR must be revised to include a clear and supported definition of "essential but hard to decarbonize" industries and provide evidence that the CTV I Project's future sources fall squarely within the definition.

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[197] *Id*. at 207.
[198] *Id*. at 208.
[199] *Id*. at 209.
[200] *Id*. (emphasis added).
[201] RDEIR, Vol. 2, App'x K.4 - Source Identification Memo at 3.
[202] *Id*.

c. The GHG analysis fails to account for all project elements.

The Recirculated Draft EIR's analysis of GHG emissions is informationally inadequate and lacks substantial evidence to support its conclusions. It fails to disclose the full range of projected emissions from the overall scope of activities relating to the CTV I Project, or even from the full operations of capture and storage activities.

The GHG impact analysis discloses that the County plans to issue entitlements for the whole storage capacity of 49.25 MMT of CO_2, as well as CCS facilities capturing CO_2 from the existing plants (the gas plant and power plant) at the Elk Hills oil field. Future sources, according to the Recirculated Draft EIR, "are required to be permitted with a separate CUP process and environmental review for compliance with CEQA."[203]

The analysis then provides an estimate of the construction and operations emissions. The analysis is provided only for the existing plants and the new capture facilities built for them. Under Table 4.8-4, "Estimated Operational Greenhouse Gas Emissions", the Recirculated Draft EIR presents the expected emissions from the existing plant, the projected emissions from mobile sources of the capture facility, and the projected amounts of CO_2 captured and sequestered until the year 2045.[204] The Recirculated Draft EIR concludes that over 20 years, the Project will result in net emissions reduction of 31,217,430 MT CO_2e.[205]

But the Recirculated Draft EIR fails to disclose the operational emissions from the capture facility *stationary sources*; instead, the document includes only its mobile emissions in Table 4.8-4. This is misleading and inadequate. Section 3.4 of the Recirculated Draft EIR details the proposed Project characteristics. The Project, according to the document, will include two amine plants for the capture process, CO_2 compression and pumping facilities including compressors, pumps, chiller system and heat exchangers,[206] pipelines and pipeline appurtenances, including potential pump stations,[207] and injection facilities that include compression or pumping stations.[208] All these Project components are completely missing from the Project GHG analysis. In addition, the attached expert report of Dr. Ron Sahu notes that the analysis is missing, and should include, GHG emissions associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance.[209] Relatedly, the DiGiulio Report notes that in the Emergency and Remedial Response Plan, CTV discussed venting CO_2 from surface facilities in the event of an emergency, but this potential loss of CO_2 is not accounted for or quantified in the analysis.[210] The analysis must include the projected GHG emissions from *all* Project operations.

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[203] RDEIR, Vol. 1 at 4.8-19.
[204] RDEIR, Vol. 1 at 4.8-23 to 4.8-24 ("Table 4.8-4 shows only the initial source permitted with this EIR (collection of pre-combustion oilfield gas from in-field CRC facilities) at the same rate").
[205] RDEIR, Vol. 1 at 4.8-24.
[206] RDEIR, Vol. 1 at 3-18.
[207] RDEIR, Vol. 1 at 3-20.
[208] RDEIR, Vol. 1 at 3-22.
[209] Sahu Report at 4.
[210] DiGiulio Report at 12.

d. The GHG analysis fails to analyze the whole Project's lifespan.

The Recirculated Draft EIR also fails to explain why the analysis goes only to the year 2045 and up to 31 MMT of CO_2,[211] when the Recirculated Draft EIR seeks to approve the whole storage capacity of almost 50 MMT, and the Project's lifespan is currently estimated to be 30 years (or roughly to 2054),[212] and potentially longer. EPA's docket for the CTV I Project Class VI permit indicates that CTV would be required to implement an EPA-approved Post-Injection Site Care and Site Closure Plan, and that it will include post-injection monitoring for at least 50 years and until it demonstrates non-endangerment of underground sources of drinking water (USDW) based on monitoring and other site data.[213]

The analysis should account for the whole storage capacity the Recirculated Draft EIR is seeking to approve, and for the whole projected life of the related CCS facilities and sources.

e. The GHG analysis fails to account for potential life extension of fossil fuel facilities.

The first proposed source for CO_2 sequestration in the CTV I Project is the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility and used at the Elk Hills power plant.[214] The GHG analysis assumes continuous operations of the power plant, which is already over 20 years old, at least into the year 2045.[215]

The GHG analysis fails to provide any information about the expected life of the power plant independently of its role as a CO_2 source for the Project, despite acknowledging that California aims to reduce its dependency on fossil fuels.[216] In some places, the Recirculated Draft EIR even assumes continued operations for the 30-year duration of the proposed Project.[217]

As the Sahu Report notes, the proposed Project would require the power plant to operate for over 50 years, while "[w]ithout significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project."[218]

Moreover, the sources list in the Recirculated Draft EIR includes both oil field gas streams and power plants—a fossil fuel and a fossil fuel operated facility—as potential sources.[219] The recirculated cumulative projects list includes multiple oil and gas operations as well as two existing gas power plants (in an "unknown" location).[220] The Project's objectives were revised in the Recirculated Draft EIR in a way that raises the concern that the Project will

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[211] RDEIR, Vol. 1 at 4.8-24.
[212] RDEIR, Vol. 1 at 4.2-14.
[213] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* at 4–5.
[214] RDEIR, Vol. 1 at 3-1.
[215] Cal. Energy Com. (CEC), *Elk Hills Power Project* (last accessed July 15, 2024), https://www.energy.ca.gov/powerplant/combined-cycle/elk-hills-power-project.
[216] RDEIR, Vol. 1 at 4.8-24.
[217] Sahu Report at 3
[218] Sahu Report at 3–4.
[219] RDEIR, Vol. 1 at 3-13.
[220] RDEIR, Vol. 1 at 3-45 to 3-47.

serve to extend the life of fossil fuels—and in fact suggests that is a specific objective of the project: the Project's objective of contributing to CRC's "adopted goals of Full-Scope Net Zero emissions" is now qualified by the sentence "by capturing and storing CO_2 emissions from CRC's Elk Hills field gas operations."[221]

The Recirculated Draft EIR fails to address the critical question of whether the CTV I Project may facilitate extending the life of the Elk Hills power plant or of any other fossil fuel source, and the resulting GHG emissions implications.

f. The GHG analysis does not disclose potential offset credit generation.

The Recirculated Draft EIR does not discuss or disclose whether Project proponents believe its operations will—or should—receive credit as offsets in the cap-and-trade market. A recent report by the Independent Emissions Market Advisory Committee noted that "there are conflicting views on whether carbon dioxide removals should be given credit as offsets in the cap-and-trade market and resolving this will be an important issue for CARB and the legislature."[222] CRC's presentation regarding the CTV I Project from November 2023 states that "[t]he capture project is targeting 45Q credit generation as well as the potential for LCFS qualification and Cap & Trade (C&T) avoidance."[223]

The question of whether the CTV I Project can generate offset credits is crucial for a full analysis of the Project's impacts. If the Project is allowed to generate credits, it means its overall GHG impacts will be materially different than those claimed under the GHG analysis, as its operation may allow for continued emissions elsewhere. The analysis must disclose and analyze the issue of offset credits generation by the Project.

g. The GHG analysis is not supported by the evidence.

The Recirculated Draft EIR's analysis for Impact 4.8-1, "Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment," is unsupported by substantial evidence and internally contradictory. This analysis assumes that unless "any of the injected CO_2 leak at injection," or "additional, unmitigated GHG emissions be created from the capture facility operations," the injected CO_2 will remain in the reservoirs, resulting in reduction of CO_2 emitted by the CO_2 source industries.[224] The Recirculated Draft EIR also, however, acknowledges briefly that leaks might happen "at injection." And even more confusingly, the document makes a significance finding based on the acknowledged (and vaguely-stated) risk of a GHG "release due to unforeseen circumstances or equipment failure."[225] Moreover, as the DiGiulio Report shows, to the extent the Recirculated Draft EIR relies on the assumption that stored CO_2 will actually both reach and remain in the reservoirs as required for the Project to meet its objectives, that assumption suffers from two major flaws. First, it does not rely on any clear standard to support the analysis and the

[221] RDEIR, Vol. 1 at 3-7.
[222] Independent Emissions Market Advisory Committee, *2023 Annual Report* (Feb. 2024) at 27.
[223] CRC and CTV, *Third Quarter 2023 Results* (Nov. 01, 2023).
[224] RDEIR, Vol. 1 at 4.8-26.
[225] RDEIR, Vol. 1 at 4.8-26.

conclusion that CO_2 will be permanently retained in the ground. Second, it is not supported by the evidence, and is often contradicted by it.

In his report, Dr. DiGiulio explains that "[a] permanence standard should be established in the recirculated DEIR to determine the effectiveness and impact of the project. In the absence of a permanence standard, there is no metric to determine whether CO_2 is permanently retained."[226] Dr. DiGiulio explains that the EPA standards are aimed at water protection, and prohibit *any* leakage into the Etchegoin Formation, while CTV refers to the Etchegoin Formation as a "dissipation interval", which means it allows migration from the storage formation.[227] To analyze the Project's potential impacts, therefore, the Recirculated Draft EIR must define its permanence criteria. The Recirculated Draft EIR fails to address this deficiency. Dr. DiGiulio recommends that a permanence criterion be specified as a 95% probability of occurrence that 99% of CO_2 will be retained in the 26R and A1/A2 reservoirs over a period of 100 years. He further recommends that a criterion for leakage to the atmosphere will be specified as a 95% probability of occurrence that 99% of CO_2 will be retained within all subsurface media over a period of 1,000 years.[228]

In addition, Dr. DiGiulio concludes in his report that the information presented in the Recirculated Draft EIR and Class VI permit applications does not support a finding that the Project will have greater than 95% probability that 99% of CO_2 will be retained in the storage reservoirs over a period of 100 years, or even a lower standard set by CARB for crediting purposes under the CCS Protocol.[229] Dr. DiGiulio explains that the retention is not credible due to the large number of wellbore penetrations in the area, the high pressure of storage, the fact the storage will primarily consist of supercritical fluid, and the elevated risk of seismic activity in the vicinity of the Project area.[230]

Dr. DiGiulio explains that leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2.[231] Given the large number of well penetrations in the area, a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection is required to assess the CO_2 retention.[232] However, as the DiGiulio Report shows, the Recirculated Draft EIR fails to support its conclusions regarding CO_2 retention with evidence.

The full extent of the failure to support the Recirculated Draft EIR's analysis and conclusions with evidence is detailed in the DiGiulio Report. A few examples of that failure are provided below.

First, Dr. DiGiulio shows that the evidence does not support the Recirculated Draft EIR's claims for confinement of CO_2 to storage areas. The Elk Hills oil field is an anticlinal structure. The Recirculated Draft EIR argues that the Monterey Formation in the 26R and A1/A2 storage

[226] DiGiulio Report at 10.
[227] DiGiulio Report at 10.
[228] DiGiulio Report at 11.
[229] DiGiulio Report at 11.
[230] DiGiulio Report at 11.
[231] DiGiulio Report at 14.
[232] DiGiulio Report at 14.

reservoirs have "*minimal*" connection outside the Area of Review. But as Dr. DiGiulio notes, the isolation of injected CO_2 in anticlinal structures is a concern, and the Recirculated Draft EIR fails to provide evidence to show that anticlinal structures in fact provide full containment.[233] In addition, the Recirculated Draft EIR claims that confinement of the Reef Ridge Shale has been demonstrated, because large quantities of gas and water have been injected into the reservoir without leakage over the years. The DiGiulio Report shows this claim suffers from two flaws: first, there is evidence to the contrary. Even more importantly, there is no evidence of how and if leakage was even monitored, and thus no support for the conclusion that gas and water that were injected in the past did not leak.[234]

As stated above, a major issue highlighted in Dr. DiGiulio's report is the Recirculated Draft EIR's failure to properly evaluate the current well penetrations from legacy oil and gas wells and the risk of leakage they pose. Dr. DiGiulio shows that wellbore integrity failure is common, and that such failure is not necessarily addressed through well plugging and can persist after the well is "properly" plugged.[235]

Dr. DiGiulio shows that despite the fact CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1/A2 reservoirs, no wellbores were deemed deficient by CTV in either reservoir and none require corrective action. As Dr. DiGiulio notes, this 0% wellbore barrier failure rate for 354 wellbores "is at odds with the published rates of wellbore failure rates ranging from 2-75% in the literature."[236] At the same time, no information that will enable verifying the accuracy of this statement is provided in the Recirculated Draft EIR. As Dr. DiGiulio explains, because the plugged wells at the Project site are expected to contain highly pressurized supercritical CO_2 for hundreds, if not thousands of years, "the County should not ignore the serious gaps in the existing regulatory framework and must require full investigation and remediation" of these wells.[237] The Recirculated Draft EIR must be revised to include all relevant information, including but not limited to wellbore diagrams, cement evaluation logs, and internal and external mechanical integrity tests, to support its conclusions with evidence.[238]

Moreover, Dr. DiGiulio notes that CTV states that there are 150 wellbores in the A1/A2 storage reservoir penetrating the Reef Ridge shale. Seventy-nine of these are currently unplugged wellbores and CTV states that 33 wells in the A1/A2 reservoir have been identified for abandonment. Accounting for these wells and 6 more that will be reconfigured, Dr. DiGiulio finds there are 40 more wells that are unaccounted for in the Recirculated Draft EIR.[239]

Dr. DiGiulio also explains that wellbore schematics are "absolutely vital" in understanding the need or potential need for corrective action, but that since CTV claimed that these schematics are business confidential information, this information is not available to those reviewing the Recirculated Draft EIR. The information on plugging locations that is now provided in Appendix 2 in the Recirculated DEIR is not a substitute for wellbore schematics, and

[233] DiGiulio Report at 6–7.
[234] DiGiulio Report at 8.
[235] DiGiulio Report at 14.
[236] DiGiulio Report at 16–17.
[237] DiGiulio Report at 14–15.
[238] DiGiulio Report at 17.
[239] DiGiulio Report at 15.

CTV should make all information associated with wellbores relevant to wellbore integrity publicly available.[240]

Finally, the DiGiulio Report highlights the fact that the Recirculated Draft EIR "is replete with vague terms that lack definitions and measurable standards."[241] The technical documents often use terms like "adequate" and "sufficient" in places where exact, measurable definitions are necessary for a proper analysis. As an example, the Recirculated Draft EIR argues that all wells within the Area of Review in the A1/A2 reservoir are protective of the USDW because there is "sufficient" annular cement within the confining Reef Ridge Shale. But what "sufficient" means in this context is left undefined.[242] In other places, wells are described as being in "adequate" condition regarding annular isolation, without any explanation of what "adequate" is.[243] Dr. DiGiulio highlights multiple such uses of vague and undefined terms that must be clarified to allow for proper review of the Recirculated Draft EIR and guarantee its conclusions are supported by the evidence.

In sum, the analysis takes credit for the potential CO_2 storage of the Project, but fails to support the conclusion that CO_2 will be retained in the ground with evidence.

2. The Recirculated Draft EIR's halfhearted and contradictory finding of potentially significant GHG impacts violates CEQA.

The Recirculated Draft EIR's conclusions and findings regarding the significance of GHG impacts are incoherent and internally contradictory, finding at once both that GHG emissions impacts are, and are not, significant. The finding of significant impact, specifically, is not accompanied by any data or analysis describing or analyzing the nature or extent of the significant impact, and the document also appears to deny that this impact exists alongside its disclosure of the impact. These conclusions and findings cannot, by their own terms, be informationally adequate, nor are they supported by substantial evidence. The document should instead provide a detailed analysis of impacts supporting its finding, as set forth below.

The environmental analysis finds that "[a]ccounting for the GHG emissions reductions from CCS, the Project's impacts related to GHG emissions would be less than significant."[244] But then it goes on to make a significance finding, saying:

> However, the estimated reductions are contingent upon injected CO_2 remaining in the identified geographically confined reservoirs for storage in perpetuity without leakage from injection and capture activities. Should any of the injected CO_2 leak at injection or additional, unmitigated GHG emissions be created from the capture facility operations, then GHG emissions from the project would be potentially significant.[245]

[240] DiGiulio Report at 16.
[241] DiGiulio Report at 15.
[242] DiGiulio Report at 15.
[243] DiGiulio Report at 15–16.
[244] RDEIR, Vol. 1 at 4.8-26.
[245] RDEIR, Vol. 1 at 4.8-26.

With this brief statement, the Recirculated Draft EIR concludes that despite implementation of several mitigation measures, "the possibility of a release due to unforeseen circumstances or equipment failure remains" and the CTV I Project's impacts from GHG emissions "remain significant and unavoidable."[246] This specific acknowledgment of significant impact from the risk of unintended releases of GHGs is articulated in the Recirculated Draft EIR's GHG impacts section as one of the rationales for the GHG significance finding, but is not included in the summary of impacts in Table 1.1.[247] Moreover, as discussed more fully above and in the DiGiulio Report, the Recirculated Draft EIR's impact analysis fails to properly disclose and analyze this risk.

First, if this conclusion is correct—if the Project may have a significant (negative) impact on GHG emissions because of the risk of release from failure at any stage in Project operations—then the County should not approve the CTV I Project, as it does not fulfill its fundamental objective: to capture and permanently store CO_2 emissions underground.

Second, the Recirculated Draft EIR's handling of this issue violates CEQA. The document attempts to avoid accounting for the Project's impacts by acknowledging the possibility of leakage and finding that risk to be a significant and unavoidable impact, and at the same time failing to include any analysis of the nature, extent, or magnitude of this risk—and elsewhere the Recirculated Draft EIR appears to deny the risk even exists. The document thus does not comply with CEQA's requirement that an EIR will "be prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences."[248] And the conclusions are thus not supported by substantial evidence.

The courts are clear that "[A]n EIR's designation of a particular adverse environmental effect as 'significant' does not excuse the EIR's failure to reasonably describe the nature and magnitude of the adverse effect."[249] Yet the Recirculated Draft EIR does exactly that. The GHG discussion makes no reasonable effort "to explain the nature and magnitude of the impact" from GHG leakage, as CEQA requires.[250] It includes no information regarding the probability of CO_2 leakage, the circumstances under which it might happen, the potential magnitude of such leakage, or its impacts on GHG emissions. It simply classifies the impact as significant and unavoidable without any meaningful discussion. By doing so, it also violates the rule set by the courts that an EIR must set forth the bases for its findings; a bare conclusion regarding an environmental impact without an explanation of its factual and analytical basis is not sufficient.[251]

As stated in the DiGiulio Report, CO_2 leakage from geologic storage is bound to occur, and "the important question is not whether there will be leakage, but whether the extent of

[246] *Id*.
[247] RDEIR, Vol. 1 at 1-13.
[248] *Sierra Club, supra*, 6 Cal.5th 502 at 514.
[249] *Cleveland Nat'l Forest Found. v. San Diego Assn. of Governments* (2017) 3 Cal.5th 497, 514.
[250] *Sierra Club, supra*, 6 Cal.5th 502 at 519.
[251] *Laurel Heights*, *supra*, 47 Cal.3d at 404.

leakage is acceptable […] and how leakage will be monitored and quantitated."[252] The Recirculated Draft EIR fails to do just that.

There are several leakage risks that a proper analysis must account for and analyze. First, the risk of leakage from well penetration: the DiGiulio Report explains that research shows that more than 8 wells/km^2 concentrations are considered worst case scenario regarding CO_2 retention in the ground.[253] The presence of 354 well penetrations in the storage area leads to a well penetration density of 9.6 wells/km^2, which represents a worst-case scenario for permanence for geologic storage of CO_2.[254] The Recirculated Draft EIR must be revised to include a robust evaluation of wellbore integrity of both plugged and unplugged wells, to properly reflect the risk of leakage from these wells.

Leakage from wellbores can also manifest in the form of a CO_2 well blowout.[255] Despite the fact that release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions, the Recirculated Draft EIR fails to discuss the probability of such an event when discussing GHG emissions impacts.[256]

The Recirculated Draft EIR also fails to analyze the issue of lateral confinement to storage areas. As the DiGiulio Report shows, there is no evidence to support the assumption that CO_2 stored in reservoirs will in fact be confined and will not migrate beyond them.[257] The document must be revised to support these assumptions and assess the risk of leakage from lateral migration.

The DiGiulio Report also shows that the Recirculated Draft EIR's analysis of seismic risk is highly deficient and not supported by the evidence, as it fails to properly account for all factors of seismic risk.[258] The flaws in the Recirculated Draft EIR's seismic analysis are discussed in detail below. However, as explained in the DiGiulio Report, the effects of natural or induced seismicity are of particular concern at the CTV I Project, due to its effect on wellbores, which can occur even after a well is permanently plugged and abandoned. The Recirculated Draft EIR must be revised to properly account for the seismicity risks, and once this is done, to properly account for the risk of CO_2 leakage resulting from seismic activity.

The Recirculated Draft EIR's GHG analysis must be revised to include an accurate, meaningful discussion of GHG impacts that is supported by the evidence, and this evidence-supported analysis must reflect a consistent conclusion as to the nature, magnitude, and significance of the impact.

[252] DiGiulio Report at 9.
[253] DiGiulio Report at 9.
[254] DiGiulio Report at 9.
[255] DiGiulio Report at 4.
[256] DiGiulio Report at 5.
[257] DiGiulio Report at 6–9.
[258] DiGiulio Report at 25.

3. The Recirculated Draft EIR's GHG consistency analysis is inadequate under CEQA.

Under Impact 4.8-2, the Recirculated Draft EIR purports to analyze whether the Project will conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gas.[259] Under this impact area, the Recirculated Draft EIR first analyzes the CTV I Project's consistency with CARB's 2022 Scoping Plan.[260] The Scoping Plan analysis is inadequate under CEQA. Not only is it short, generic, and superficial, but it also fails to address important ways in which the Project is not consistent with the Scoping Plan.

The Recirculated Draft EIR's consistency analysis is made up of a few paragraphs generally describing the Scoping Plan discussion of carbon capture, removal and sequestration, followed by a bullet point list of the Scoping Plan's "Strategies for Success" in the sector, and ending with a single paragraph stating flatly that the Project "would support the Strategies for Success identified in the CARB 2022 Scoping Plan," "would comply with any new regulations developed as a result of implementation of the identified Strategies" and "is reasonably expected to reduce region wide and Statewide GHG emissions." The paragraph concludes with no further discussion to show the Project would be consistent with the CARB 2022 Scoping Plan.[261]

First, the analysis is generic. It fails to provide the reader with "sufficient information to foster informed public participation and to enable the decision makers to consider the environmental factors necessary to make a reasoned decision,"[262] as required under CEQA. The analysis also fails to provide substantial evidence to support its conclusions. Except for flatly declaring consistency, the analysis does not address any of the Scoping Plan Strategies beyond simply listing them. It fails to make a connection between the Strategies and the Project, and explain how the Project is consistent with them, or how they are even relevant to the Project. Just as an example, the identified Strategies that call for the state to "Evaluate and streamline permitting barriers to project implementation while protecting public health and the environment" and to "update the CARB Carbon Capture and Sequestration Protocol with the best available science and implementation experience" have nothing to do with the Project.

Second, the analysis fails to address the crucial issue of the Project's CO_2 sources' consistency with the Scoping Plan. The Scoping Plan states that CCS is included in the Scoping Plan "to address emissions from limited sectors, including electricity generation, cement production facilities, and refineries."[263] The Scoping Plan also discusses implementation in the electricity sector in or before 2045 as well as the potential to support hydrogen production.[264] As discussed above, the Recirculated Draft EIR fails to provide information regarding its future CO_2 sources and therefore cannot conclude the Project is consistent with the Scoping Plan. Moreover, the only disclosed CO_2 source in the Recirculated Draft EIR is the pre-combustion Elk Hills oil field gas which provides about one third of its power for oil field operations—not even a sector

[259] RDEIR, Vol. 1 at 4.8-28.
[260] RDEIR, Vol. 1 at 4.8-28 to 4.8-30.
[261] RDEIR, Vol. 1 at 4.8-30.
[262] *Berkeley Keep Jets Over the Bay Comm. v. Bd. of Port Comm'rs*, 91 Cal.App.4th 1344, 1356, 111 Cal. Rptr. 2d 598, 606 (2001), as modified on denial of reh'g (Sept. 26, 2001).
[263] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 86.
[264] *Id.*

the Scoping Plan lists for CCS implementation. The Recirculated Draft EIR's conclusion that the CTV I Project is consistent with the Scoping Plan is therefore unsupported by the evidence and also contradicted by it.

Finally, the Recirculated Draft EIR fails to address the fact that the CTV I Project's proposed mitigation measures are inconsistent with the Scoping Plan. As discussed below, a primary mitigation measure proposed in the Recirculated Draft EIR, in addition to monitoring plans and compliance with regulations, is buying credits to offset GHG emissions.[265] However, the Scoping Plan makes clear that GHG mitigation measures come in a hierarchical order: first, the lead agency must "exhaust[] all the on-site GHG" mitigation. Then, "CARB recommends prioritizing local, off-site GHG mitigation measures" and only then use "non-local off-site mitigation, and voluntary offsets issued by a recognized and reputable voluntary carbon registry."[266] As discussed below, the Recirculated Draft EIR fails to comply with the requirement that offsets will be issued by a recognized and reputable registry, and it also fails to exhaust, or even discuss, all onsite GHG mitigation and other local measures. Finally, it fails to acknowledge and discuss the fact that by improperly relying on offsets, it is inconsistent with the Scoping Plan.

4. The Recirculated Draft EIR fails to analyze and mitigate cumulatively considerable GHG emissions impacts.

The Recirculated Draft EIR's analysis of the CTV I Project's cumulative GHG emissions impacts suffers from many of the same flaws pointed out above regarding its project-level analysis, and from several other serious flaws. The document must be revised to correct these flaws before any decision can be made regarding the Project.

First, there are basic misstatements and inconsistencies that call the analysis into question. As one example, the analysis claims that "Table 4.8-3 shows total GHG reductions of 3,967,977 MT CO_2e over 20 years from implementation of the project".[267] In fact, Table 4.8-3 shows the estimated construction GHG emissions, not total reductions,[268] and those projected reductions of the Project, according to the other tables in the GHG analysis, are 31,217,430 MT CO_2e over 20 years, not 3,967,977 as stated in the cumulative analysis.[269]

Moreover, the Recirculated Draft EIR frames its cumulative GHG analysis in fundamentally misleading ways. For example, the document includes the following statement: "Since the project individually results in a net reduction in GHG emissions, the project would also contribute to reductions in cumulative GHG emissions."[270] First, this statement directly contradicts the Recirculated Draft EIR's cumulative GHG significance finding, which concludes

[265] RDEIR, Vol. 1 at 4.8-27 to 4.8-28.
[266] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 270–71.
[267] RDEIR, Vol. 1 at 4.8-32.
[268] RDEIR, Vol. 1 at 4.8-22.
[269] RDEIR, Vol. 1 at 4.8-24.
[270] RDEIR, Vol. 1 at 4.8-32.

that the Project will contribute to cumulatively considerable significant GHG emissions.[271] And second, this statement completely misses the point of cumulative impact analysis: that "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[272] In other words, if a CEQA analysis could infer a project's cumulative impacts directly from its individual impact, there would be no need for a cumulative impact analysis at all.

Another major flaw is that the cumulative impacts analysis fails to analyze the CTV I Project's cumulative *projects*. Under CEQA, cumulative impact analysis requires consideration of "other projects causing related impacts,"[273] including "probable future projects."[274] The Recirculated Draft EIR provides a list of cumulative projects under its project description section, but it fails to analyze their impacts in the GHG analysis, claiming that "information cannot be provided" regarding their potential GHG impacts.[275] This claim is not supported by the evidence and is in fact contradicted by it, as discussed above. The cumulative impacts analysis must analyze the projects in its cumulative projects list, as well as any probable future project that plans on sending CO_2 for sequestration at the CTV I Project (as discussed in detail above in the discussion of project description and below in this letter's section on cumulative impacts analysis).

Instead of discussing the cumulative projects the Recirculated Draft EIR discloses, the Recirculated Draft EIR focuses on the CTV I Project's cumulative impacts together with the impacts of "past, present and reasonably foreseeable future oil and gas development including wells and abandonment activity," explaining this focus is "[d]ue to the proposed project's location within an existing oil and gas field."[276] This is underinclusive. While geographic proximity can be a factor in identifying cumulative projects, it is not the only determinative factor.[277]

The Recirculated Draft EIR fails to explain why it focuses on the cumulative impacts of the CTV I Project with only the oil and gas development. It is riddled with vague statements like "impacts from oil and gas development in Kern County on cumulative GHG emissions were determined to remain significant and unavoidable despite implementation of mitigation measures"[278] that lack any explanation as to their relevance to the CTV I Project's cumulative analysis. Potentially, there is a connection between the oil field operations and CTV I because of the Project's usage of depleted oil and gas reservoirs, but that cannot explain the analysis, since the depleted reservoirs are already identified. It is unclear whether this connection stems from plans to sequester more CO_2 sourced from oil and gas production. The Recirculated Draft EIR

[271] See, e.g., RDEIR, Vol. 1 at 1-13 ("The project's cumulative contribution to GHG emissions after implementation of the recommended mitigation measures would remain cumulatively significant and unavoidable").
[272] *Communities for a Better Env't v. Cal. Resources Agency* (2002) 103 Cal.App.4th 98, 114, 126.
[273] CEQA Guidelines, § 15130(a)(1).
[274] CEQA Guidelines, § 15130(b)(1)(A).
[275] RDEIR, Vol. 1 at 4.8-25.
[276] RDEIR, Vol. 1 at 4.8-31.
[277] CEQA Guidelines, § 15130(b)(1)(A).
[278] RDEIR, Vol. 1 at 4.8-32.

must be revised to clarify this point, as well as the rest of the connection between the Project and future oil and gas development.

The Recirculated Draft EIR's cumulative GHG impact analysis is legally inadequate, not supported by substantial evidence, and must be revised to address all the inaccuracies, inconsistencies, and unsupported assumptions, include all relevant cumulative projects, and explain its analysis.

5. The Recirculated Draft EIR does not provide adequate mitigation for GHG impacts.

The GHG mitigation measures identified in the Recirculated Draft EIR fail to meet CEQA's standards for effective, enforceable mitigation. The proposed measures are ineffective, unenforceable, and vague, and there is no evidence to support their efficacy. To the extent some of the vagueness will be clarified in the future, the document also illegally defers that mitigation.

Under CEQA, proposed mitigation measures must be "fully enforceable" through permit conditions, agreements, or other legally binding instruments.[279] Any proposed mitigation must also provide assurance that such implementation will in fact occur.[280] The proposed measures fail on all counts.

a. MM 4.8-1 constitutes inadequate and unlawfully deferred mitigation.

To mitigate what the Recirculated Draft EIR finds to be a potentially significant impact from GHG emissions, it proposes a monitoring plan under MM 4.8-1. This Mitigation Measure requires that prior to injection, the owner/operator will submit "a monitoring plan that complies with all requirements of the EPA UIC permit" for the Project, to demonstrate the retention of the CO_2 in the reservoir. The Measure states that the plan shall be submitted to the County, concurrent with submittal to the EPA for review, and that "[a] copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department."[281]

Given how crucial it is to guarantee that CO_2 stored in the reservoir will remain there, both for mitigating a potentially significant impact and for achieving the Project's stated goal of CO_2 storage, it would be expected the Recirculated Draft EIR will develop a robust monitoring plan. However, the proposed Mitigation Measure is anything but robust.

In fact, all this Mitigation Measure does is reiterate an already existing rule—that CCS projects that receive a UIC permit from the EPA must prepare a monitoring, reporting, and verification (MRV) plan and submit it for the EPA's approval.[282] This Measure adds nothing to this rule except requiring that a copy of the approved plan will be provided to the County.

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[279] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, §15126.4(a)(2).
[280] *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1186–87.
[281] RDEIR, Vol. 1 at 4.8-27.
[282] 40 C.F.R § 98.448.

Relying solely on the future EPA MRV plan is inadequate under CEQA and constitutes an impermissible deferral of mitigation. The EPA UIC permit is issued under the Safe Drinking Water Act. As a result, it does not, and cannot, cover all relevant aspects of monitoring for CO_2 leakage.[283] Specifically, Dr. DiGiulio notes that the monitoring plan submitted for the Project in the Class VI permit applications does not directly consider leakage from well penetrations—although this is the most likely source of loss of CO_2. The measure must include a monitoring program specific to evaluating leakage from plugged well penetrations.[284]

A major flaw in relying on EPA's MRV plan is the fact that these plans lack clear performance standards. CEQA allows for details to be developed in future time, as long as the agency adopts specific performance standards the mitigation will achieve.[285] MRV plans that were developed under the EPA permit program have been heavily criticized for failing to include specific monitoring strategies, for containing ambiguous language, and for being difficult to verify and enforce.[286] By relying on EPA's future MRV plan for the CTV I Project, the Recirculated Draft EIR impermissibly defers its mitigation.

The DiGiulio Report makes clear why reliance on the EPA MRV plan fails to comply with CEQA's requirement for effective mitigation. For example, Dr. DiGiulio notes that continuous monitoring in the Etchegoin Formation is important to detect leakage, but further notes that under the EPA permit application, there will be only one such well in each reservoir. A proper monitoring plan should analyze and support the number of required monitoring wells above confining zones to guarantee effective detection of leakage.[287]

The DiGiulio Report finds that the Recirculated DEIR "is replete with vague terms that lack definitions and measurable standards",[288] and this problem is manifested in the proposed mitigation as well. For example, in the Corrective Action Plan filed with the EPA, CTV states that all wellbores within the Area of Review will be pressure tested prior to abandonment and will be reviewed to demonstrate adequate confinement "if necessary" and "if conditions allow." As Dr. DiGiulio notes, these statements are far too vague to be of any use,[289] and thus reliance on the plan cannot serve as enforceable and effective mitigation.

Finally, the requirement to submit a monitoring plan "[p]rior to any injection of CO_2"[290] is vague and unenforceable. CO_2 injection will be ongoing in the CTV I Project. The Measure must be revised to clarify at what point exactly a monitoring plan should be submitted, clarify that the approval of such a monitoring plan will be a condition on each new injection from each source, and clarify and guarantee the means of enforcing the plan.

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[283] DiGiulio Report at 10–11.
[284] DiGiulio Report at 18.
[285] CEQA Guidelines, § 15126.4(a)(1)(B).
[286] Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* (Dec. 2023), https://environmentalintegrity.org/news/epas-rules-for-verifying-carbon-capture-projects-are-riddled-with-holes/.
[287] DiGiulio Report at 17.
[288] DiGiulio Report at 15.
[289] DiGiulio Report at 17.
[290] RDEIR, Vol. 1 at 4.8-27.

In particular, MM 4.8-1 must be revised to include a monitoring plan that will effectively address the potentially significant impact of CO_2 leakage or other release from the CTV I Project. As explained in the DiGiulio Report, such monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage.[291] To the extent the revised measure is lacking any specific elements or details, it must at a minimum identify performance standards to be used in developing it, as required under CEQA.[292] Given the potential impacts of the GHG emissions from the Project, it is also crucial that the monitoring plan will be open for public comments and will require the approval of CARB in addition to the County.

Finally, and crucially, a monitoring plan alone will not fully mitigate the risk of leakage or release to the extent feasible. GHG mitigation measures must also include an action plan that addresses what will happen to address any release, mitigate fully the emissions from any release, and ensure the integrity of the reservoir and overall storage mechanism.

b. MM 4.8-6 is an ineffective, unenforceable, and impermissibly deferred mitigation measure.

The first part of MM 4.8-6 states as follows:

> The project shall offset all greenhouse gas emissions associated with the capture facility, and construction equipment not covered by the Cap and-Trade program or other mandatory greenhouse gas emission reduction measures through owner/operator reductions of greenhouse gas emissions as verified by the San Joaquin Valley Air Pollution Control District, through acquisition of offset credits from the California Air Pollution Control Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District, or through inclusion in an Emission Reduction Agreement, to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur. [293]

In essence, this Measure purports to offset any GHG operational emissions "associated with" the Project's capture facility (as well as some construction emissions) using the tool of emission credits, and claims to thus achieve a "no net increase" in GHG emissions from the Project construction or operations. This Measure is not only inappropriate and unlawful as mitigation, but also reveals a fundamental failure in the Project's ability to meet its objectives.

c. MM 4.8-6 goes against the Project's fundamental premises and objectives.

The CTV I Project is a carbon sequestration project. Its main goals are to permanently store CO_2 in the ground and support California's climate goals.[294] But MM 4.8-6 proposes to

[291] DiGiulio Report at 18.
[292] CEQA Guidelines, § 15126.4(a)(1)(B)
[293] RDEIR, Vol. 1 at 4.8-27 to 4.8-28.
[294] RDEIR, Vol. 1 at 3-7.

allow the Project to allow "acquisition of offset credits from the California Air Pollution Control Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District", to offset any "emissions associated with the capture facility" and "to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur."[295] This Measure thus contemplates that the Project and associated facilities may emit substantial amounts of GHG emissions—potentially without limit—into the atmosphere, as long as they purportedly offset these emissions with emissions credits.

The notion of a carbon sequestration project that may use carbon credits to offset its own emissions is absurd, and undercuts the rationale behind carbon sequestration. An effective carbon sequestration project should be the place where CO_2 is being put in the ground physically and permanently, not a link in a chain of offsets that creates profits for its owners and harm to the public and the environment.

If a CO_2 sequestration project is allowed to offset its emissions through acquisition of offset credits, then the following scenario is possible: A GHG emitting facility that is looking to mitigate its GHG emissions can go and buy offset credits from certain registries. Alternatively, and higher in the hierarchy of preferred mitigation, that facility can send its CO_2 for sequestration at the CTV I Project and achieve the same GHG mitigation goals. The facility chooses sequestration, theoretically putting the CO_2 in the ground permanently. But the CO_2 the facility sends to CTV I may not stay in the ground; instead, CTV I may purchase the same offset credits the emitting facility could have bought in the first place, to offset the emissions from its sequestration project. The futility of this scenario is clear even before going into the many problems with relying on carbon offsets and before considering the added emissions from CO_2 transportation and the operations of the CTV I Project.

d. MM 4.8-6's reliance on offset credits is not supported by the evidence.

Under CEQA, an agency must have specific evidentiary support for a conclusion that mitigation will be effective.[296] The Recirculated Draft EIR lacks evidentiary support, however, that offset credits can achieve emission reductions.

Offset programs, in general, are a contentious tool for curbing GHG emissions, and there is mounting criticism in the scientific and environmental communities against using credits in the effort to stop climate change.[297] Research shows that nature-based solutions cannot effectively offset fossil fuel combustion due to the different nature of CO_2 emissions in the two

[295] RDEIR, Vol. 1 at 4.8-27 to 4.8-28.
[296] See, e.g., *Sierra Club v. County of San Diego* (2014) 231 Cal.App.4th 1152, 1168.
[297] Amazon Watch, *Statement: Offsets Don't Stop Climate Change* (Oct. 6, 2021), https://amazonwatch.org/news/2021/1006-statement-offsets-dont-stop-climate-change.

categories,[298] and offsets are likely to increase GHG emissions rather than decrease them.[299] Environmental justice advocates have pointed out that offsets perpetuate environmental injustice by increasing the relative burden of pollution on already overburdened communities, including low-income communities of color, while GHG reduction is happening, if at all, elsewhere. [300]

There is also a consensus that, to be effective, offsets credits must be real, permanent, additional, verifiable, and enforceable.[301] Additionality is especially hard to ascertain: "additional" emission reductions are reductions not otherwise required by law or likely to occur anyway. Assembly Bill (AB) 32, California's landmark GHG reduction statute, clarifies that "additional" means "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur."[302] To be "additional," therefore, an offset credit must not result from actions otherwise legally required, *and* it must be in addition to any reduction that would otherwise occur. MM 4.8-6 fails to include any requirement for additionality of credits, nor for any of the requirements listed above, and thus there is no support for the effectiveness of the mitigation measure.

The Recirculated Draft EIR also lacks evidence that there exist any offset programs capable of ensuring that offsets are "additional." This is a particular concern given that MM 4.8-6 does not include any requirements regarding the offsets' origin, allowing for international offsets, which are especially challenging to verify.[303] There is also no support for the assumption there are enough GHG offset credits available to satisfy the mitigation measures' requirements. This problem is exacerbated by the fact that the Recirculated Draft EIR fails to quantify the volume of emissions that will need to be mitigated using offsets.

e. MM 4.8-6 is ineffective, unenforceable, and impermissibly deferred.

Even if offset credits could be, under certain conditions and limitations, a proper mitigation measure for GHG emissions, and even if they could be acceptable mitigation for a carbon sequestration project, MM 4.8-6 is inadequate as CEQA mitigation.

First, as mentioned above, there are no performance standards for these offsets, and no requirement they will be real, permanent, additional, verifiable, and enforceable. Instead, the measure relies on offsets issues by different parties, including unidentified "third parties," to issue the credits. As courts have recognized, protocols adopted by voluntary market registries may not meet standards necessary to ensure that credits in fact reduce emissions.[304]

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[298] Carton, W. at el, *Undoing Equivalence: Rethinking Carbon Accounting for Just Carbon Removal*, Frontiers in Climate (Apr. 16, 2021), https://www.frontiersin.org/articles/10.3389/fclim.2021.664130/full.
[299] Anderegg, W., *Gambling With the Climate: How Risky of a Bet Are Natural Climate Solutions?,* AGU Advances (July, 22 2021), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021AV000490.
[300] Amazon Watch, *Statement: Offsets Don't Stop Climate Change*.
[301] *Golden Door Properties, LLC v. County of San Diego* (2020) 50 Cal. App. 5th 467, 511.
[302] Health & Safety Code, § 38562(d)(2).
[303] *Golden Door Properties, LLC*, *supra*, 50 Cal.App.5th 467 at 513.
[304] *Golden Door Properties, LLC*, *supra*, 50 Cal. App. 5th 467 at 511–12.

The only check on any offsets' effectiveness in mitigating GHG impact is the requirement that they will be "verified" by the San Joaquin Valley Air Pollution Control District (SJVAPCD) or through inclusion in an Emission Reduction Agreement. MM 4.8-6 thus impermissibly defers mitigation.[305] By leaving the decision on verification of the credits solely to the judgment of the SJVAPCD, without setting any performance standards and process for the verification and only generally requiring "no net increase," the Measure violates CEQA. "Simply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[306]

The option given in the Mitigation Measure to offset emissions through inclusion in an Emission Reduction Agreement is also invalid under CEQA, for the same reasons. Emission Reduction Agreements are not defined anywhere in the Recirculated Draft EIR in the context of GHG emissions and are used by the Air District for reduction of certain other air pollutants, not GHGs. CARB's review of SJVAPCD Emission Reduction Credit (ERC) System states with respect to GHG that:

> Ultimately, the impact of these GHG ERCs is not clear, as there is no currently authorized use in an NSR context consistent with District rules or in the context of GHG Cap and Trade programs. To CARB's knowledge, none of these GHG ERCs have been used.[307]

Finally, MM 4.8-6 is unenforceable. Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[308] Here, the Measure fails to specify in any detail how the Air District will quantify the emissions reductions it needs to achieve, or does achieve, through this measure, the process by which the offsets will be purchased, and proof of their purchase filed, or any enforcement mechanism to ensure that this Measure is actually implemented.

In fact, aside from vaguely stating that the Project "shall offset," the Mitigation Measure fails to state at what point any offset "shall" happen, or whether the Air District or the County will require offsets as a condition of approval of any permit.

The last part of MM 4.8-6 deals with future sources that will be sending CO_2 for injection in one sentence. It summarily states: "All sources providing CO_2 for injection must certify that any additional CO_2 generated from the source capture facility has been mitigated to "no net increase" before injection at Carbon Terra Vault 1."[309]

This part of the Mitigation Measure aimed at future sources suffers from the same severe flaws as described above, only exacerbated. It is entirely ineffective and unenforceable, as it only

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[305] *King & Gardiner Farms*, *supra*, 45 Cal.App.5th at 856.
[306] *Id.* See also *Sierra Watch v. County of Placer* (2021) 69 Cal.App.5th 86, 110; *Golden Door Properties, LLC*, *supra*, 50 Cal.App.5th 467 at 517.
[307] CARB Enforcement Division, *Review of the San Joaquin Valley Air Pollution Control District Emission Reduction Credit System* (June 2020) at 30, https://ww2.arb.ca.gov/sites/default/files/2020-06/SJV_ERC_FINAL_20200604.pdf
[308] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).
[309] RDEIR, Vol. 1 at 4.8-28.

requires vaguely that future CO_2 sources will "certify" that any "additional" CO_2 has been "mitigated to 'no net increase.'" It fails to explain what type of certification can be used and under what conditions, or even to name the agency to whom such "certification" will be submitted and how it will be verified. It also fails to explain what "additional" means in the context of this Measure.

Moreover, the Measure fails to address in any way the carbon generated by *trucks* that will bring CO_2 for injection. As stated before, the Recirculated Draft EIR, though it fails to provide any analysis on the issue, anticipates that some sources will ship their CO_2 using trucks. Such GHG emission sources must be addressed under the document's GHG mitigation measures.

f. MM 4.8-2 through MM 4.8-5 unlawfully rely on reporting requirements or existing or future regulations or plans, without demonstrating these measures meaningfully mitigate Project impacts.

The remaining GHG mitigation measures do not, individually or together, succeed in mitigating GHG impacts.

MM 4.8-2 requires quarterly reporting on the amount of CO_2 injected into the CCS project, and the source of the CO_2.[310] While such reporting is essential, it is not enough, taken together with the other mitigation measures, to mitigate impacts to the extent feasible.

MM 4.8-3 merely requires permitted stationary sources to comply with the Cap-and-Trade regulation and implement Best Performance Standards (BPS) applicable to greenhouse gas reduction for Components at Light Crude Oil and Natural Gas Production, Natural Gas Processing Facilities.[311] But these BPS only apply to certain types of facilities, and if these facilities are not subject to Cap-and-Trade, this mitigation measure will not apply to them at all. Moreover, the Final Staff Report prepared for the SJVAPCD Climate Action Plan states explicitly that "[u]se of performance based standards is not a method of mitigating emissions."[312]

Similarly, MM 4.8-4 and MM 4.8-5 merely require compliance with SJVAPCD regulations (Rule 4401 and 4409) and regulations adopted or amended for methane.[313]

MM 4.8-3, MM 4.8-4, and MM 4.8-5 rely on existing or future regulations, without adding any standards or measures to mitigate potential impacts from GHG emissions. CEQA allows the use of compliance with regulatory standards as mitigation, but only where the regulatory standards ensure actual mitigation of project impacts to the extent feasible. CEQA therefore requires that a determination that compliance will be sufficient to prevent significant

[310] RDEIR, Vol. 1 at 4.8-27.
[311] RDEIR, Vol. 1 at 4.8-27.
[312] SJVAPCD, *Final Staff Report - Climate Change Action Plan: Addressing GHG Emissions Impacts under CEQA* (2009) at 59.
[313] RDEIR, Vol. 1 at 4.8-27.

impacts be based on a project-specific analysis of potential impacts and the effect of regulatory compliance.[314]

C. The Recirculated Draft EIR's Analysis and Mitigation of Energy Use Impacts is Inadequate.

The Recirculated Draft EIR fails to adequately disclose, analyze, and mitigate the CTV I Project's impacts to energy resources. CEQA Guidelines, Appendix F lays out the following directives for proper discussion of a proposed project's energy impacts in an EIR:

> The goal of conserving energy implies the wise and efficient use of energy. The means of achieving this goal include:
>
> (1) decreasing overall per capita energy consumption,
>
> (2) decreasing reliance on fossil fuels such as coal, natural gas and oil, and
>
> (3) increasing reliance on renewable energy sources.[315]

The analysis required under CEQA thus provides the opportunity for project proponents to evaluate the energy consequences of their decisions.

The Recirculated Draft EIR applies, as a threshold of significance, whether the Project will "result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation."[316] The Recirculated Draft EIR concludes that:

> [C]onstruction activities associated with the proposed project would result in the consumption of petroleum-based fuels. However, there are no unusual project characteristics that would necessitate the use of construction equipment or vehicles that would be less energy efficient than at comparable construction sites in other parts of the state. Therefore, it is expected that construction fuel consumption associated with the proposed project would not be any more inefficient, wasteful, or unnecessary than at other construction sites in the region.[317]

In this conclusion, the Recirculated Draft EIR applies, as a threshold, whether the Project would be "*more* inefficient, wasteful, or unnecessary than at other construction sites in the region." But CEQA instead requires an evaluation of whether this project is energy-efficient, not average; CEQA requires mitigation of impacts to energy consumption, where feasible. The claim that the Project has no significant impact on energy resources is thus not supported by substantial evidence. The EIR should require, for example, use of electricity-powered construction equipment and vehicles in all feasible applications.

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[314] *Californians for Alternatives to Toxics v. Dept. of Food & Agric.* (2005) 136 Cal.App.4th 1.
[315] CEQA Guidelines, Appendix F, § 2.
[316] RDEIR, Vol. 1 at 4.6-12.
[317] RDEIR, Vol. 1 at 4.6-14.

Moreover, the Recirculated Draft EIR does not provide sufficient information or analysis to evaluate the Project's overall relationship to energy consumption, and does not even address this question. CO_2 storage projects will often tend to substitute for, rather than facilitate, decreasing reliance on fossil fuels such as coal, natural gas, and oil. The Project's energy conservation analysis fails for many of the same reasons its project description, GHG impact analysis, and cumulative impact analysis are inadequate. In particular, an analysis that includes information about the relationship between Project CO_2 storage operations and Project CO_2 sources is necessary, to fully disclose and analyze whether and to what extent CTV I will facilitate development and use of fossil fuel infrastructure or extend the life of existing fossil fuel CO_2-emitting industries. The Recirculated Draft EIR's failure to include any meaningful discussion of the Project's CO_2 sources renders the discussion inadequate to evaluate how the Project will decrease reliance on fossil fuels or increase reliance on renewable energy.

D. The Recirculated Draft EIR's Analysis and Mitigation of Geologic Risks is Inadequate.

The Recirculated Draft EIR fails to adequately disclose, analyze, and mitigate the significant geologic impacts of the CTV I Project in this region. These failures are unacceptable given the setting in which the Project may occur and render the Recirculated Draft EIR defective as an informational document.

The expert report of Dr. DiGiulio addresses the numerous deficiencies in the County's analysis and why it underestimates the severity of the Project's geologic impacts in further detail. Dr. DiGiulio's analysis highlights the serious risk of CO_2 leaks from the storage reservoirs as well as seismic hazards on wellbores in the Elk Hills oil field, and concludes:

> Given the large number of well penetrations, high pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. . . .
>
> In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, the [Recirculated Draft EIR] should not be approved.[318]

1. The Recirculated Draft EIR must fully account for the significant risk of leaks due to existing wellbores at the Elk Hills oil field.

The Recirculated Draft EIR fails to properly consider any of these issues because it fails at the outset to fully account for the geologic setting at the Elk Hills oil field. When analyzing a project's adverse environmental impacts under CEQA, "[t]he significance of an activity depends on the setting."[319] It is imperative that an EIR accurately and fully describe a project's environmental setting because this description forms the baseline for evaluating its environmental impacts.[320] Indeed, the Recirculated Draft EIR here must demonstrate not only that the CTV I Project's geologic impacts were adequately investigated but that these impacts

[318] DiGiulio Report at 36–37.
[319] *Kings County Farm Bureau*, 221 Cal.App.3d at 718; see also CEQA Guidelines, § 15125.
[320] See CEQA Guidelines, § 15125(a).

were "considered *in the full environmental context.*"[321] It is impossible for the Recirculated Draft EIR to fulfill its informational purpose if it is not adequately describing and considering the existing environment and geologic setting that may be impacted by the Project.

The Elk Hills oil field and its surrounding region have been deeply shaped by oil and gas drilling activity for many decades. Elk Hills is one of the oldest and largest oil fields in the U.S., discovered over 100 years ago, and is characterized by "the presence of a large number of well penetrations."[322] As discussed in the DiGiulio Report, "[l]eakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2" and the large number of wellbores at Elk Hills therefore "increases the possibility of leakage" which could be "catastrophic."[323]

These risks are exacerbated where, as here, wellbores have not been permanently plugged back to surface, and the Recirculated Draft EIR contains discrepancies in the number of wellbores that require plugging.[324] Some recent estimates indicate that Elk Hills contains nearly 1,400 idle, unplugged wells that have not produced oil or gas for an average 14 years.[325]

Even if properly plugged, Dr. DiGiulio notes that wellbore integrity failure and leaks from plugged wells "is common," with research finding failure rates from 2-75%.[326] Yet the Recirculated Draft EIR found an implausible 0% failure rate in both storage reservoirs, with no wellbores deemed deficient or requiring corrective action.[327]

The Recirculated Draft EIR fails to acknowledge these issues or disclose the inherent and heightened risks of CO_2 storage in a depleted oil field like this one, which renders it lacking in substantial evidence to support its subsequent conclusions about impacts and mitigation.

2. The Recirculated Draft EIR fails to disclose critical details about the Project.

In fact, many of the Recirculated Draft EIR's conclusions about geologic impacts are "impossible to verify" due to missing details.[328] Dr. DiGiulio notes that the document excludes critical information needed to assess wellbore integrity at Elk Hills and the likelihood of leaks

[321] CEQA Guidelines, § 15125(c) (emphasis added).
[322] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem*, LA Times (Feb. 6, 2020), https://www.latimes.com/projects/california-oil-well-drilling-idle-cleanup/; DiGiulio Report at 4.
[323] DiGiulio Report at 4–5, 7–9 (discussing that the RDEIR appears to have ignored not just the large number of wellbores at the storage areas but also those outside the storage areas at Elk Hills); see also Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* at 5–6.
[324] DiGiulio Report at 15–16; see also RDEIR, Vol. II, App'x A6: Summary of Written Public Comments Received on DEIR (Dec. 2023), Letter from Jeremy Lancaster, State Geologist, Cal. Geological Survey (Mar. 1, 2024) at 850–52 (noting Draft EIR's discrepancy between 7,500+ wells drilled at Elk Hills vs. 354 wellbores at the storage reservoirs).
[325] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem*.
[326] DiGiulio Report at 14.
[327] *Id.* at 16–17.
[328] *Id.* at 16.

from the reservoirs. As one example, the Recirculated Draft EIR repeatedly references appendices with vague or undefined descriptors, and key wellbore schematics are missing.[329] In another example, critical information "relevant to wellbore integrity (e.g., internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, cement squeeze operations, etc.)" is missing and should be included to facilitate full public participation.[330]

The Recirculated Draft EIR thus violates CEQA's mandate for an EIR to "include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project."[331] Even if pieces of this information are included in EPA's Class VI permit materials or elsewhere, the County is required to include these details with the Recirculated Draft EIR for public review and comment, and to use it to inform its own analysis of impacts and appropriate mitigation for the CTV I Project. The failure of the Recirculated Draft EIR to include this information means the County must revise it with the missing information discussed in the DiGiulio Report included, and provide an adequate public comment period on the recirculated draft.

3. The Recirculated Draft EIR must address how seismic hazards will exacerbate potential geologic impacts.

The Recirculated Draft EIR also does not accurately describe and consider the full environmental context related to seismic activity in the region. Although the Recirculated Draft EIR notes that the County is in the highest seismic hazard zone and discusses the basic seismic history of the region,[332] it inappropriately narrows its analysis of impacts to the bounds of the Elk Hills oil field, which fails to capture potentially significant adverse geologic and safety impacts in the broader region. The analysis otherwise waves away further review of the potential impacts of natural or induced seismicity due to the project because "there are no known major faults within the project area."[333]

By contrast, Dr. DiGiulio classifies the impacts of seismicity on the Project area as "high risk" (vs. the Recirculated Draft EIR's classification of "low to medium" risk) and recommends the County conduct a detailed seismicity evaluation in order to properly determine that seismicity will not impact containment of injected CO_2.[334] The report defines the appropriate "region of concern" as encompassing all seismic events within 200 kilometers from the storage reservoirs, discusses key seismic events in the region's history, and points out that the Recirculated Draft EIR's discussion of seismic events within a smaller 100-kilometer range of the oil field is insufficient for ensuring the Project avoids catastrophic loss of containment.[335] Critically, the seismic risk analysis fails entirely to consider legacy wells or the significant consequences of leaks through these wells.[336] The Recirculated Draft EIR's omission of this

[329] *Id.* at 15–17.
[330] *Id.* at 16.
[331] *Laurel Heights*, *supra*, 47 Cal.3d at 405.
[332] RDEIR, Vol. 1 at 4.7-14, 4.7-5.
[333] RDEIR, Vol. 1 at 4.7-19.
[334] DiGiulio Report at 20, 25–26, 30.
[335] DiGiulio Report at 20–23.
[336] DiGiulio Report at 25.

requisite level of analysis renders the geologic impacts section lacking in substantial evidence to support its conclusions.

In addition, the County's dismissal of the risks of seismicity induced from injection of CO_2 at Elk Hills as "unlikely" is inconsistent with the scientific literature linking fluid injection into deep underground wells with earthquakes.[337] The DiGiulio Report notes "[e]ven in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of [magnitude] 4."[338] The report discusses numerous real-world examples of injection-induced seismicity that the Recirculated Draft EIR fails to disclose or address when considering the impacts of the CTV I Project, including in particular incidents of CO_2 injection inducing seismic events.[339]

Dr. DiGiulio further explains that "[f]or induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the [Recirculated Draft EIR] adequately consider induced seismicity."[340] Thus, the County cannot outsource its obligations to properly analyze and mitigate the potential impacts of induced seismicity by ceding those obligations to EPA, a tactic it deploys throughout the geologic impacts section.[341]

Given the risks of natural and induced seismicity and the fact that Kern County and the region surrounding the Elk Hills oil field is already one of the most seismically active in the state—the Central Valley is considered a "hot spot" where oil and gas wells and earthquakes are clustered in space[342]—the Recirculated Draft EIR cannot dismiss potential impacts. Indeed, Dr. DiGiulio notes "[s]eismicity may be induced tens of kilometers away from large-scale injection" which further expands the impact area the County should consider for the Project well beyond the Elk Hills oil field.[343]

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[337] RDEIR, Vol. 1 at 4.7-19; see, e.g., Goebel, T.H.W. et al., *Wastewater Disposal and Earthquake Swarm Activity at the Southern End of the Central Valley, California*, Geophys. Res. Lett., 43 (2016), 1092–99 (hydrogeological modeling reveals wastewater disposal likely contributed to seismicity via localized pressure increase along a seismically active fault, with results suggesting induced seismicity may remain undetected in California without detailed analysis of local geologic setting, seismicity, and fluid diffusion, and proximity of high-rate injectors and large active faults can cause noticeable earthquakes under certain geologic conditions).

[338] DiGiulio Report at 31.

[339] DiGiulio Report at 30–33.

[340] DiGiulio Report at 33.

[341] See Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects*.

[342] Kang, M. et al., *Potential Increase in Oil and Gas Well Leakage Due to Earthquakes*, Environ. Res. Commun. (2019), 1: 121004 at 3, https://doi.org/10.1088/2515-7620/ab576e.

[343] DiGiulio Report at 31; see also Kuchment, *Drilling for Earthquakes*, Scientific American (2016), 315, 1, 46–53, https://www.scientificamerican.com/article/drilling-for-earthquakes/ ("Evidence suggests that earthquake risks can spread for miles beyond the original disposal sites and can persist for a decade or more after drilling stops.").

Potential impacts here could include damage to project infrastructure like pipelines, compressors, injection wells, or other wells in the oil field, damage to other structures in the region like roads and buildings, and dangerous CO_2 leaks to air and groundwater that harm the environment and health of nearby communities.[344] Even ground shaking from small- to moderate-sized earthquakes is consequential for a CO_2 repository and capable of creating leakage pathways to the surface.[345] The omission of this information violates CEQA's mandate that the data in an EIR "must be presented in a manner calculated to adequately inform the public and decision makers, who may not be previously familiar with the details of the project," and to give the readers "a better road map to the information it intends to convey."[346]

Overall, the County fails to provide substantial evidence to support the assumptions and conclusions in the geologic impacts section.

4. The Recirculated Draft EIR fails to adequately address cumulative geologic impacts.

The Recirculated Draft EIR's failures described above taint its cumulative impact analysis and render it inadequate under CEQA. While it acknowledges the impacts of cumulative induced seismic activity from the CTV I Project are significant and unavoidable, it otherwise waves away all other geologic impacts and fails to conduct further analysis on the nature and magnitude of the significant risks "due to the uncertainty of the implementation of multiple [CCS] projects and the ability to simultaneously cease injection during a[] [seismic] event."[347] The Recirculated Draft EIR's bare conclusion violates CEQA.[348]

As discussed throughout these comments, the Recirculated Draft EIR must also address "probable future projects."[349] This includes the numerous other CO_2 sources being prepared for CTV I as well as further industrial development that is expected in the region in connection with the Project.

5. The Recirculated Draft EIR fails to adopt all feasible mitigation to address geologic risks.

The Recirculated Draft EIR sets forth mitigation measures to address the geologic impacts of the CTV I Project that are wholly inadequate under CEQA. The DiGiulio Report

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[344] See, e.g., Millman, *California Earthquakes Caused $200 Million in Damage, Report Says*, Wall Street Journal (July 24, 2019), https://www.wsj.com/articles/california-earthquakes-caused-200-million-in-damage-report-says-11564006544 (pair of recent 6.4 and 7.1 magnitude earthquakes in Kern County caused about $200 million in property damage alone, not including damage to infrastructure such as roads or to a nearby naval base); Natural Resources Defense Council (NRDC), *Drilling in California: Who's at Risk?* (2014) at 9, https://www.nrdc.org/sites/default/files/california-fracking-risks-report.pdf; DiGiulio Report at 24.

[345] Zoback, M. & Gorelick, S., *Earthquake Triggering and Large-Scale Geologic Storage of Carbon Dioxide*, 109 PNAS 10164 (2012) at 10165–66, https://doi.org/10.1073/pnas.1202473109.

[346] *Vineyard Area Citizens*, *supra*, 40 Cal. 4th at 443.

[347] RDEIR, Vol. 1 at 4.7-26 to 4.7-27.

[348] *Sierra Club*, *supra*, 6 Cal.5th at 519.

[349] Pub. Resources Code, § 21083(b)(2).

details numerous deficiencies in the County's mitigation measures and why they must be addressed.

The Recirculated Draft EIR acknowledges that earthquakes may disturb surface and subsurface facilities like wellbores at the Project site and could result in loss, injury, or death.[350] It also acknowledges that the site may be subject to strong ground shaking that could cause structural damage and other Project components that could injure people.[351] Thus, the County must adopt all feasible mitigation.

MM 4.7-1 requires CRC to prepare a comprehensive seismic activity monitoring plan that includes connection to the Statewide seismic monitoring program of the California Seismic Network and compliance with state requirements, including "[a]ppropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; [i]dentification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures."[352]

The elements of MM 4.7-1 are inadequate and do not represent all feasible mitigation for the impacts of earthquakes and ground shaking. The DiGiulio Report points out that, while a seismic monitoring plan would be able to detect an earthquake, it does not reduce damage to surface and subsurface facilities, and thus the impacts should be considered significant and unavoidable, rather than less than significant as the Recirculated Draft EIR concludes.[353]

The DiGiulio Report provides numerous recommendations for seismic monitoring network design that are missing and should be included in MM 4.7-1 to comply with CEQA's requirement to adopt all feasible mitigation.[354] As the Report notes, "monitoring of natural seismicity is not mitigation."[355]

In addition, MM 4.7-1 is riddled with vague and indefinite terms. Under CEQA, a mitigation measure must include criteria or performance standards against which the mitigation's actual implementation can be measured.[356] MM 4.7-1, however, is a laundry list of vague actions such as "appropriate" subsurface monitoring, "[i]dentification of hazards and conditions," and "notification protocols for all applicable agencies and emergency procedures."[357] The Recirculated Draft EIR must be revised to include measurable and enforceable mitigation measures to address the Project's impacts. Open-ended and therefore potentially meaningless terms in a mitigation measure that will be developed at an unspecified time in the future also violate CEQA's requirements for deferred mitigation.

MM 4.7-1 is also effectively unenforceable because the Recirculated Draft EIR does not contain permit conditions, agreements, or other legally binding instruments that ensure the

[350] RDEIR, Vol. 1 at 4.7-17.
[351] RDEIR, Vol. 1 at 4.7-19.
[352] RDEIR, Vol. 1 at 4.7-18.
[353] DiGiulio Report at 29.
[354] DiGiulio Report at 33–36.
[355] DiGiulio Report at 29.
[356] *San Joaquin Raptor Rescue Ctr.*, *supra*, 149 Cal.App.4th at 670.
[357] RDEIR, Vol. 1 at 4.7-18.

seismic monitoring plan will be prepared and implemented, and who will enforce it.[358] The Measure must specify that no construction or grading permits shall be issued, and no activities expected to cause earthquakes or ground shaking may otherwise commence, unless and until the County, EPA Region 9, CARB, and California Seismic Network all approve the seismic monitoring plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[359]

The DiGiulio Report points out that the Recirculated Draft EIR's claim that mitigation of strong ground shaking "is typically provided by designing structures in accordance with the latest edition of the California Building Code" is flawed.[360] Because the Building Code does not address wellbore integrity, compliance would not mitigate potential impacts for this Project, thus the impacts should be considered significant and unavoidable, not less than significant.[361]

It is important to note that merely requiring compliance with agency regulations or other existing requirements like the California Building Code does not conclusively indicate that the Project would not have a significant and adverse impact. Those legal requirements may not be strong enough to protect against environmental impacts. In *Kings County Farm Bureau v. City of Hanford*, for example, the court found that the fact that EPA and the local air pollution control district had issued the necessary air emission permits for the construction of a coal fired cogeneration plan did not nullify the CEQA requirement that the lead agency analyze the significant air quality impacts of the entire project.[362] Similarly here, the Recirculated Draft EIR cannot rely on the Building Code to conclude that impacts would not be significant based on those requirements, without at least describing what those requirements are and how they would reduce the Project's geologic impacts to less than significant.

MM 4.7-3 is also inadequate and does not represent all feasible mitigation for the impacts of unstable soil or land that could result in landslides, subsidence, liquefaction, or collapse. The Measure states that CRC "shall implement all requirements of a site-specific geotechnical report" with no further detail or direction.[363] This language is vague and indefinite, and defers development of the geotechnical report until an unspecified time in the future. The Recirculated Draft EIR must be revised to include measurable and enforceable terms for the report to address the Project's impacts. Moreover, without any permit conditions or other legally binding instruments to ensure the report will be prepared and implemented, this measure is entirely unenforceable. The Recirculated Draft EIR must specify that no permits shall be issued and no activities expected to cause landslides, subsidence, liquefaction, or collapse may begin until the County and other relevant agencies approve the report.

The flaws in the Recirculated Draft EIR's analysis of geologic risks also impacts its development of mitigation measures to address cumulative impacts. After acknowledging

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[358] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4(a)(2).
[359] *King and Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET*, *supra,* 218 Cal.App.4th at 738.
[360] RDEIR, Vol. 1 at 4.7-19.
[361] DiGiulio Report at 29.
[362] *Kings County Farm Bureau*, *supra*, 221 Cal.App.3d at 716.
[363] RDEIR, Vol. 1 at 4.7-22.

significant and unavoidable cumulative impacts, the document makes no attempt to adopt feasible mitigation, claiming "there are no other feasible and reasonable mitigations available" other than the deficient measures discussed above.[364] This failure violates CEQA, particularly given the analysis and recommendations in the DiGiulio Report.

In addition to addressing the deficiencies in the Recirculated Draft EIR's current mitigation measures for geologic impacts and strengthening its seismic monitoring and mitigation plan measures, the DiGiulio Report recommends numerous additional feasible mitigation measures that the County should adopt to address the CTV I Project's serious impacts. One example that would protect nearby communities—and reflect measures already considered for other impacts in the Recirculated Draft EIR—is to "determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s)."[365]

E. The Recirculated Draft EIR's Analysis and Mitigation of CO_2 Pipeline Safety Hazards is Inadequate.

The Recirculated Draft EIR fails to adequately disclose, analyze, and mitigate the serious carbon dioxide pipeline safety hazards of the CTV I Project. The attached Kuprewicz Report addresses the numerous deficiencies in the County's analysis in further detail and why they obscure the severity of the Project's pipeline safety impacts. The issues raised in the report highlight why the Recirculated Draft EIR is defective as an informational document.

1. The Recirculated Draft EIR fails to provide critically important pipeline information.

As the Kuprewicz Report concludes, "[i]mportant pipeline information is missing in the [Recirculated Draft EIR] that will not permit decisionmakers to make an informed decision about this Project."[366] The Report offers a list of key examples of the Recirculated Draft EIR's "major shortcomings" and failure to disclose critical details about the Project.[367]

The missing details about the nature of the CTV I Project's pipeline construction and operations prevent understanding of the applicable regulations and safety jurisdiction of relevant agencies, and thus a complete analysis and appropriate mitigation. As one example, the Recirculated Draft EIR includes a laundry list of potential sources for the Project "without identifying how such sources will be transported to the Elk Hill facilities—a critical omission."[368]

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[364] RDEIR, Vol. 1 at 4.7-27.
[365] DiGiulio Report at 5.
[366] Kuprewicz Report, Attachment A at 2. The Kuprewicz Report consists of a brief cover note addressing the Recirculated Draft EIR, and Attachment A, which is Richard Kuprewicz's assessment of the original Draft EIR. The cover note states that the Recirculated Draft EIR did not meaningfully address his assessment of the original Draft EIR, which still fully applies, and that the pipeline safety analysis and relevant mitigation measures remain inadequate.
[367] Kuprewicz Report, Attachment A at 2–5.
[368] Kuprewicz Report at 1.

The Recirculated Draft EIR also contains inaccurate and misleading details that obscure a full understanding of potential pipeline safety impacts. For example, the Kuprewicz Report discusses the Recirculated Draft EIR's attempts to minimize the extent of impacts from the Satartia, MS pipeline rupture.[369] Relatedly, the Recirculated Draft EIR also completely fails to address the possibility of a CO_2 injection well blowout, which "can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases."[370]

The deficiencies in the Recirculated Draft EIR are particularly consequential given the history of explosions and disasters that have harmed people in pipeline-related incidents,[371] and the ongoing harms faced by communities in the Elk Hills region due to oil and gas activity. In fact, as recently as February 2024, a pipeline burst in Bakersfield, releasing barrels of oil on a public street next to Buena Vista Elementary School.[372] Between January 1, 2010, and January 19, 2023, a total of 8,140 pipeline incidents were reported to the Pipeline and Hazardous Materials Safety Administration (PHMSA), an average of 1.7 incidents per day. Hazardous liquid pipelines (which encompass CO_2 pipelines) accounted for more than half of these incidents.[373] The DiGiulio Report also discusses at length examples of large-scale CO_2 releases and their impacts on neighboring communities.[374]

Notably, a prior similar carbon capture proposal in the Elk Hills oil field that would have compressed CO_2 from a hydrogen plant and transported it to the field via pipeline to 25 injection wells for enhanced oil recovery found serious safety risks.[375] Specifically, the project risk assessment for its approximately 3 mile pipeline—about a quarter of the length of the CTV I Project's planned pipelines—determined that a large amount of CO_2 could be released into the atmosphere if it failed.[376] Studies find that exposure to large amounts of CO_2 could lead to harmful impacts like irritation, chronic or irreversible tissue damage, or narcosis, and to irreversible health effects, impairing, or even death for close exposure to the release.[377] None of these issues are addressed in the Recirculated Draft EIR, rendering it lacking in substantial evidence to support its conclusions.

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[369] Kuprewicz Report, Attachment A at 6.
[370] Kuprewicz Report, Attachment A at 6–7.
[371] See, e.g., Zegart, Dan, *The Gassing of Satartia*.
[372] LaVigne, *Pipe Burst Spills Oil in Front of Buena Vista Elementary School*, KERO-TV (Feb. 8, 2024), https://www.turnto23.com/news/in-your-neighborhood/bakersfield/pipe-burst-spills-oil-in-front-of-buena-vista-elementary-school.
[373] FracTracker Alliance, *2022 Pipeline Incidents Update: Is Pipeline Safety Achievable?* (Feb. 1, 2023), https://www.fractracker.org/2023/02/2022-pipeline-incidents-update-is-pipeline-safety-achievable/.
[374] DiGiulio Report at 4–5.
[375] Submitted by Occidental of Elk Hills, Inc. to Cal. Dept. of Conservation, *Proposed Enhanced Oil Recovery Project (Phase 1), Underground Injection of Carbon Dioxide Gas, Stevens Reservoirs – T30, 31S, R23, 24E, Sections 33S, 34S, 35S, 2G, 3G, & 4G, Engineering Study, Geologic Study, and Injection Plan* (Oct. 2, 20212) at 1, 6.
[376] Stantec, *Hydrogen Energy Center Application for Certification Amendment –Attachment D: Hazards Assessment of CO_2 Supply Line* (Apr. 12, 2011) at 7.
[377] *Id.* at 6–7.

The Recirculated Draft EIR's failures are particularly stark given the evidence that most CCS pipelines fall largely within environmental justice communities, like those surrounding Elk Hills, that live in close proximity to industrial pollution.[378]

Given its serious deficiencies, the Recirculated Draft EIR's dismissal of all pipeline-related impacts, including cumulative impacts, as less than significant is not supported by substantial evidence.

2. The Recirculated Draft EIR fails to adopt all feasible mitigation to address pipeline safety hazards.

Because of the missing and inaccurate information regarding CO_2 pipeline safety issues, it is impossible for the Recirculated Draft EIR to satisfy CEQA's requirement to adopt all feasible mitigation measures for these impacts. The proposed measures are also ineffective, unenforceable, and vague, and illegally defer mitigation.

For example, MM 4.9-4 requires a construction permit site plan for all CO_2 pipelines, which will be reviewed and approved by the County and California State Fire Marshall (OSFM), noting that PHMSA has delegated CO_2 pipeline oversight to OSFM.[379] In addition to this Measure being vague and improperly deferring the plan to an unspecified future date, it is unclear whether OSFM actually has proper jurisdiction over the CTV I Project's CO_2 pipelines. As discussed in the Kuprewicz Report, the Recirculated Draft EIR's failure to provide CO_2 purity information and clearly distinguish between facility and injection pipelines obscures whether either agency has jurisdiction and responsibility for the Project.[380] The report also highlights that federal pipeline safety regulations are seriously inadequate, thus the County cannot rely on compliance alone to avoid fulfilling its own separate obligations under CEQA to properly assess and mitigate impacts.[381]

As another example of the Recirculated Draft EIR's deficient mitigation measures, MM 4.9-10 only requires compliance with EPA's Class VI permit before injection can begin.[382] As discussed throughout these comments, merely requiring compliance with existing regulations or other requirements like the Class VI requirements without further review or analysis does not conclusively indicate that the Project would not have significant and adverse impacts.

Concerningly, MM 4.11-7 seems to indicate that offsite sources can inject at CTV I via CO_2 pipelines permitted by the California Public Utilities Commission (PUC) for common carrier companies—without explaining the nature of these offsite sources or any relevant details about the connecting pipelines or potential common carrier companies.[383] This measure is therefore vague, indefinite, and does not represent all feasible mitigation. Moreover, given the current moratorium on intrastate pipelines in the state due to the requirements of Senate Bill

[378] Rota, M., *Carbon Dioxide Waste Capture and Injection: A False Solution for Louisiana and the World* (2023), https://healthygulf.org/carbon-waste-injection-false-solution-for-louisiana/.
[379] RDEIR, Vol. 1 at 4.9-58.
[380] Kuprewicz Report, Attachment A at 2–3.
[381] Kuprewicz Report, Attachment A at 5.
[382] RDEIR, Vol. 1 at 4.9-61.
[383] RDEIR, Vol. 1 at 4.11-54.

905,[384] the relevance of common carrier CO_2 pipelines is vague and "should be raising serious concerns about possible efforts to move CO_2 in converted existing pipelines as a gas to circumvent the moratorium."[385] Given it appears CRC has recently applied to the PUC for a certificate to operate as a gas utility in the state, the Recirculated Draft EIR's omission of these details, or CRC or CTV's larger plans for pipeline transport, is glaring and improper under CEQA.[386]

These highlighted examples are just a sample and illustrate the overall failures of the Recirculated Draft EIR to analyze and adopt all feasible CO_2 pipeline safety mitigations for the CTV I Project. The Kuprewicz Report recommends additional feasible mitigation measures that the County should adopt to address CO_2 pipeline impacts, including, as noted elsewhere, that the County should adopt setbacks from the pipelines.[387]

F. The Recirculated Draft EIR's Analysis and Mitigation of Water Supply Impacts is Inadequate.

An accurate analysis of the CTV I Project's impact on the local water supply is crucial because water is scarce in Kern County and groundwater pumping has occurred at unsustainable levels for decades, resulting in overdraft conditions region-wide, county-wide, and within the Project Area. Unfortunately, the Recirculated Draft EIR fails to adequately disclose and analyze water supply impacts and correspondingly fails to adopt all feasible mitigation.

As an initial matter, it is worth noting that the Recirculated Draft EIR is confusing because the header for the section on Utilities and Service Systems—one of the several sections that address water supply issues—is mislabeled as "4.17 Utilities and Service Systems."[388] The section on Utilities and Service Systems is actually section 4.19. The erroneous header should be corrected because it is confusing to the reader and complicates navigation of the document.

1. The Recirculated Draft EIR's description of the environmental and regulatory setting for water supply is inadequate.

The Recirculated Draft EIR is misleading and fails as an informational document because, remarkably, it fails to acknowledge the most basic fact about water supply in Kern County: there is "no surplus water available" in the County to meet domestic and/or irrigation demands, meaning that any use of municipal and industrial (M&I) quality water by the proposed

[384] Senate Bill No. 905 (2021–2022 Reg. Sess.), approved by Governor, Sept. 16, 2022.
[385] Kuprewicz Report at 1.
[386] Cal. P.U.C., *Application of California Resources Production Corporation for a Certificate of Public Convenience and Necessity to Operate as a Gas Corporation in the State of California* (July 10, 2023).
[387] Kuprewicz Report, Attachment A at 4–5; DiGiulio Report at 5; see also Hillebrand, M. et al., *Toxicological Risk Assessment in CO_2 Capture and Storage Technology*, International Journal of Greenhouse Gas Control 55 (2016) 118–43 (concentrations of CO_2 releases from pipelines are function of distance, thus safety distances have to be calculated wherein no hazardous concentrations are reached, varying between <1 m and 7.2 kilometers).
[388] See, e.g., RDEIR, Vol. 1 at 4.19-2 (with "4.17 Utilities and Service Systems" in the header).

CTV I Project necessarily "reduces potential supplies for other purposes and users."[389] The Recirculated Draft EIR should disclose this reality upfront to the public and decisionmakers.

The details that the Recirculated Draft EIR does provide downplay the Project's water supply impacts and are inadequate. For example, in describing the relevant "Environmental Setting" for the CTV I Project's impact on water supply, the document merely notes that "[t]he project site is located within the Tulare Lake Basin," which "is ranked as 'high priority' in a statewide ranking of groundwater importance."[390] The Recirculated Draft EIR also notes "[t]he Kern County Subbasin ('Subbasin') is the specific groundwater subbasin in which the project resides."[391]

To meaningfully inform readers, the Recirculated Draft EIR must explain the significance of the Tulare Lake Basin's designation of "high priority" and offer more details on conditions in the Tulare Lake Basin generally and the Kern County Subbasin specifically.

The Tulare Basin is designated as "high priority" both because the region is heavily reliant on groundwater and because groundwater supplies are in a condition of "critical overdraft."[392] Similarly, the Kern County Subbasin has been identified as "high priority," reflecting that the area is "critically overdrafted" and suffers from related problems including "land subsidence and groundwater quality degradation."[393] Persistent overdraft of groundwater also "dries up wells."[394]

Although the Recirculated Draft EIR acknowledges that the Kern County Subbasin, "as a whole, has an overdraft of 324,326 acre-feet per year over the baseline conditions,"[395] nowhere is the significance of this fact explained.

The Recirculated Draft EIR is similarly misleading and incomplete in its description of the regulatory setting for water supply. The document includes a general discussion of the Sustainable Groundwater Management Act (SGMA) and how it is being implement in the Project Area.[396] As part of this discussion, the Recirculated Draft EIR notes the status of six groundwater sustainability plans (GSPs) that have been prepared for the San Joaquin Valley Kern County Subbasin.[397] However, nowhere does the Recirculated Draft EIR explain that

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[389] Kern County Planning & Natural Resources Dept., *Draft Supplemental Recirculated Environmental Impact Report for Revisions to Title 19-Kern County Zoning Ordinance, Supplemental Water Supply Baseline Technical Report* (July 2020) at 4, 58.
[390] RDEIR, Vol. 1 at 4.10-1.
[391] RDEIR, Vol. 1 at 4.10-2.
[392] RDEIR, Vol 2., Water Supply Assessment for the Carbon Terravault 1 Project at 2–3.
[393] RDEIR, Vol. 2, West Kern Water District, Urban Water Management Plan 2020 Update (June 2021) at 34.
[394] Rachel Becker, *San Joaquin Valley growers may face probation for failing to protect groundwater*, Cal Matters (Oct. 12, 2023), https://calmatters.org/environment/2023/10/san-joaquin-valley-groundwater/.
[395] RDEIR, Vol. 1 at 4.10-35, 4.19-2, 4.19-21.
[396] RDEIR, Vol. 1 at 4.10-15 to 4.10-17, 4.19-7 to 4.19-8.
[397] RDEIR, Vol. 1 at 4.10-16, 4.19-8; see also *id*. at 4.19-13 to 4.19-14.

SGMA applies to Kern County and the Project Area because the Act was designed to address chronic groundwater overdraft and its negative consequences.

Further, the Recirculated Draft EIR neglects to address whether or how the six GSPs will affect the available water supplies in the Kern County Subbasin generally or for the Project specifically. Although the Recirculated Draft EIR indicates that state authorities have determined that the six GSPs are deficient in some respects, the Recirculated Draft EIR also confirms that, under SGMA, local Groundwater Sustainability Authorities are still "required to begin implementation of the plans . . . while working to amend the plans and address the deficiencies."[398] The Recirculated Draft EIR should address the expected consequences of the GSPs—if any—on the proposed CTV I Project and its planned operations and water use.

2. The Recirculated Draft EIR's analysis of the Project's impact on water supply is contradictory, inaccurate, and misleading.

The Recirculated Draft EIR fails as an informational document because it does not clearly explain the source or amount of water that will be used by the Project.

First, the Recirculated Draft EIR makes conflicting statements about the source of water to be used by the CTV I Project. In section 4.10, the Recirculated Draft EIR states: "[t]he proposed project would use water during construction and for operation of the project. Water for the project would be supplied by the WKWD from existing water allocations for Elk Hills and CRC."[399] Further, according to section 4.10, "all water would be trucked to the site from the WKWD." [400]

The foregoing description of the source of the Project's water supply is contradicted by text in section 4.19 which states that—for Project operations—"[w]ater to operate the carbon capture and storage (CCS) facilities is proposed to be sourced from produced water from existing oil and gas operations within Elk Hills."[401]

Second, no matter the source, the Recirculated Draft EIR inaccurately and misleadingly describes the Project's water supply demand. Table 4.19-2 describes the Project's water demand as follows:

[398] RDEIR, Vol. 1 at 4.10-17, 4.19-8, 4.19-14.
[399] RDEIR, Vol. 1, at 4.10-34.
[400] RDEIR, Vol. 1 at 4.10-35.
[401] RDEIR, Vol. 1 at 4.19-19.

Table 4.19-2: Water Supply Availability

	Allotment (acre-feet per year)	Project Demand	Usage of Water Allotment
Elk Hills	3,000		
CRC	2,200		
Construction (18 months)		75 acre-feet	1.4%
Operation (per year)		19.49 acre-feet	0.37%
Total	**5,200**	**94.49 acre-feet**	**1.77%**

Key:
CRC = California Resources Corporation

This table is clearly wrong. The table incorrectly combines a one-time water demand for construction (75 acre-feet) with an annual operational demand (19.49 per year) and concludes that the "Total" Project demand is 94.49 acre-feet. But this is not an accurate total. Just the first phase of the Project is expected to last "26 years,"[402] meaning that operational water demand will amount to at least 506.74 acre-feet (19.49 acre-feet annually x 26 years). The Recirculated Draft EIR must be revised to eliminate Table 4.19-2, which is inaccurate and misleading. Further, the document must disclose how much water the Project will use over its full operational lifetime.

3. The Recirculated Draft EIR's finding that the Project will not substantially reduce groundwater supplies is not supported by substantial evidence.

The Recirculated Draft EIR offers several reasons to support its conclusion that the CTV I Project will not substantially decrease groundwater supplies, all of which are erroneous.

First, the Recirculated Draft EIR states: "Project operation would not rely on locally sourced groundwater wells, as all water would be trucked to the site from the WKWD [West Kern Water District]."[403] But WKWD supplies the water it provides from "groundwater within the Kern County subbasin,"[404] meaning the Project's water use will still impose a burden on local groundwater supplies.

Second, the Recirculated Draft EIR asserts that, even accounting for pre-Project water use at the Project site, water use is expected to remain below the WKWD's future water budget for CRC and Elk Hills, which affords 5,200 acre-feet per year.[405] As an initial matter, it is unclear if the future water budget adopted for the Project site by WKWD in 2020 remains valid, given that the Kern Groundwater Authority (KGA) is currently responsible for an annual

[402] RDEIR, Vol. 1 at 1-6, 2-1, 3-2, 3-12.
[403] RDEIR, Vol. 1 at 4.10-35.
[404] RDEIR, Vol. 1 at 3-36; accord 4.10-40, 4.10-43, 4.19-2 (stating "WKWD primarily pumps groundwater").
[405] RDEIR, Vol. 1 at 4.19-20 to 4.19-21.

overdraft of 239,346 acre-feet per year,[406] and state authorities have disapproved KGA's proposed Groundwater Sustainability Plan for the area.[407]

In any event, the fact that the WKWD may have budgeted for operations at the site does not mean that the Project's expected water use will not have a significant impact. As noted above, there is no surplus water in Kern County, groundwater in the Kern Subbasin is suffering from critical overdraft, and the water to be used by the Project will all be sourced from groundwater. Whether water use at the site was anticipated or not, the Project will still be using substantial quantities of groundwater.

Third, the Recirculated Draft EIR avers that, "[s]hould the project require water supplies in excess of the allotment from the District, impacts to water supplies would be considered potentially significant. In order to address this, MM 4.19-1 would be implemented, ensuring that any groundwater or reclaimed water used is accounted for and regulated."[408]

The Recirculated Draft EIR's adoption of MM 4.19-1 does not support a finding that the Project's groundwater use will be mitigated to a level of insignificance. That is because MM 4.19-1 in no way limits or mitigates the Project's water use. Rather, the Measure just specifies that the Project Owner/operator shall "provide information on any groundwater . . . that will be used," and County officials, in turn, "shall compile the water use information in a report" to be posted online annually.[409] This Measure does not reduce or limit water use; it merely requires that "that any groundwater . . . used is accounted for."[410]

4. The Recirculated Draft EIR fails to adopt all feasible mitigation for the Project's cumulative impacts on water supply.

Putting aside the Recirculated Draft EIR's unsupported finding that the Project will not have a significant direct impact on groundwater supplies, the document does acknowledge that "the cumulative impacts of any use of groundwater in the area are considered significant."[411] Consequently, the County must adopt all feasible mitigation to address this cumulative impact.

The Recirculated Draft EIR identifies several mitigation measures that will purportedly address this significant cumulative impact on water supply: MMs 4.9-1, 4.10-1, 4.10-2, 4.10-3, 4.10-4, 4.10-5, and 4.19-1.[412] But none of these measures will actually reduce the Project's impact on groundwater supplies:

[406] See, e.g., RDEIR, Vol. 1 at 4.19-21
[407] See, e.g., RDEIR, Vol. 1 at 4.19-13 to 4.19-14.
[408] RDEIR, Vol. 1 at 4.10-35, 4.19-21.
[409] RDEIR, Vol. 1 at 1-65, 4.19-21 to 4.19-22.
[410] RDEIR, Vol. 1 at 4.19-27.
[411] RDEIR, Vol. 1 at 1-14 to 1-15, 4.10-43, 4.19-28, 5-5 to 5-6, 6-7.
[412] RDEIR, Vol. 1 at 4.10-43 to 4.10-44.

- MM 4.9-1 provides worker training on the handling of hazardous substance,[413] but the Project site is not a source of groundwater for M&I uses, which is supplied from elsewhere by WKWD.[414]
- MMs 4.10-1 through 4.10-5 all address onsite operations (i.e., stormwater measures and management of drilling muds, drilling fluids, and produced water)[415] but, again, the Project site is not a source of groundwater for M&I uses, which is supplied from elsewhere by WKWD.
- MM 4.19-1, as discussed above, merely requires reporting on groundwater use, and does not limit its use in any way.

Consistent with CEQA's requirement to adopt all feasible mitigation, the County should require the following feasible measures to mitigate the Project's impacts on local groundwater supplies:

- The County should identify specific purposes for which the Project may use M&I quality water—limited to those purposes for which such high-quality, freshwater is truly necessary—and direct that all other water uses in the Project area shall be met by recycling oil field-produced water. The Recirculated Draft EIR indicates that such recycling and reuse of oil filed-produced water already occurs at the site.[416] The County should make this voluntary practice mandatory.
- The County should set a cap on the CTV I Project's water use. According to the Recirculated Draft EIR, if construction activities (75 acre-feet) and operational activities (19.49 acre-feet) were to occur in the same year, the Project's water demand would total 94.49 acre-feet annually.[417] The Project should be held accountable for its estimated water needs and limited to an annual cap of 95 acre-feet per year or less for its CCS operations. In setting the cap, the County should subtract any use(s) included in the Project's estimated water demand that could be met by recycling oil field-produced water.
- The County should levy and collect an annual "fair-share" fee from the Owner/operator to be paid to the KGA to account for the Project's contribution to cumulative impacts on local groundwater supplies that KGA must mitigate pursuant to SGMA.

[413] RDEIR, Vol. 1 at 1-46, 4.9-56.
[414] RDEIR, Vol. 1 at 4.10-7 to 4.10-8 (noting "there is no appreciable quantity of groundwater in the project area" and "any groundwater encountered in this area is generally unusable"); 4.19-2 (stating WKWD's "[w]ater supply is obtained within the District from wells located in the northeast corner of the District in the underflow area of the Kern River Basin and from an area north and adjacent to the State of California's Tule Elk Reserve").
[415] RDEIR, Vol. 1 at 1-53 to 1-56, 4.10-29 to 4.10-33.
[416] RDEIR, Vol. 1 at 4.10-8.
[417] RDEIR, Vol. 1 at 4.19-21.

5. The Recirculated Draft EIR inadequately analyzes and mitigates disposal of oil field-produced water.

The Recirculated Draft EIR notes that "[a] significant percentage of the oil field-produced water in the project area is either recycled into the same geologic zones from which it was produced or is sequestered in deeper zones that are isolated from sources of drinking water."[418] Water that is not recycled or sequestered underground requires disposal. According to the Recirculated Draft EIR, produced water "may also be transported, via truck or pipeline to existing wastewater treatment facilities permitted to receive production water for disposal" or "stored in surface impoundments where it percolates into groundwater and/or evaporates."[419]

The Recirculated Draft EIR is inadequate as an informational document because it does not specify what percentage of the oil field-produced water is currently (in the oil field) or will be (for the Project) recycled and reinjected onsite as opposed to disposed of in some other way. Instead, the Recirculated Draft EIR merely surmises that "very little water is disposed of . . . because purchasing fresh water is more expensive than recycling water."[420] The document can and should be more specific to inform the public and decisionmakers; it should detail current water disposal volume(s) and practice(s) at the Project site and how these are expected to change, if at all, with the construction and operations of the proposed CCS facility.

It is important that the Recirculated Draft EIR accurately address the fate of oil field-produced water because it has consequences for the CTV I Project's impacts:

- As the Recirculated Draft EIR suggests, a high rate of recycling would lessen the degree to which the Project will compete with other users for scarce municipal and industrial-quality water.[421]
- Conversely, if transportation of the oil field-produced water by truck or pipeline is required for disposal, related environmental impacts must be evaluated and mitigated. For example, the Recirculated Draft EIR notes that truck traffic impacts air quality.[422]
- Surface disposal of oil field-produced water in ponds also threatens impacts that should be disclosed if the practice will occur. "Because it was commingled with hydrocarbons in the formation," produced water "typically contains chemicals associated with the formations, such as salts, oils and greases, inorganic and organic chemicals, and naturally occurring radioactive material, that exceed state and federal standards for drinking water."[423] Disposal in surface impoundments can therefore increase air pollution as well as contaminate the soil and harm biological resources.

[418] RDEIR, Vol. 1 at 4.10-8.
[419] RDEIR, Vol. 1 at 4.9-7.
[420] RDEIR, Vol. 1 at 4.10-8.
[421] RDEIR, Vol. 1 at 4.10-8.
[422] See, e.g., RDEIR, Vol. 1 at 4.3-63, 4.3-66, 4.3-72.
[423] RDEIR, Vol. 1 at 4.9-7.

Although the Recirculated Draft EIR does not analyze the impact, the document seems to contemplate that surface impoundments will, in fact, be used for disposal of oil field-produced water. More specifically, MM 4.10-5 states: "[t]he Owner/operator shall not discharge produced water into any surface disposal facility unless the facility has received the Waste Discharge Requirements from the Central Valley Regional Water Quality Control Board, or the need for Water Discharge Requirements has been waived by the Central Valley Regional Water Quality Control Board."[424] Likewise, MM 4.1-2 states: "[s]umps and ponds shall be permitted only to the extent authorized by the Central Valley Regional Water Quality Control Board . . . and shall comply with all applicable legal requirements and mitigation measures for . . . percolation or evaporation ponds for produced water."[425]

If the CTV I Project proposes to use such surface impoundments at the Project site, the extent to which they may be used and the impacts of such use must be disclosed. An adequate impact analysis is necessary to inform the development of all feasible mitigation measures and to include meaningful public input on the impacts and proposed mitigation.

G. The Recirculated Draft EIR's Analysis and Mitigation of Biological Resources Impacts is Inadequate.

Protecting biological resources is a fundamental tenet of CEQA. Under Public Resources Code section 21001(c), it is the policy of the state to "[p]revent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities." EIRs must provide an in-depth analysis of whether a project will: reduce substantially the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; or reduce substantially the number or restrict the range of an endangered, rare, or threatened species.[426]

In addition to review under CEQA, when a project has the potential to significantly impact a species listed under the federal or California Endangered Species Act, consultation with wildlife agencies and an Incidental Take Permit (ITP) are required.[427]

1. The Recirculated Draft EIR must account for the threatened, endangered, and sensitive animal and plant species in the Central Valley and Elk Hills oil field.

The Elk Hills oil field and surrounding area is known to support high densities of species protected by state and federal law. The California Department of Fish and Wildlife (CDFW) has specifically called out several species known to be supported in the area through prior biological surveys, including the blunt-nosed leopard lizard, giant kangaroo rat, San Joaquin kit fox, Swainson's hawk, San Joaquin antelope squirrel, American badger, short-nosed kangaroo rat,

[424] RDEIR, Vol. 1 at 1-56, 4.10-33.
[425] RDEIR, Vol. 1 at 1-27, 4.1-23.
[426] CEQA Guidelines, § 15065(c)(1).
[427] Cal. Fish & Game Code, § 2081; Endangered Species Act, § 10.

burrowing owl, California glossy snake, and California jewelflower.[428] As CDFW noted in its comment on the original Draft EIR, since 2022, "two species have become candidates for listing under CESA and remain candidates as of the date . . . . [the] Temblor legless lizard and Crotch's bumble bee."[429]

In its comments on the Notice of Preparation, CDFW recommended additional surveys for special status plant species and also noted the potential for San Joaquin pocket mouse.[430] In addition, CDFW shared with the California Geologic Energy Management Division (CalGEM) in 2022 that "there is potentially suitable habitat [in the Elk Hills oil field] within the well pad footprints and/or adjacent to the wells that can serve as refugia, denning, breeding, foraging, and dispersal habitat" for additional species "likely to occur within th[e] oil field," including the Tipton kangaroo rat, tricolored blackbird, Temblor legless lizard, Kern mallow, San Joaquin woolly threads, Buena Vista Lake shrew, LeConte's thrasher, loggerhead shrike, Tulare grasshopper, San Joaquin coachwhip, California glossy snake, coast horned lizard, western pond turtle, western spadefoot, prairie falcon, California horned lark, and Crotch bumble bee.[431] That 2022 letter also notes that several special-status plant species may occur in the oil field, including California Rare Plant Rank species Horn's milk-vetch, heartscale, Lost Hills crownscale, slough thistle, recurved larkspur, Temblor buckwheat, Tejon poppy, alkali-sink goldfields, pale-yellow layia, showy golden madia, California alkali grass, and oil neststraw.[432]

[428] Letter from Bob Stafford, California Department of Fish and Wildlife, to Cindi Hoover, Kern County Planning & Natural Resources Dept. (Apr. 6, 2022), RDEIR, Vol. 2, App'x A.2: Comment Letters at 148 (hereafter "Stafford Letter"); see also RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1067, CDFW Letter: Comment from Julie A. Vance, Cal. Department of Fish & Wildlife, to Keith Alvidrez, Kern County Planning & Natural Resources Dept. (Mar. 1, 2024) (hereafter "CDFW Letter").
[429] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on Draft EIR (December 2023) at 1067–68, CDFW Letter.
[430] Stafford Letter at 159, 162.
[431] Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW (revised Aug. 12, 2022) at 1.
[432] *Id.* at 6.

Table 1. *Threatened, Endangered and Sensitive Animals, Plants, and Plant Communities of the Elk Hills Area (threatened and endangered species are bolded)*

Common Name	***Scientific Name***	***Federal/State Status***	***CDFW Letter***[433]
	Plants		
California jewelflower	***Caulanthus californicus***	***FE/CE, 1B.1***	**1, 2**
San Joaquin woollythreads	***Monolopia congdonii***	***FE/1B.2***	**2**
Kern mallow	***Eremalche parryi ssp. kernensis***	***FE/1B.2***	**2**
Horn's milk-vetch	*Astragalus hornii var. hornii*	*S/1B.1*	2
heartscale	*Atriplex cordulata var. cordulata*	*S/1B.2*	2
Lost Hills crownscale	*Atriplex coronata var. vallicola*	*S/1B.2*	2
Slough thistle	*Cirsium crassicaule*	*S/1B.1*	2
recurved larkspur	*Delphinium recurvatum*	*S/1B.2*	2
Temblor buckwheat	*Eriogonum temblorense*	*S/1B.2*	2
Tejon poppy	*Eschscholzia lemmonii ssp. kernensis*	*S/1B.1*	2
alkali-sink goldfields	*Lasthenia chrysantha*	*--/1B.1*	2
pale-yellow layia	*Layia heterotricha*	*S/1B.1*	2
showy golden madia	*Madia radiata*	*S/1B.1*	2
California alkali grass	*Puccinellia simplex*	*S/1B.2*	2
oil neststraw	*Stylocline citroleum*	*S/1B.1*	2
	Insects		
Crotch bumble bee	*Bombus crotchii*	*--/WL*	2
	Amphibians		
western spadefoot	*Spea hammondii*	*S/SSC*	2
	Reptiles		
Temblor legless lizard	*Anniella alexanderae*	*Under Review / Candidate*	2
western pond turtle	*Actinemys marmorata*	*/SSC*	2
California glossy snake	*Arizona elegans occidentalis*	*--/SSC*	1, 2
blunt-nosed leopard lizard	***Gambelia sila***	***FE/CE, FP***	**1, 2**
San Joaquin coachwhip	*Masticophis flagellum ruddocki*	*--/SSC*	2
coast horned lizard	*Phyrnosoma blaimvillii*	*/SSC*	2
	Birds		
burrowing owl	*Athene cunicularia*	*S/SSC*	1, 2
tricolored blackbird	***Agelais tricolor***	***CT***	**2**
loggerhead shrike	*Lanius ludovicianus*	*/SSC*	2
California horned lark	*Erempohila alpestris actia*	*/WL*	2
prairie falcon	*Falco mexicanus*	*/WL*	2
Le Conte's thrasher	*Toxostoma lecontei*	*S/SSC*	2
Swainson's hawk	***Buteo swainsoni***	***CT***	**1, 2**
	Mammals		

[433] Stafford Letter at 148; Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW.

Nelson's (San Joaquin) antelope squirrel	***Ammospermophilus nelsoni***	***S/CT***	**1, 2**
giant kangaroo rat	***Dipodomys ingens***	***FE/CE***	**1, 2**
short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	*S/SSC*	1, 2
Tipton kangaroo rat	***Dipodomys nitratoides nitratoides***	***FE/SE***	**1, 2**
Buena Vista Lake shrew	Sorex *ornatus relictus*	*FE/SSC*	2
Tulare grasshopper mouse	*Onychomys torridus tularensis*	*S/SSC*	2
San Joaquin pocket mouse	*Perognathus inornatus*	*--/SSC*	1
American badger	*Taxidea taxus*	*--/SSC*	1, 2
San Joaquin kit fox	***Vulpes macrotis mutica***	***FE/CT***	**1, 2**

Federal Designation

FE—Federally listed as endangered
FT—Federally listed as threatened.
S—BLM Sensitive Species.

State Designation

CE—State listed as endangered.
CT—State listed as threatened. Species that although not presently threatened in California with extinction are likely to become endangered in the foreseeable future.
SSC—California Department of Fish and Wildlife's "Species of Special Concern." Species with declining populations in California.
WL—Watch List
1B.1—Plant rare, threatened or endangered in Cal. and elsewhere, and very threatened in Cal.
1B.2—Plant rare, threatened or endangered in Cal. and elsewhere, and fairly threatened in Cal.

Many of these same species were listed in the letter the Center for Biological Diversity, Central Valley Air Quality Coalition, and Central California Environmental Justice Network submitted in response to the Notice of Preparation for the Project, based on species found in the U.S. Geologic Survey quadrangles surrounding the Project site.

2. The Recirculated Draft EIR fails to respond to comments from the public and the California Department of Fish and Wildlife.

As an initial matter, between the original Draft EIR and the Recirculated version, there are no substantive changes to survey methodologies or mitigation measures. The County therefore ignored comments from the public as well as CDFW without explanation or support for doing so.

For example, the Recirculated Draft EIR's Summary of Written Public Comments notes that, when commenting on the original Draft EIR, the CDFW "[r]ecommended *specific mitigation measures for each species*, such as conducting surveys, avoiding disturbance to habitat . . . ."[434] The County did not, however, propose mitigation measures for each species, as detailed below. In fact, the Recirculated (and original) Draft EIR entirely *excludes* some species,

[434] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1 (emphasis added); see also *id.* at 1065, CDFW Letter.

like the Tipton kangaroo rat, or otherwise fails to offer mitigations that evidence shows would *reduce* impacts to species, such as the blunt-nosed leopard lizard. In another example, the CDFW instructed the County to "obtain incidental take authorization;"[435] our organizations' comment letter pointed out that any existing ITP is deficient. The County ignores this ITP requirement as well.

The Recirculated Draft EIR also fails, without explanation, to take up the CDFW's specific requests to (1) clarify Mitigation Measure 4.4-1(B), noting that it is unclear what that Measure means for implementation of protocol surveys; (2) analyze the potential direct or indirect impacts to the Elk Hills Conservation Area and the associated listed species, including to ensure that infrastructure and injected CO_2 avoid the protected area's boundary in order "to minimize the potential for CO_2 leaks impacting the rare species"; (3) consult with the U.S. Fish and Wildlife Service; and (4) to adequately describe the Project's impacts to streams, pursuant to Fish and Game Code section 1600 et seq.[436]

The CDFW made clear in its comment on the original Draft EIR that these and other recommendations were "[i]n addition to" its comments sent to the County in 2022[437] and that "the following modifications and/or edits be incorporated into the final EIR, including proposed avoidance, minimization, and compensatory measures, prior to its adoption by Kern County."[438] The County utterly fails to reflect the CDFW's expert advice in the Recirculated Draft EIR.

3. The Recirculated Draft EIR must address construction and operation impacts to species.

While the Recirculated Draft EIR claims there are no significant and unavoidable Project impacts to biological resources, this conclusion misses the mark and reflects a failure to account for the evidence showing that operating CCS projects can be severely detrimental, or even deadly, to wildlife, plants, and habitats.

The Project poses risks to biological resources from leakage and uncontrolled blowouts of compressed CO_2 from pipelines and injection wells. Compressed CO_2 forms a low dense cloud that can spread long distances from the release site and sicken and asphyxiate living things, including plants and animals.[439] CO_2 injection in oil fields and CO_2 pipeline transport have resulted in leakage and blowouts in several states that have caused wildlife deaths and significant habitat degradation. For example, a CO_2 injection well blowout in the Tinsley field, Mississippi, took 37 days to bring under control and killed deer, birds, fish, and other animals.[440] The

[435] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on Draft EIR (Dec. 2023) at 1.
[436] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on Draft EIR (Dec. 2023) at 1072–73, CDFW Letter.
[437] Aside from the CDFW's recommendations described in this section, we describe and reference other recommendations from the CDFW, sent during the Notice of Preparation and original Draft EIR periods, throughout this comment letter.
[438] *Id.* at 1068.
[439] See Pipeline Safety Trust and AccuFacts, *CO_2 Pipelines: Dangerous and Under-Regulated* (Mar. 2022), https://pstrust.org/wp-content/uploads/2022/03/3-23-22-Final-Accufacts-CO2-Pipeline-Report2.pdf.
[440] Zegart, *The Gassing of Satartia*.

blowout ejected CO_2 along with mud and drilling fluids, requiring the removal of 27,000 tons of drilling mud and contaminated soil and 32,000 barrels of liquids, and causing extensive habitat damage.[441] Other examples of CO_2 harms to wildlife and plants, and research on this topic, include:

- In 1986, a sudden, catastrophic release of CO_2 from Lake Nyos in Cameroon killed 1,700 people and 3,000 cattle. The CO_2 spread 10 km from the lake. Bird, insect, and small mammal populations in the area were not seen for at least 48 hours after the event.[442]
- Experiments with controlled injections of CO_2 into soil showed adverse effects on plants in response to CO_2 exposure. Biomass changes were seen in all plants studied; for example, clover plants decreased by 79% while grass decreased by 42%. The researchers' overarching conclusion was that elevated concentrations of soil CO_2 damages both soil microbiology and growing vegetation.[443]
- Other research on CO_2 and plants showed reduced plant growth and extensive mortality where CO_2 concentrations were greatest in the soil. For the plants that survived, root and shoot growth was significantly lower than in controls. Reproductive variables such as number of seeds per plant and seed dry weight per plant were also reduced compared to controls.[444]

The Recirculated Draft EIR's analysis must also consider the impacts posed to burrowing species in the Project site, including the area in which the CO_2 plume is expected to spread. (The Recirculated Draft EIR acknowledges that construction could cause loss of burrows and dens during construction at p. 4.4-40, but not during Project operation.) Burrowing animals are particularly vulnerable to death from CO_2 suffocation in the event of CO_2 pipeline or injection well blowout, since released CO_2 could fill nearby burrows where animals are resting or retreating. Federally listed burrowing species in the Project area include the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and blunt-nosed leopard lizard.

Finally, the County must explain why, in the Recirculated Draft EIR, it removed all references to the "Biological Study Area" (BSA) and replaced that language with "project area." The original Draft EIR defined the BSA as including "everything within the limits of the project footprint (the carbon capture and storage [CCS] Surface Land Area) and a 250-foot survey buffer, where feasible."[445] We argued in our comment letter on the original Draft EIR that the Project's impacts to species from CO_2 leaks and blowouts must be considered within the scope of

[441] Amy, *Oil spills in Mississippi, Alabama lead to $3.5 million in penalties for the company,* Clarion Ledger (Apr. 30, 2019), https://www.clarionledger.com/story/news/2019/04/30/oil-spills-penalties-mississippi/3625587002/.
[442] Kling, G.W. et al., *The 1986 Lake Nyos Gas Disaster in Cameroon, West Africa*, 236 Science 169 (1987).
[443] Smith, K.L. et al., *Environmental Impacts of CO2 Leakage: Recent Results from the ASGARD Facility, UK*, 37 Energy Procedia 791 (2013).
[444] Al-Traboulsi et al., *Potential Impact of CO2 Leakage from Carbon Capture and Storage (CCS) Systems on Growth and Yield in Spring Field Bean*, 80 Environ. Exper. Botany 43 (2012).
[445] Draft EIR, Vol. 1 at 4.4-3.

the BSA. The County must explain a) why it removed the BSA; b) if removal of the BSA constitutes a change in how (and where) Project impacts were considered; c) why the maps in the Biological Resource section changed to no longer show the BSA's 250-foot buffer; and d) the reason for the change from BSA to project area in the Recirculated Draft EIR.

4. The Recirculated Draft EIR's reconnaissance surveys are deficient.

There are deficiencies in the reconnaissance surveys that the Recirculated Draft EIR relies upon to identify potentially impacted species. In evaluating whether a project will affect endangered, rare, or threatened species, lead agencies can use reconnaissance-level surveys—rather than protocol-level surveys or other methods—*only* where the choice of methodology is supported by substantial evidence.[446] Without explanation or evidence supporting its decision, the Recirculated Draft EIR notes that "[n]o protocol surveys were conducted."[447] And merely changing the name from the original Draft EIR's "reconnaissance surveys"[448] to "biological resource" surveys[449] without making any other changes in the content of surveys conducted does not resolve this error.

Of the 39 species CDFW identified as potentially occurring in the Project area (see Table 1 in section V.G.1), the Recirculated Draft EIR identifies just 27 that may be potentially affected by the Project following literature, database analysis, and reconnaissance surveys in September—December 2022. But the initial database review and reconnaissance/biological resource surveys were insufficient to identify all sensitive species that may potentially occur in the Project area. In particular, despite the poor timing of the reconnaissance/biological resource surveys to detect many species, the Recirculated Draft EIR relies on these sources to exclude the Tipton kangaroo rat and several plant species that CDFW has noted occur or have the potential to occur near the Project site, as explained further below.

a. Tipton Kangaroo Rat

The Tipton kangaroo rat (TKR) is a "keystone" species in the San Joaquin Valley because it provides important "components of the biological niche."[450] CDFW wrote in comments on the scoping phase of the Project that TKR "have been documented to occur near the Project site" and that suitable habitat is present for the species to "occupy or colonize the Project."[451] CDFW went on to recommend a trapping plan to determine the presence of TKR, to be reviewed and approved by CDFW prior to execution, and that "these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities in order to determine if impacts . . . could occur."[452]

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[446] *Gray*, *supra*, 167 Cal.App.4th at 1124.
[447] RDEIR, Vol. 1 at 4.4-39.
[448] See, e.g., Draft EIR, Vol. 1 at 4.4-39.
[449] See, e.g., RDEIR, Vol. 1 at 4.4-39.
[450] RDEIR, Vol. 1 at 4.4-38.
[451] RDEIR, Vol. 2, App'x A.2: Comment Letters at 154.
[452] RDEIR, Vol. 2, App'x A.2: Comment Letters at 155.

Despite its importance and likelihood to appear in and use the Project site, the Recirculated Draft EIR fails almost entirely to acknowledge this species. First, contrary to CDFW's recommendation, the Biological Analysis Report did not include a trapping plan submitted to and approved by CDFW. Second, the Project's reconnaissance/biological resource survey did not take place in the recommended timeframe of between April 1 and October 1, but instead in winter, when—as one might expect—no Tipton kangaroo rats were observed. Rather than include this species for further evaluation in protocol-level surveys, the Project removed it from consideration with the following flimsy rationale: "The BSA is outside of the known geographic range (east of the California aqueduct) of the species."[453] This statement not only is not supported by substantial evidence, it is contradicted by multiple letters from CDFW.

The TKR should have been properly surveyed, as CDFW recommended, and included in the Recirculated Draft EIR as potentially occurring in the Project area to ensure it was analyzed and covered by mitigation measures.

b. Blunt-nosed Leopard Lizard

The Recirculated Draft EIR ignores the CDFW's concerns—expressed in both the Notice of Preparation comment and the agency's comment on the original Draft EIR—about survey protocols for the blunt-nosed leopard lizard (BNLL). According to CDFW, "[t]he Biological Resources section of the DEIR appears to rely primarily on reconnaissance level surveys conducted for the DEIR and ignores the substantial body of biological information collected within the [Elk Hills Oil Field]."[454] The CDFW went so far as to call the original Draft EIR's conclusion that no lizards were observed "*wholly misleading* given the extensive distribution of BNLL known to occur . . . as supported by decades of surveys and research."[455] Moreover, as the CDFW explains, "no other area within the range of BNLL [is] as extensively studied for the BNLL" as the Elk Hills oil field, and the populations of these lizards "are extremely dense" in portions of the oil field.[456] The CDFW recommends that the County disclose the species' "probability densities, ongoing monitoring routes and associated detections, and historical observations" to inform the CEQA analysis and related impacts to "this Fully Protected species."[457]

The Recirculated Draft EIR does none of what the CDFW asked, resulting in a CEQA document that continues to be not only "misleading," but also illegal. Instead, the Recirculated Draft EIR offers only that protocol-level and pre-construction surveys occurred three miles southwest of the Project area five years ago, in 2019; the document also names surveys conducted in several years prior.[458] The Recirculated Draft EIR does not, however, share results of those specific surveys, or as the CDFW requested, any probability densities, monitoring routes, or detections. The document says only in the aggregate, the separate Elk Hills

[453] RDEIR, Vol. 2, App'x C.1: Biological Analysis Report at 1701.
[454] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1068, CDFW Letter.
[455] *Id.* (emphasis added).
[456] *Id.*
[457] *Id.*
[458] RDEIR, Vol. 1 at 4.4-17.

Conservation Area's semi-annual monitoring since 1999 has yielded 475 BNLL detections.[459] This is utterly insufficient and unresponsive to what the CDFW requested.

c. San Joaquin Antelope Squirrel

The CDFW correctly notes that while the original Draft EIR indicated that reconnaissance surveys detected multiple occurrences of the San Joaquin antelope squirrel (SJAS), "no reference was made to the substantial body of SJAS detection data that exists for the [Elk Hills oil field]."[460] This species is considered "fairly widespread" throughout the field, and the agency recommended that the County disclose "OXY/CRC's ongoing SJAS monitoring and associated detections," along with historical observations, to better inform the CEQA analysis and mitigations.[461] The Recirculated Draft EIR does none of this, without explaining why.

d. Giant Kangaroo Rat

Like the species mentioned above, the CDFW points out that the original Draft EIR ignores "extensive giant kangaroo rat (GKR) survey data within [the Elk Hills oil field]" from OXY/CRC.[462] The survey areas "overlap substantially with the proposed Project boundaries" and are therefore highly relevant.[463] Despite this, the Recirculated Draft EIR ignores this evidence without explanation. The Recirculated Draft EIR also fails to take up the CDFW's recommendation to disclose ongoing monitoring, detections, and historical observations. Instead, the Recirculated Draft EIR only adds that surveys conducted between 2001-2005 and semi-annual monitoring in the Elk Hills Conservation Area showed 1,240 active signs of GKR.[464] This is short of what the CDFW said is needed "to better inform the CEQA impact analysis."[465]

e. Special Status Plants

CDFW identified multiple plant species that may be located in the Project area. The agency recommended in comments on the Notice of Preparation that Project sites should be surveyed "by a qualified botanist following the 'Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities' . . . . This protocol, which is intended to maximize detectability, includes the identification of reference populations to facilitate the likelihood of field investigations occurring during the appropriate floristic period."[466] The protocol is "meant to help people meet California Environmental Quality Act (CEQA) requirements for adequate disclosure of potential impacts to plants" and further recommends that field surveys be conducted multiple times during flowering or fruiting, when

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[459] *Id.*
[460] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1069, CDFW Letter.
[461] *Id.*
[462] *Id.*
[463] *Id.*
[464] RDEIR, Vol. 1 at 4.4-21.
[465] RDEIR, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1070, CDFW Letter.
[466] RDEIR, Vol. 2, App'x A.2: Comment Letters at 159.

plants will be evident and identifiable.[467] The Recirculated Draft EIR's methodology and recommendations are at odds with this protocol.

Surveys are particularly important because information in databases is voluntarily submitted and "obtained opportunistically and is often focused on protected lands or on lands where development has been proposed."[468] CDFW identified with aerial imagery that many plant species could be impacted by the development in the Elk Hills oil field, including Horn's milk vetch, slough thistle, alkali-sink goldfields, pale-yellow layia, and California alkali grass.[469] CDFW further stated that:

> [i]n order to adequately assess any potential impacts to biological resources, focused biological surveys are advised to be conducted by a qualified wildlife biologist during the appropriate survey period(s) in order to determine whether or not any special status species may be present within the well development areas and prior to any ground-disturbing activities. Survey results can then be used to inform the level of environmental review and identify any mitigation, minimization, and avoidance measures necessary to reduce potential impacts to special status biological resources to less than significant.[470]

The Project's Biological Analysis Report appears to recognize the importance of surveys to supplement information in databases. It says that "the absence of recorded occurrence in these databases at any specific location does not preclude the possibility that a special-status resource may be present, which is why site-specific surveys were undertaken."[471] The Recirculated Draft EIR, though, fails to conduct plant surveys in a manner that conforms with the CDFW recommendations and would produce meaningful results.

First, it is not clear if the determination of whether species had the potential to occur was made prior to or after reconnaissance/biological resource surveys.[472] And, if made after surveys, the "site-specific surveys" conducted for the Biological Analysis Report are not the same as the surveys recommended by CDFW to determine the species in the Project area and develop mitigations. For example, the Project conducted surveys between September and December, outside bloom times.[473] The Recirculated Draft EIR's Table 4.4-7 shows the "optimal blooming period[s]" for special-status plants with potential to occur as largely starting in March and April

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[467] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (Mar. 2018) at 1.
[468] RDEIR, Vol. 2, App'x C.1: Biological Analysis Report at 2559.
[469] RDEIR, Vol. 2, App'x A.2: Comment Letters at 151.
[470] *Id.* at 146–47.
[471] RDEIR, Vol. 2, App'x C.1: Biological Analysis Report at 2559.
[472] *Id.* at 2560 ("The results of the database inquiries were reviewed to develop a comprehensive list of sensitive biological resources that may be present on or in the vicinity of the Project site (see Table A-1 in App'x A). This list was then evaluated against existing site conditions observed during the biological field surveys of the BSA to determine which special-status resources have the potential to occur and then the potential for impacts to those resources as a result of the implementation of the Project.").
[473] RDEIR, Vol. 1 at 4.4-57, Table 4.4-7.

and ending in May and June.[474] The Recirculated Draft EIR offers no explanation for conducting plant surveys outside of these blooming periods.

Further, there is also no evidence that the surveyors possess specific plant knowledge, have experience "conducting floristic botanical field surveys," or that the surveys followed other requirements in CDFW's 2018 protocols for surveying document.[475] CDFW's protocol specifically states that it is inappropriate to conduct "'[f]ocused surveys' that are limited to habitats known to support special status plants or ***that are restricted to lists of likely potential special status plants***" because they "are not adequate to identify all plants in a project area to the level necessary to determine if they are special status plants,"[476] but this is exactly what the Recirculated Draft EIR proposes.[477]

5. The Recirculated Draft EIR's proposed mitigation measures are unsupported and/or insufficient.

A large number of species-specific mitigation measures lack support, ignore scientific evidence, and/or expert agency recommendations submitted during the scoping period, fail to adhere to legal requirements, and ultimately must be substantially revised. Further, the Recirculated Draft EIR lacks entirely mitigations for specific species or offers vague and/or yet-to-be-determined mitigation plans that must be specified and recirculated for comment from the public and experts.

a. Blunt-nosed Leopard Lizard

The BNLL is a Fully Protected species in California and the proposed Project is located in "what is known as the highest quality BNLL habitat" within the Elk Hills oil field.[478] The Recirculated Draft EIR fails to provide sufficient mitigation measures to detect the species and avoid take, just as it fails to adequately respond to concerns, evidence, and suggestions offered by the CDFW during the Project scoping period.

Mitigation Surveys

In addition to the failures of the population surveys noted above, the County's proposed mitigation surveys are insufficient. They provide that "[n]o more than one year prior to ground disturbing activities, focused surveys . . . shall be conducted in all potential" habitat" (MM 4.4-9(b)); as well as "[w]ithin 30 days before any ground-disturbing activities in special-status species habitat, the qualified biologist shall conduct a pre-disturbance survey" (MM 4.4-1(C)). But as the CDFW pointed out in their scoping comment: "Protocol-level surveys for BNLL are not synonymous with 30-day 'preconstruction surveys' often recommended for other wildlife species. In addition, the BNLL protocol specifies different survey effort requirements based on whether the disturbance results from maintenance activities or if the disturbance results in habitat

[474] *Id*.
[475] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* at 11.
[476] *Id.* at 4.
[477] RDEIR, Vol. 1 at 4.4-57.
[478] RDEIR, Vol. 2, App'x A.2: Comment Letters at 150.

removal (CDFW 2019)."[479] The Recirculated Draft EIR does not address the difference between protocol-compliant surveys and 30-day preconstruction surveys, or the difference in survey type based on Project activity and impact. The BNLL mitigation measures for surveys must provide more specifics on how the proposed surveys will comply with the nuances in the protocols.

Further, the County's mitigation measures must be clearer on the timing of the one-year survey and provide more explanation for how the timing will fit with the BNLL's complex lifecycle and the fact that the species can remain below ground for years at a time. MM 4.4-9 says only that "focused surveys . . . shall be conducted" within a year of construction. The BNLL breeds from May to June, and eggs hatch in July and August.[480] The species is then active during the day in the spring, summer, and fall months, though adult activity decreases during the hot summer months of July and August, just as the hatchlings emerge from the burrows.[481] At that point, adults generally retreat into their burrows for the winter.[482] Hatchlings stay out until October or November, before going into burrows.[483] Adults are capable of remaining below ground for two winters when poor environmental conditions, such as drought, are present.[484] The Mitigation Measure for longer-term surveys must therefore account for detecting both adult and juvenile BNLLs, as well as the fact that adults may remain underground for two years in a row.

Deferred Mitigation

MM 4.4-9(c) says that if BNLL are found during surveys, an "avoidance plan shall be prepared." The Mitigation Measure then recommends certain minimum actions to be included in the plan, such as a Worker Awareness Program and a speed limit.[485]

But the County cannot defer creation of a mitigation measure until a problem is detected. Under the CEQA rule against improper deferred mitigation, an EIR may not outline a mitigation measure in overly general terms, leaving the details to be decided at a later time, without setting performance standards or showing how the impact can be mitigated as described in the EIR.[486] Formulation of a measure's specific requirements for biological impacts may be permissible if the measure refers to the options that will be considered and the measure identifies specific

[479] RDEIR, Vol. 2, App'x A.2: Comment Letters at 150.
[480] California Herps, *Blunt-Nosed Leopard Lizard - Gambelia sila*, https://californiaherps.com/lizards/pages/g.sila.html (last accessed Mar. 1, 2024).
[481] U.S. Fish and Wildlife Service (FWS), *Blunt-Nosed Leopard Lizard*, https://www.fws.gov/species/blunt-nosed-leopard-lizard-gambelia-silus (last accessed Mar. 1, 2024).
[482] *Id.*
[483] *Id.*
[484] *Id.*
[485] *Id;* see also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius" until additional measures are determined).
[486] CEQA Guidelines, §15126.4(a)(1)(B); *Preserve Wild Santee v. City of Santee* (2012) 210 CA4th 260, 280 (rejected measure calling for management of species without specifying performance standards or other guidelines for that management); *San Joaquin Raptor Rescue Ctr.*, *supra*, 149 CA.4th at 669 (measure specifying that future surveys for special status species be completed and undefined habitat management plan be developed in response to surveys found legally inadequate).

performance standards.[487] All of these required safeguards and specifics are lacking in MM 4.4-9(c).

Cumulative Analysis

The CDFW recommended in the scoping period that the County perform a "robust cumulative impact analysis" of the BNLL because of the "significant loss of habitat for the species," the fact that the Project area and surrounding lands "contain some of the highest quality remaining habitat" for the BNLL, and that any "ground disturbing activities . . . may have the potential to significantly impact" populations.[488] The Recirculated Draft EIR entirely ignores this recommendation and it is not reflected either in the analysis or the mitigation measures. There is no explanation for why CDFW's recommendation was ignored. The County must take up this recommendation and adjust its analysis and mitigation measures accordingly.

Buffer Zones

The mitigation measures for BNLL buffer areas fail to match the analysis and evidence CDFW provided in the scoping period. CDFW sought to determine the appropriately sized buffer to create a "reasonable chance of preventing take."[489] The agency reviewed the best available scientific information on the area which individual BNLL use and the distances that individuals are known to move between points.[490] They summarized relevant findings and concluded that the buffer area would need to be 164 acres *at a minimum* to avoid take.[491]

Rather than grapple with this informed and reasoned recommendation, the mitigation measures for the BNLL are vastly under-protective. MM 4.4-9(a) provides only a 50-foot buffer where ground-disturbing activities could impact suitable burrows. MM 4.4-9(b) prescribes a 250-foot buffer if the species is detected. (Even here, it is unclear what "detected" means—the same Mitigation Measure states that no buffer is needed if no BNLL "is observed," but "observation" may not be the same as detecting signs of the lizard.)[492]

The Recirculated Draft EIR's prescribed 50-foot buffer is 2% of the CDFW recommendation, and the 250-foot buffer only 10% of the CDFW recommendation. Moreover,

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[487] *Clover Valley Found. v. City of Rocklin* (2011) 197 CA.4th 200, 237 (requirement that permits be obtained from Department of Fish and Wildlife and Corps of Engineers served as performance standards supporting agency's determination that impact to listed species and its habitat would be mitigated); see also *Rialto Citizens for Responsible Growth v. City of Rialto* (2012) 208 CA.4th 899, 945; *Cal. Native Plant Society*, *supra*, 172 CA.4th at 621; *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 CA.4th 777, 794; *Defend the Bay v. City of Irvine* (2004) 119 CA.4th 1261, 1275.

[488] RDEIR, Vol. 2, App'x A.2: Comment Letters at 150.

[489] RDEIR, Vol. 2, App'x A.2: Comment Letters at 151.

[490] RDEIR. Vol. 2, App'x A.2: Comment Letters at 151.

[491] RDEIR. Vol. 2, App'x A.2: Comment Letters at 152–53 (going on to explain that "a reasonable plan for avoidance is to assume that the lizard might utilize up to 98.8 acres in any direction from where it was observed," and assuming a circular home range, the diameter would be 2340.8 feet, or a 395-acre circle as a buffer).

[492] See also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius until additional measures are determined").

the evidence the CDFW analyzed showed the *minimum* home range for the BNLL to be 1.1 acres (with other findings extending up to nearly 22 acres). One acre is 660 feet long—meaning the buffers in the mitigation measures are not even half of the bare minimum space needed to protect the species. These buffers simply fall far short of what is needed to meet the County's legal obligations and avoid take of the species. The Recirculated Draft EIR offers no explanation for running counter to the best available scientific evidence of what may be reasonable to avoid take.

b. San Joaquin Kit Fox

There is both high likelihood of San Joaquin Kit Fox (SJKF) presence and occupation of the Project site and a need for strong mitigation measures. Per the CDFW, SJKF "may be attracted to the Project area due to the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance."[493] Mitigations must eliminate or substantially limit the likelihood of den collapse, inadvertent entrapment, reduced reproductive success, reduction in health and vigor of young, and direct mortality of individuals.[494]

The current SJKF mitigation measures are deficient and fail to align with scientific evidence and/or legal requirements in several ways. First, the CDFW was clear in its scoping comment that avoiding Project impacts to SJKF "is likely infeasible," and this Project warrants consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities.[495] This is because the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity."[496]

Second, while MM 4.4-6 provides for buffers around potential and confirmed dens, it also directs that any dens that "cannot be avoided" will be removed. Calling for den removal fails to align with evidence provided during the scoping period that kit fox relocation is complex and likely to fail.[497] The Mitigation Measure further fails to propose how exactly den "excavation" will occur, if/where relocation will happen, and how relocation will take into account critical factors such as expense, available habitat, impact on existing populations, and documentation.[498] Den removal also implicates species take which, as noted below, requires a separate ITP than what the County currently claims covers Project activities.[499] The Mitigation Measure also fails to acknowledge the USFWS's guideline that occupied natal or pupping dens will not be destroyed until the foxes have vacated, thus requiring postponement of Project

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[493] RDEIR, Vol. 2, App'x A.2: Comment Letters at 153.
[494] *Id.*
[495] *Id.* at 154.
[496] *Id*.
[497] Bremner-Harrison, S. et al., *Feasibility and Strategies for Translocating San Joaquin Kit Foxes to Vacant or Restored Habitats* (2007), https://esrp.csustan.edu/publications/pdf/esrp_2007_kitfoxreloction_w.pdf.
[498] See *id.* at 3-7.
[499] See, e.g., FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 4 (2011), https://www.fws.gov/sites/default/files/documents/survey-protocols-for-the-san-joaquin-kit-fox.pdf (emphasizing that "Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the Service" and that if "at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described [therein] should be resumed").

activities.[500] Details such as these must be included in the mitigation measures so that all parties (including the Project developer, workers, and local regulators) are aware of their obligations and limitations.

Third, other measures to project the SJKF do not align with CDFW and USFWS recommendations. (Of note, MM 4.4-6 directs the reader to other measures "including capping pipes, covering trenches, adding exit ramps to excavated areas" at MM 4.4-15. But MM 4.4-15 concerns wetlands and waters, whereas 4.4-13 concerns additional measures to avoid adverse impacts to species, such as speed limits and covering open trenches. This drafting error should be corrected.) For example, the CDFW recommends all perimeter fencing be raised 5 to 7 inches above ground level to allow SJKF movement through the Project site and to minimize impacts to SJKF habitat connectivity.[501] MM 4.4-13(h) prescribes perimeter fencing to be 4 inches off the ground—meaning, this fencing would be too short for the SJKF to pass. The USFWS also recommends that new sightings of kit fox shall be reported to the California Natural Diversity Database.[502] The County should amend its mitigation measures to take into account these expert agency recommendations.

c. Giant Kangaroo Rat, Tipton Kangaroo Rat, Short-Nosed Kangaroo Rat, and San Joaquin Antelope Squirrel

As an initial matter, the Recirculated Draft EIR must correct its omission of the TKR. According to CDFW, the GKR, TKR, and Short-Nosed Kangaroo Rat (SNKR) "have been documented to occur near the Project site (CDFW 2022), and the Project Area supports some of the best GKR habitat present in the Elk Hills oil field."[503] It is unclear why the Recirculated Draft EIR fails to discuss the TKR in the Biological Resources section.[504] This omission must be corrected by including an analysis of research and impacts, and inclusion of species-specific mitigation measures.

Regarding surveys, the CDFW recommended trapping surveys for the GKR, TKR, and SNKR, to be conducted according to trapping plans developed in consultation with CDFW.[505] CDFW further recommended that these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities.[506] Once completed, they requested that all survey results be sent to CDFW.[507] Without explanation or evidence to explain why it would not have to conduct such surveys (including for the TKR), the Recirculated Draft EIR does not take up any of these recommendations. Relatedly,

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[500] *Id.* at 4 (2011).
[501] RDEIR, Vol. 2, App'x A.2: Comment Letters at 154.
[502] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.
[503] RDEIR, Vol. 2, App'x A.2: Comment Letters at 154; *see also* RDEIR, Vol. 1 at 4.4-38 (noting that the USFWS published a recovery plan for species in the San Joaquin Valley, including the TKR, identifying it as a "keystone" species).
[504] RDEIR, Vol. 1 at Table 4.4 (listing the TKR but providing no further information, unlike other species).
[505] RDEIR, Vol. 2, App'x A.2: Comment Letters at 154.
[506] *Id.*
[507] *Id.*

the CDFW recommended seeking ITPs upon detection of any of the protected rat species; it does not appear the Project has done this.[508]

While the Recirculated Draft EIR's 50-food den buffer aligns with the CDFW recommendation,[509] the mitigation measures ignore the CDFW's caution that buffers may not be sufficient to ensure that the species can "freely disperse to and from burrows."[510] Inhibiting the movement of these protected species could be considered "capture" and/or result in prohibited species take.[511] To address this, the CDFW recommended that no burrow be surrounded more than 180 degrees around by development activities.[512] The Recirculated Draft EIR ignores this recommendation without explanation or evidence. The mitigation measures should adopt this 180-degree protection in addition to buffers around rodent dens.

The issues above are similar with the San Joaquin antelope squirrel (SJAS), which is known to occur throughout the Elk Hills oil field.[513] Like the rat species, the CDFW recommended that no SJAS burrow be surrounded more than 180 degrees around by development activities.[514] The Recirculated Draft EIR fails to adopt this measure and fails to offer explanation or evidence that omitting this protection would somehow avoid capture and/or take. The CDFW also informed the County of the need for a separate ITP permit for SJAS take.[515]

d. Swainson's Hawk

Swainson's hawks have been documented to occur in the areas bordering the Elk Hills oil field, and the habitat type present provides suitable foraging and nesting habitat.[516] Despite this, the Recirculated Draft EIR lacks any mitigation measures specific to the species.

The CDFW recommended specifically for the Swainson's hawk that, upon discovery of an active nest, a minimum half-mile buffer be delineated and that such a buffer be maintained until the breeding season ends or a qualified biologist determines the birds have fledged.[517] Instead, MM 4.4-8 (which broadly covers all bird nests) provides that if a nest is detected, it will be continuously surveyed for 24 hours to establish behavior baseline prior to construction; then continuously monitored to detect any behavioral changes. Monitoring of a nest falls short of an immediate buffer and the Recirculated Draft EIR does not provide evidence that simple monitoring will be sufficient to reduce adverse impacts to the species. Further, the Measure does not clarify who will do the 24-hour monitoring or the continuous behavioral monitoring; at the very least this must be a qualified biologist selected by the County.

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[508] *Id.* at 154–55 (stating that "the existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").
[509] RDEIR, Vol. 1 at Table 4.4-6.
[510] RDEIR, Vol. 2, App'x A.2: Comment Letters at 154.
[511] *Id.*
[512] *Id.*
[513] *Id.* at 156.
[514] *Id.*
[515] *Id.* at 157.
[516] *Id.*
[517] *Id.* at 158.

The Recirculated Draft EIR also entirely fails to address the loss of Swainson's hawk foraging habitat and tree removal, two concerns CDFW raised during the scoping period.[518] The CDFW provided reasoned and supported recommended mitigations to address these concerns that must be incorporated into the Recirculated Draft EIR.

e. Burrowing Owl

Burrowing owls have been documented in the Project vicinity, per CDFW.[519] The Project has the "potential to significantly impact local [] populations" and, and as described in CDFW's "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), "excluding and/or evicting [burrowing owls] from their burrows is considered a potentially significant impact under CEQA."[520]

The CDFW's Staff Report is clear that Project-specific CEQA mitigation is important for burrowing owls and unless otherwise provided in a state, local, or regional conservation strategy, mitigation measures must incorporate the following four principles: 1) use of the precautionary principle; 2) use of mitigation effectiveness monitoring and reporting, as well as adaptive management; 3) protect and conserve owls in wild, semi-natural, and agricultural habitats; and 4) protect and conserve natural nest burrows or surrogates.[521] The Staff Report then lists best practices for mitigation measures grounded in scientific literature.[522] These include, broadly, avoidance, pre-construction surveys, site surveillance, and buffer zones.[523]

The Recirculated Draft EIR does not take the CDFW's scoping comment or Staff Report fully into account, leaving its burrowing owl mitigations insufficient to reduce adverse impacts and unsupported by any evidence.

First, accurate surveys to detect burrowing owl presence is key, and CDFW suggested during the scoping period that the Project conduct "three or more surveillance surveys" with each visit occurring at least three weeks apart during peak breeding season (April 15 to July 15).[524] Mitigation Measure 4.4-1 provides only that "any required focused/protocol surveys shall be conducted . . . with protocol survey timelines." The Recirculated Draft EIR does not address the guideline for three or more surveillance surveys for owls, nor does it contain evidence or an explanation for why this approach would not be taken.

Second, MM 4.4-4 provides that burrowing owls present in the Project area or within 500 feet outside the breeding season "may be moved away . . . using passive relocation techniques." While this measure pledges to follow CDFW guidelines, the Recirculated Draft EIR fails to acknowledge that according to the CDFW, "excluding birds from burrows is not a take

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[518] *Id.*
[519] *Id.* at 160.
[520] *Id.*
[521] CDFW, *Staff Report on Burrowing Owl Mitigation, State of California* (March 7, 2012) at 3–4, https://www.sandiegocounty.gov/content/dam/sdc/pds/ceqa/JVR/AdminRecord/IBR/RTCReferences/3a%20CDFG%202012_Staff%20Reports%20on%20Burrowing%20Owl%20Mitigation.pdf.
[522] *Id.* at 8.
[523] *Id.* at 8–10.
[524] RDEIR, Vol. 2, App'x A.2: Comment Letters at 160.

avoidance, minimization, or mitigation method and is instead considered a potentially significant impact under CEQA."[525] The Recirculated Draft EIR must therefore acknowledge that displacing owls is an impact and analyze it as such. Should MM 4.4-4 maintain the approach of displacing owls, it must also incorporate the CDFW's guideline that burrow exclusion be conducted only by qualified biologists and only during the non-breeding season, and that occupied burrows be replaced with artificial ones at a ratio of 1:1.[526]

Finally, there is no logical connection between the full suite of impacts to burrowing owls named in the Recirculated Draft EIR and the mitigation measures named. The document acknowledges that "[n]oise, vibration, and increased human activity" from construction "could alter the daily behaviors of individual owls and affect foraging success, displace owls from their burrows, or lead to nest failure."[527] The Recirculated Draft EIR then claims MMs 4.4-1, -3, -4, -11, and -13 "would reduce impacts,"[528] but these Measures on their face do not fully address the impacts. MM 4.4-1 concerns surveys, MMs 4.4-3 and -4 address buffers and owl nest exclusion, MM 4.4-11 describes worker education, and MM 4.4-13 lists additional measures such as trash and dust control. The Measures listed are a start, but the Recirculated Draft EIR does not fully connect how they will address noise, vibration, and other impacts that could alter the daily behaviors of owls; the impacts are therefore left unmitigated.

f. Nocturnal Species

There are six protected nocturnal species in the Project area,[529] but the mitigation measures fail to adequately reduce impacts to these species (and other species) from the array of nighttime Project activities expected to occur.

As an initial matter, the Biological Resources section acknowledges that construction could occur at night and therefore require lighting that may affect diurnal and nocturnal wildlife.[530] But elsewhere in the document, the Recirculated Draft EIR states that nighttime Project activities could include "drilling activities, vehicle and equipment activities supporting drilling, and safety and security lighting for areas, such as construction yards, work areas, vehicle and equipment parking areas, and staging and laydown areas,"[531] and that Class VI well drilling "typically run[s] continuously, 24 hours a day" for "up to 60 days."[532] The full range of nighttime activities mentioned in other parts of the Recirculated Draft EIR must be incorporated, analyzed, and mitigated in the Biological Resources section.

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[525] *Id.* at 161 (citing the CDFW Staff Report).
[526] *Id.* at 161.
[527] RDEIR, Vol. 1 at 4.4-46.
[528] *Id.*
[529] The species are the California glossy snake, RDEIR, Vol. 1 at 4.4-44, 4.4-18; the giant kangaroo rat, *id.* at 4.4-22 (noting that "suitable burrows with diagnostic signs of kangaroo rat were observed" during surveys); the short-nosed kangaroo rat, *id.* at 4.4-22; the San Joaquin pocket mouse, *id.* at 4.4-22; the American badger, *id.* at 4.4-23 (noting that "dens displaying signs consistent with the use of a badger were observed" in the Project area); and the San Joaquin kit fox, *id.* at 4.4-23.
[530] RDEIR, Vol. 1 at 4.4-40.
[531] RDEIR, Vol. 1 at 4.1-24.
[532] RDEIR, Vol. 1 at 4.1-25.

Perhaps because of this disconnect, the only nighttime-related mitigation measure for species merely directs use of "directing lighting" and compliance "with applicable lighting mitigation measures."[533] Nighttime lighting is harmful to nocturnal species, but lighting is far from the only impact of nighttime construction and other activities that needs to be mitigated. (Moreover, the lighting mitigation is far too vague to be evaluated or measured and must be revised to include specifics and information about enforcement.) For example, the San Joaquin kit foxes "are known to sometimes rest and play near the den entrance in the afternoon, but most above-ground activities begin near sunset and continue sporadically throughout the night."[534] Accordingly, for that species, the U.S. Fish and Wildlife Service recommends that "[n]ight-time construction should be minimized" and if it does occur, "then the speed limit should be reduced to 10-mph" and "[o]ff-road traffic outside of designated project areas should be prohibited."[535]

The County must therefore develop mitigation measures to address the full array of impacts to nocturnal species from activities such as traffic, noise, vibrations, and continuous drilling. The County must also develop measures to address impacts to daytime species whose rest and other behaviors might be disrupted by nighttime disturbances and continuous drilling.

g. Worker Environmental Awareness Program

Mitigation Measure 4.4-11 to create a Worker Environmental Awareness Program is a good start but, as written, falls short of the County's legal requirements and could benefit from adopting recommendations by other agencies.

For one, the Recirculated Draft EIR defers development of the program, stating only in MM 4.4-11 that it "shall be developed." As noted earlier in this comment section, the County cannot defer development of a mitigation measure and instead must provide specifics prior to finalizing the Recirculated Draft EIR. A worker educational program is not the type of mitigation that requires further data or inputs from operations to prescribe measures, nor is it impractical or infeasible to devise the specifics of such a program now.[536]

One template the County could consider comes from the USFWS regarding the SJKF. They recommend an employee education program that does the following:

> The program should consist of a brief presentation by persons knowledgeable in kit fox biology and legislative protection to explain endangered species concerns to contractors, their employees, and military and/or agency personnel involved in the project. The program should include the following: A description of the San Joaquin kit fox and its habitat needs; a report of the occurrence of kit fox in the project area; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of measures being taken to reduce impacts to the species during project construction and implementation. A fact sheet

[533] RDEIR, Vol. 1 at 4.4-59.
[534] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 3.
[535] *Id.* at 5.
[536] See, e.g., *Defend the Bay v. City of Irvine* (2004) 119 Cal.App.4th 1261, 1275; *Preserve Wild Santee*, *supra,* 210 Cal.App.4th at 281; CEQA Guidelines, § 15126.4(a)(1)(B).

conveying this information should be prepared for distribution to the previously referenced people and anyone else who may enter the project site.[537]

This type of thorough education is appropriate for all protected species that are or could occur at the Project site. These materials must be developed and shared with the public and decisionmakers prior to finalizing and certifying the Recirculated Draft EIR.

Similarly, MM 4.4-12 provides that "wildlife found that might have been affected by exposure to CO_2 shall immediately cause a shutdown of all injection operations." This measure is important and should therefore be incorporated into the Worker Environmental Awareness Program, along with other information about exactly *how* to identify wildlife suffering symptoms of CO_2 exposure.

h. Cumulative Impacts and Mitigations

The Recirculated Draft EIR concludes that "the cumulative impacts of the project when combined with other known and unknown projects, would be significant and unavoidable" for biological resources.[538] The Recirculated Draft EIR then offers no additional mitigation measures beyond the ones proposed to address direct impacts.[539]

The Recirculated Draft EIR opts not to independently consider and evaluate potential cumulative impacts to biological resources because of the *Final Environmental Impact Report—Revisions to the Kern County Zoning Ordinance—2015(C) Focused on Oil and Gas Local Permitting*, referred to in the EIR as the Oil and Gas EIR.[540] The relationship to this Recirculated Draft EIR is somewhat opaque. The County uses the Oil and Gas EIR "as a source of information regarding cumulative impacts," but supposedly "does not rely" on it "for purposes of tiered review under CEQA."[541] By way of further explanation, the Oil and Gas EIR's information "provides evidence for the record of the analysis of cumulative impacts" for activities included in the Project.[542]

We agree that CEQA Guidelines section 15152 guides whether the County can tier to a previous analysis, but the County's supposed use but non-reliance on the Oil and Gas EIR is unconvincing. Per the Guidelines, "tiering" is defined as "using the analysis of general matters contained in a broader EIR" with later EIRs, incorporating by reference the general discussions from the broader EIR, and concentrating the later EIR solely on the issues specific to the later project.[543] This definition of tiering describes how the County is using the Oil and Gas EIR for this Project—meaning, the County is tiering to the challenged EIR, even if it claims not to be.

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[537] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.
[538] RDEIR, Vol. 1 at 4.4-67.
[539] *Id.* at 4.4-66.
[540] *Id.* at 4.4-65 to 4.4-66.
[541] *Id.* (citing CEQA Guidelines, § 15152).
[542] *Id.* at 4.4-66.
[543] CEQA Guidelines, § 15152(a).

6. The Recirculated Draft EIR's reliance on a prior conservation easement deed for Endangered Species Act coverage is improper.

It is unclear to what extent Kern County proposes to rely on previously issued plans for Endangered Species Act coverage for the Project, but reliance on existing coverage through take permits is improper. As the Recirculated Draft EIR recognizes, unauthorized take of species is unlawful, and the County must have an ITP to cover any species take.[544] Yet the Recirculated Draft EIR claims that California Resources Corporation has an ITP from 2012, pointing to Appendix C.2. The Recirculated Draft EIR also references an "Elk Hills Habitat Conservation Plan" but does not provide the plan anywhere in the appendices.[545]

The Recirculated Draft EIR's discussion of ITP coverage is problematic for several reasons. First, the document provided in Appendix C.2 (both in the original and Recirculated Draft EIR) is not an ITP or Habitat Conservation Plan—it is a conservation easement deed for conservation areas that largely do not overlap with the Project site.[546] The document mentions only a small number of the potentially impacted protected species.[547] And the document mentions "certain impacts of oil and gas production facilities and activities at the Elk Hills oil field," which do not encompass the CO_2 capture, compression, transportation and injection activities of this Project.[548] Although the Center for Biological Diversity is aware that a previous oil field operator prepared a Habitat Conservation Plan in 2009 as part of an ITP application necessary to extend a prior permit beyond 2014 and authorize incidental take of species associated with continued oil and gas production activities,[549] there is no publicly available information indicating that plan was finalized.[550]

Because the original Draft EIR does not contain the actual ITP, the Center for Biological Diversity requested from Kern County the ITP noted in other Elk Hills oil field drilling approval documents.[551] The Center received a document in response, ITP number 2081-2014-019-04, issued to California Resources Corporation Elk Hills, LLC. We are including it with our comment submission since this permit must be part of the administrative record. We note that this document we submitted does not appear in the Recirculated Draft EIR's Volume 2

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[544] RDEIR, Vol. 1 at 4.4-23 (take requires an ITP issued under section 2081 or a finding that an ITP issued under the federal Endangered Species Act is consistent with state requirements); *id.* at 4.4-25 (section 10 of the federal Endangered Species Act allows a permit applicant to obtain an ITP through submission of a habitat conservation plan); see also MM 4.4-2 (stating that there may be no incidental take of any protected species without a permit or approved conservation plan).
[545] RDEIR, Vol. 1 at 4.4-36.
[546] RDEIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area at 2667 *et seq.*; RDEIR, Vol. 2, App'x C.3: Conservation Easement Deed – Elk Hills Conservation Area Map at 2687 *et seq.*
[547] RDEIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area; RDEIR, Vol. 1 at 4.4-36.
[548] RDEIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area.
[549] 71 Fed. Reg. 6883.
[550] See 78 Fed. Reg. 39836.
[551] Letter from Center for Biological Diversity to Kern County Planning & Natural Resources Department, *Elk Hills Oilfield Incidental Take Permit* (Jan. 16, 2024); CalGEM, *Notice of Determination, NOD-OG California Resources 072022-201-1* (Aug. 25, 2022).

appendices, and we believe this is an error. ITP 2081-2014-019-04 must be in the record since it is mentioned in Project documents, including the Biological Analysis Report.[552]

Second, ITP 2081-2014-019-04 does not sufficiently include the CTV I Project as a Covered Activity. The ITP explains that the activities covered involve "continued oil and gas related activities and the exploration and development of new wells necessary to enhance recovery and processing of oil and gas reserves."[553] The CTV I Project, in contrast, proposes to capture CO_2 from existing oil field operations, but also "is dependent on the sources permitted for injection into the storage, the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[554] As noted earlier in this comment letter, additional sources of CO_2 could include DAC, hydrogen, and waste to energy facilities. Moreover, CO_2 compressors, pipelines, injection wells, and other infrastructure are fundamentally different from oil and gas counterparts.

Third, and relatedly, the existing ITP covers only four species—the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and Tipton kangaroo rat—not the full range of species that could suffer take from the CTV I Project.[555] Even the CDFW—the state's authoritative agency on this issue—reiterated throughout its comment during the Scoping Phase that the existing ITP is insufficient to cover the Project's impacts on protected species.[556] The agency again raised this point in comments on the original Draft EIR, stating that a new ITP and take authorizations are required for candidate species like Crotch's bumble bee.[557] The CDFW issued its opinion based not only on species that the ITP fails to cover, but the deficiency of the existing ITP to address impacts to the four covered species.[558]

It should also be noted that while the current ITP covers incidental take of the TKR resulting from oil and gas production, the Recirculated Draft EIR arbitrarily excludes this species from surveys and consideration of mitigation measures. CRC must therefore obtain a new ITP to cover *all* activities that could result in take of protected species flagged as occurring or potentially occurring in the Project Area. Obtaining ITP(s) covering CTV I Project activities and other species must occur before any construction begins to avoid unlawful take. The County must therefore revise its conclusion that if it "elects in the future to pursue any disturbance . . . that requires additional take authorization," and the Project would obtain a new ITP, per MM

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[552] See, e.g., RDEIR, Vol. 2, App'x C.1: Biological Analysis Report at 2570.
[553] CDFW, ITP No. 2081-2014-019-04, Elk Hills Oil and Gas Field at 2–3 (hereinafter, "ITP Permit 2081"); see also *id.* at 6–10 (listing covered activities and not including CCS).
[554] RDEIR, Vol. 1 at 4.8-24.
[555] ITP Permit 2081 at 11 ("These species and only these species are the 'Covered Species' for the purposes of this ITP.").
[556] RDEIR, Vol. 2, App'x A.2: Comment Letters at 146–65; see also section VI.G, *supra* (noting instances in which the ITP does not cover protected species for the activities proposed).
[557] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1071, CDFW Letter.
[558] See, e.g., RDEIR, Vol. 2, App'x A.2: Comment Letters at 154 (noting that the Project warrants consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities and for this species, the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").

4.4-2. [559] The Recirculated Draft EIR must then be revised to analyze and account for the new ITP.

7. The Recirculated Draft EIR must do more to analyze and mitigate impacts to the Project area's two candidate species.

The Temblor legless lizard (TLL) and Crotch's bumble bee are both Special Status Animal Species with Potential to Occur on Site that could potentially be affected by the Project.[560] The CDFW issued recommended mitigation measures and reminded the County of legal requirements should these species be detected. The Recirculated Draft EIR does not incorporate the proposed mitigations, nor is there indication that the County or Project has followed the legal requirements described.

a. Temblor Legless Lizard

For the TLL, the CDFW notes that habitat loss is the primary threat, and the species is known to occur within and in the vicinity of the Project Area.[561] For this reason, the CDFW concluded that the Project "may have the potential to significantly impact local TLL populations."[562] Despite this, the original and Recirculated Draft EIR propose only "protocol surveys" and pre-disturbance surveys, along with several other generic mitigations associated with other species.[563] The Recirculated Draft EIR ignores the fact that the CDFW points out TLLs "are difficult to detect . . . and are not typically found within dens and/or burrows," making the proposed protocol surveys and avoidance buffers from dens and/or burrows insufficient to "constitute avoidance."[564] The Recirculated Draft EIR offers no evidence to contradict the CDFW, nor does it explain why it ignored these facts.

The CDFW then proposes three mitigation measures: (1) surveys using a CDFW-approved methodology; (2) consultation and development of an avoidance plan; and (3) take authorization prior to commencing ground disturbing activities.[565] The Recirculated Draft EIR ignores each recommendation, as these measures are not reflected in the updated document.

b. Crotch's Bumble Bee

The CDFW is starkly clear in its comment that, for Crotch's bumble bee (CBB), it "does not concur that the Mitigation Measures" in the original Draft EIR "are sufficient to mitigate impacts, to ensure that the Project Area is surveyed sufficiently to determine the presence or absence" of the species, "and to adequately mitigate for the species."[566] The CDFW then recommended three mitigation measures to remedy these deficiencies. The Recirculated Draft

[559] RDEIR, Vol. 1 at 4.4-64 (emphasis added).
[560] See RDEIR, Vol. 1 at Table 4.4-4.
[561] RDEIR, Vol. 2, App'x A.6: Summary of Written Public Comments on original Draft EIR (Dec. 2023) at 1070, CDFW Letter.
[562] *Id.*
[563] *Id.*
[564] *Id.*
[565] *Id.* at 1070–71.
[566] *Id.* at 1071.

EIR, without explanation, does not address the CDFW's concerns, nor does it incorporate any of the proposed changes.

Specifically, the CDFW suggested (1) focused surveys for the CBB and its habitat during the blooming period prior to construction, to be conducted by a qualified biologist and in line with the CDFW's methodology; (2) an avoidance buffer if surveys cannot be completed and consultation with the CDFW to discuss how to avoid take; and (3) take authorization through a new ITP.[567] These measures are reasoned and from an expert agency, and the County must not ignore these important steps to protect this species and its habitat.

H. The Recirculated Draft EIR's Analysis and Mitigation of Land Use Impacts is Inadequate.

1. The Land Use analysis fails to disclose the impacts it purports to mitigate with MM 4.11-7.

The Recirculated Draft EIR introduces a new mitigation measure, MM 4.11-7, that was not part of the original Draft EIR, into the land use section.[568] This measure is added under the analysis of Impact 4.11-2, which considers whether the CTV I Project would "[c]onflict with Any Applicable Land Use Plan, Policy, or Regulation Adopted for the Purpose of Avoiding or Mitigating an Environmental Effect."[569]

MM 4.11-7 limits future CO_2 sources to specific industries, industrial sources, and fossil fuel facilities and types, requires that all sources be located in Kern County, and includes several other conditions regarding the approval and planning processes for such future sources.

CEQA requires an EIR to describe and adopt all feasible mitigation measures to address a project's significant environmental impacts.[570] It requires that "[d]irect and indirect significant effects of the project on the environment shall be *clearly identified and described*, giving due consideration to both the short-term and long-term effects.[571] The discussion of mitigation measures under CEQA "[…] shall identify mitigation measures *for each significant environmental effect identified* in the EIR."[572] MM 4.11-7 fails on all counts.

First, the Recirculated Draft EIR fails to disclose the land-use impact that MM 4.11-7 is set to mitigate. In the discussion under Impact 4.11-2, the Recirculated Draft EIR explains how mitigation measures MM 4.11-1 to 4.11-6 are aimed at avoiding "conformality issues", making sure only specific uses can be approved on the Project site, and avoiding activities that could penetrate the capstone of the storage reservoir or disturb its wildlife protective buffer.[573] MM 4.11-7 is not mentioned in this discussion.

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[567] *Id.* at 1071–72.
[568] RDEIR, Vol. 1 at 4.11-53 to 4.11-54.
[569] RDEIR, Vol. 1 at 4.11-24.
[570] Pub. Resources Code, § 21002; CEQA Guidelines, § 15126.4(a)(1).
[571] CEQA Guidelines, § 15126.2(a) (emphasis added).
[572] CEQA Guidelines, §15126.4(a)(1)(A) (emphasis added).
[573] RDEIR, Vol. 1 at 4.11-50.

The only statement in the Recirculated Draft EIR with some relevance to MM 4.11-7 is where it generally refers to *all* measures together, saying all measures "will provide additional protections, notification for surrounding property owners, and full review of all future sources for compliance with the Zoning Ordinance, General Plan, and CEQA."[574]

But the land use section fails to disclose *what is the impact* MM 4.11-7 will mitigate, or how such impact will be mitigated by it. Because of that omission, it is impossible for the public and decisionmakers to assess MM 4.11-7's effectiveness or even understand the County's logic for proposing it. For example, what is the rationale behind the different requirements the Measure sets for incorporated versus non-incorporated cities? There is no information on this issue in the Recirculated Draft EIR. The general statement above about measures guaranteeing "full review of all future sources for compliance with the Zoning Ordinance, General Plan, and CEQA" is meaningless, as all projects must comply with the law and with general plans, and MM 4.11-7 adds nothing to this requirement.

It is particularly confounding why the new Measure was placed under the land use section. While all the other measures in the section are tied to land use issues and include land use instruments, requiring specific land use entitlements, notices or notations,[575] MM 4.11-7 sets requirements that are more relevant to the CTV I Project's potential impacts on *other* resource areas, mostly GHG emissions and air quality.

The Recirculated Draft EIR must be revised to account for the impacts MM 4.11-7 is set to mitigate, which are not limited to land use impacts, and properly analyze how the Measure will address and mitigate those impacts.

2. MM 4.11-7 is vague and unenforceable.

Under CEQA, proposed mitigation measures must be "fully enforceable" through permit conditions, agreements, or other legally binding instruments.[576] Any proposed mitigation must also provide assurance that such implementation will in fact occur.[577]

Section C.2 of MM 4.11-7 sets the following requirement for CO_2 sources within an incorporated City in Kern County: "the listed use has capture technology for CO_2 that shows compliance with the preparation of an environmental document, with Kern County as a Responsible Agency and not the use of an exemption from CEQA review."

The requirement for capture technology to show "compliance with the preparation of an environmental document" is vague to the point of being meaningless. Technologies, as such, do not require a CEQA process. If the measure intends to condition source approval on the preparation of environmental documents, it should say so explicitly.

[574] RDEIR, Vol. 1 at 4.11-51
[575] RDEIR, Vol. 1 at 4.11-51 to 4.11- 53.
[576] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, §15126.4(a)(2).
[577] *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1186–87; *Federation of Hillside & Canyon Ass'ns v. City of Los Angeles* (2000) 83 CA4th 1252, 1260.

Similarly, section C.2 of the Measure lists requirements for CO_2 pipelines, stating that any CO_2 pipelines permitted by the California Public Utilities Commission (CPUC) for a common carrier company that requests to connect to CTV I for injection must either "comply with a CUP and EIR" or that "Kern County has participated in the CPUC process and reasonable and feasible mitigation for protection of Kern County communities has been included." Again, the answer to what is "reasonable and feasible mitigation for protection of Kern County communities" is left completely open, without any standards to determine whether this condition is indeed fulfilled.[578] MM 4.11-7 should be revised to include clear and enforceable terms and conditions.

I. The Recirculated Draft EIR Fails to Analyze and Mitigate Cumulatively Considerable Impacts.

Under CEQA, an EIR must discuss significant "cumulative impacts."[579] Cumulative impacts are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts."[580] A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable future projects with impacts that might compound or interrelate with those of the project at hand.[581] Such analysis is necessary because "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[582]

As is the case for all impact categories, a lead agency's threshold findings of significance with regard to cumulative impacts must "be supported by substantial evidence"; and, where found, cumulatively considerable impacts must be adequately mitigated.[583]

CEQA requires an agency to analyze "probable future projects."[584] The courts have found that "[P]rojects that are undergoing environmental review are reasonably probable future projects"[585] and that "any future project where the applicant has devoted significant time and financial resources to prepare for any regulatory review should be considered as probable future projects for the purposes of cumulative impact."[586]

An adequate cumulative impacts analysis and discussion requires a thorough assessment of the incremental significance of the CTV I Project's impacts over time, and in consideration of "other projects causing related impacts."[587] The Recirculated Draft EIR concludes that the CTV I Project will cause potentially significant impacts for a number of impact areas. For some impact

[578] *Gray*, *supra*, 167 Cal.App.4th at 1119.
[579] CEQA Guidelines, § 15130(a).
[580] CEQA Guidelines, § 15355(b).
[581] Pub. Resources Code, § 21083(b)(2); CEQA Guidelines, § 15065(a)(3).
[582] *Communities for a Better Environment*, *supra*, 103 Cal.App.4th at 114.
[583] See CEQA Guidelines, § 15064.7(b).
[584] CEQA Guidelines, § 15130(b)(1)(A).
[585] *Gray, supra,* 167 Cal. App. 4th 1099 at 1127–28.
[586] *Id.* at 1127–28.
[587] CEQA Guidelines, § 15130(a)(1).

areas, the EIR concludes the impact will be cumulatively significant and unavoidable. These areas include aesthetics, agricultural resources, air quality, biological resources, cultural resources, energy, geology and soils, hydrology and water quality, GHG, mineral resources, noise, and utilities and service systems.[588]

However, the Recirculated Draft EIR fails to conduct an appropriate cumulative impacts analysis and support its conclusions with evidence, because it fails to consider the full range of projects that are required in a cumulative impact analysis. Simply declaring a potentially significant cumulative impact is not sufficient, because that declaration by itself neither discloses, nor analyzes, nor guarantees mitigation for, the projected incremental impacts of the project in combination with other projects.

As described above, the project description section of the Recirculated Draft EIR lists under "Cumulative Projects" several projects in the County, and provides nothing more than the name, location, type, acreage, and status of these projects.[589] In doing so, the Recirculated Draft EIR ignores "probable future projects" that must be analyzed in a proper cumulative impacts analysis.

1. The Recirculated Draft EIR must analyze all the projects included in its "cumulative projects" list.

The Recirculated Draft EIR must analyze all the projects included in its "cumulative projects" list in a proper cumulative impacts analysis, and properly assess their potential significant impacts. The Recirculated Draft EIR fails to do so, and most of the projects in the cumulative impacts list are never mentioned again elsewhere in the document. One example of the failure to analyze the cumulative impacts of the Project is the CarbonFrontier CCS Project proposed by Aera (CarbonFrontier Project).

Kern County published the draft EIR for the CarbonFrontier Project in June 2024, at nearly the same time as the Recirculated Draft EIR for CTV I. The CarbonFrontier EIR contemplates a CCS project with over 200,000 acres storage space, located about 9 miles from the CTV I Project site. Similar to CTV I, this project will source CO_2 from an oil field's gas stream, and will have the capacity to receive CO_2 from outside sources.[590] This project is clearly a reasonably probable future project undergoing environmental review. The CarbonFrontier draft EIR briefly mentions CTV I in its short discussion of the Aera merger with CRC, but otherwise dismisses any relationship between the projects, stating that "[t]hey are both included in the respective cumulative impact list in each individual EIR."[591]

But the CarbonFrontier Project is not discussed *anywhere* in the Recirculated Draft EIR beyond its listing as a cumulative project in Table 3-8. Merely listing a project as cumulative

[588] RDEIR, Vol. 1 at 1-13 to 1-15.
[589] RDEIR, Vol. 1 at 3-45 to 3-47 (Table 3-8).
[590] Kern County, *Draft Environmental Impact Report CarbonFrontier CCS Project by Aera Energy, LLC,* (June 2024) at 1-2.
[591] Kern County, *Draft Environmental Impact Report CarbonFrontier CCS Project by Aera Energy, LLC* at 3-16.

does not satisfy the requirement under CEQA to analyze and mitigate cumulative impacts. The Recirculated Draft EIR must be revised to include an analysis of all its cumulative impacts together with the listed projects.

In *Bakersfield Citizens for Local Control v. City of Bakersfield*, 124 Cal. App. 4th 1184, the court found that the cumulative impact analyses for two shopping centers with similar features, a few miles apart from each other, "were fundamentally flawed because they did not recognize that the shopping centers were relevant projects and did not analyze the type and severity of impacts that will result from construction and operation of both projects."[592] While the Recirculated Draft EIR does the first step of including the CarbonFrontier in its cumulative project list, it completely fails to take the required second step—it does not analyze the type and severity of cumulative impacts from CTV I's construction and operation together with the CarbonFrontier Project.

The *Bakersfield* court looked into the potential individual impacts of each shopping center and found that each EIR found an unavoidable adverse impact on ambient air quality. Based on this and a few other impacts, the court concluded that "CEQA compels assessment and disclosure of these combined environmental effects."[593] Similarly, both Draft EIRs for the two CCS projects find significant impacts on air quality and greenhouse gases,[594] but fail to assess and disclose them cumulatively.

2. The Recirculated Draft EIR must analyze cumulative impacts from its probable future sources.

Some of the projects on the cumulative projects list are mentioned as potential CO_2 sources in the "Future Sources – Identification" section in the Recirculated Draft EIR. Analysis of a carbon sequestration project's sources of CO_2 is an essential element of review of cumulative project impacts. An analysis of these sources is necessary not only to understand the impact of their operation together with the CTV I Project, but also in order to give the public and the County decisionmakers information regarding whether and to what extent CTV I will facilitate and incentivize new GHG emissions, rather than reduce existing emissions, whether it will extend the life of existing fossil fuel CO_2-emitting industries, and whether it will create pollution from construction or operation of new facilities. The cumulative analysis fails to include any meaningful discussion of the Project's CO_2 sources.

From the list of cumulative projects, two potential sources are notably absent, and the Recirculated Draft EIR must, at a minimum, analyze them:

a. Hydrogen Plant

The new "Future Sources – identification" section in the Recirculated Draft EIR includes blue hydrogen as a potential source of CO_2 for the CTV I Project.[595] The new section also

[592] *Bakersfield Citizens*, *supra*, 124 Cal. App. 4th at 1214.
[593] *Bakersfield Citizens*, 124 Cal. App. 4th at 1216.
[594] Kern County, *Draft Environmental Impact Report CarbonFrontier CCS Project by Aera Energy, LLC* at 1-2 to 1-16; RDEIR, Vol. 1 at 1-11 to 1-15.
[595] RDEIR, Vol. 1 at 3-13.

describes briefly "[c]ompanies that have publicly indicated their interest in sending CO_2 to the project."[596] Under "Hydrogen", the Recirculated Draft EIR acknowledges that "Lone Cypress Energy Services, LLC, has entered a CDMA to explore development of a clean hydrogen production plant that would produce hydrogen using a steam methane reforming (SMR) process, using natural gas (methane) as feedstock. CO_2 produced as a by-product of the SMR reaction would be captured for underground storage."[597]

The Recirculated Draft EIR states that while an application for the SMR hydrogen project was submitted to the County, and a Notice of Preparation was released in February 2024, the project applicant has withdrawn the application.[598] It provides no other details on the status of the Lone Cypress project, whose status was described as "EIR in Process" in the original Draft EIR, nor does it state the reason for the withdrawal of the application or whether the project proponent intends to re-submit it. According to a letter from CRC and CTV to the EPA, the project is not cancelled, but rather "reassessed."[599]

The Recirculated Draft EIR also fails to disclose that beyond the CDMA it now acknowledges. CTV has announced that it is a direct partner in the Lone Cypress project, noting in a media release that "the CTV [Joint Venture (VR)] has the right to take a majority equity stake in the project, as well as to provide sequestration services for all subsequent Lone Cypress hydrogen projects in California."[600]

Moreover, in an email sent to Kern County Planning Department staff, staff is instructed to hold off publishing the Notice of Preparation (NOP) for the Lone Cypress hydrogen project, because the County intended to imminently release the original Draft EIR for CTV I. The email specifically states the reason for delaying the NOP is that "it will complicate the cumulative projects description" and the County does not have time to change anything.[601] It is clear therefore that but for this delay, the Lone Cypress project should have been analyzed as a cumulative project in the original Draft EIR the County published in December 2023.

Regardless of the specific Lone Cypress application, the Recirculated Draft EIR must analyze the cumulative impacts of a hydrogen project as a CO_2-sending source to the Project. A hydrogen plant is clearly a "reasonably probable future project" under CEQA for cumulative impacts analysis purposes.

As the Recirculated Draft EIR summarily acknowledges, the draft EPA Class VI permit for the CTV I Project identified only two other specific sources beyond the oil field gas as an

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[596] RDEIR, Vol. 1 at 3-14.
[597] RDEIR, Vol. 1 at 3-15.
[598] RDEIR, Vol. 1 at 3-15.
[599] Letter from Travis Hurst, CRC and CTV to David Albright, Groundwater Protection Section (June 17, 2024) at 1.
[600] CRC, *California Resources Corporation Announces Carbon Dioxide Management Agreement For CTV's First Permanent Carbon Storage Project* (Dec. 7, 2022), https://www.crc.com/news/news-details/2022/California-Resources-Corporation-Announces-Carbon-Dioxide-Management-Agreement-For-CTVs-First-Permanent-Carbon-Storage-Project/.
[601] Email from Lorelei Oviatt, Kern County Planning & Natural Resources Dept., *Re: Elk Hills Blue Hydrogen Parcel Map Waiver and CEQA* (Dec. 1, 2023).

initial source—the Lone Cypress Blue Hydrogen and the Avnos DAC project. The 26R storage project draft permits issued by EPA, attached as appendix E.3 to the Recirculated Draft EIR, lists three sources of CO_2 seeking approval: the oil field gas, the Lone Cypress hydrogen plant, and the Avnos DAC project. The draft permits state they are to be located within the Elk Hills oil field.[602]

On July 10, 2024, the EPA published a revised versions of the draft permits for comments, noting the revisions include the removal of references to the Avnos Direct Air Capture Facility and Lone Cypress Hydrogen Facility as proposed carbon dioxide sources.[603]

The Recirculated Draft EIR argues that an EPA action on draft permits "[…] does not mean the projects are approved,"[604] but fails to account for the significance of the EPA permit process for a proper cumulative impacts analysis.

EPA is the primary regulatory authority for Class VI injection permits, which are required for CO_2 injection into underground subsurface rock formations, as the Project intends to do. In other words, an EPA permit is an indispensable condition for the Project to move forward. And the permits, in their current draft form, allow injection of CO_2 from only those three sources. The draft permits make clear that the Project proponent may request to inject CO_2 from other sources, but this will require further application, review, and approval by EPA, as described in Section N of the permits.[605] Section N lists the conditions for approval of *additional* emission sources, a process which includes disclosure of the CO_2 stream, description of the source industry, evaluation of potential air pollution impacts, and public notice, among other things.

The draft permit requirements mean that detailed information is already known regarding the oil field gas, the hydrogen plant, and the DAC project, and can be used in the cumulative impacts analysis. EPA is clear that its process to issue the original draft permits included "a thorough technical review of all information submitted by CTV in its permit application, as well as the operational standards, monitoring requirements, and existing geologic setting" that was sufficient for the EPA to make a determination under the Safe Drinking Water Act.[606]

Moreover, the Project evidently relies on sources beyond the oil field gas initial source to send CO_2 to the Project *almost immediately* after it begins operation: The Recirculated Draft EIR's analysis discloses that at a maximum, the oil field's CO_2 will add up to 203,485 tons per year (tpy) of captured CO_2.[607] But its GHG analysis projects over 300,000 tons of CO_2 to be injected by its second year—clearly from approved sources beyond the initial source.

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[602] RDEIR, Vol. 2, App'x E.3 – 26R Storage Project Draft Permits. The same language repeats in all four permit drafts included in the appendix.
[603] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* (July 2024) at 1.
[604] RDEIR, Vol. 1 at 3-14.
[605] RDEIR, Vol. 2, App'x E.3 – 26R Storage Project Draft Permits.
[606] EPA, *Public Notice of Intent to Issue a Class VI Underground Injection Control Permit for Carbon TerraVault JV Storage Company Sub 1, LLC* (Dec. 2023) at 1.
[607] RDEIR, Vol. 1 at 3-2.

A hydrogen project, whether it is the Lone Cypress project or a different but substantially similar hydrogen project, is clearly a "reasonably probable future project" given the contents of the EPA draft permits and the applicant's predictions for the Project's capture of CO_2. Regardless of whether the hydrogen project is part of the latest draft permits or not, the SMR hydrogen plant also clearly falls under what the courts describe as a "future project where the applicant has devoted significant time and financial resources to prepare for *any* regulatory review."[608] The EPA regulatory review requires significant time and resources, and the hydrogen project that is part of that ongoing review must be considered a probable future project.

It should be noted that in their letter to EPA, CRC and CTV are clear that this removal of sources is happening in the "short-term." They are also clear that "even if the Lone Cypress and/or Avnos project does not proceed, CRC expects that over time sources of CO_2 for the 26R UIC permits will likely include hydrogen and direct air capture facilities (among other potential future sources of CO_2)."[609]

It is also evident that CRC contemplates the development of blue hydrogen plants as part of its operation. In a letter to CARB, CRC urges the agency to include in its Low Carbon Fuel Standard (LCFS) amendments hydrogen plants that will rely on CCS to capture GHG emissions, stressing that should the agency act differently, it will "ultimately frustrate the deployment of low carbon hydrogen projects in California."[610]

In addition, the Recirculated Draft EIR discloses that the Project is already undergoing another regulatory review process: CARB review under the CCS Protocol adopted under the LCFS.[611] The review, which is required for the CTV I Project to qualify for LCFS credits, is highly technical and complex. Project proponents are required to provide detailed, third-party verified information regarding the geological CO_2 sequestration, and show they adhere to the Protocol and qualify for certification that the CO_2 will be retained in the ground. As is clear from the Recirculated Draft EIR, CTV I already filed at least 13 reports with CARB to address the permanence requirements related to site characteristics, risk assessment, plume extent evaluation, testing and monitoring, well operation, post-injection site care, and more.[612]

The reports the Project proponent filed with CARB clearly identify a hydrogen plant as the main source for CO_2, stating: "[t]he anthropogenic CO2 will be sourced from an onsite blue hydrogen plant (up to 200,000 tonnes per annum) with additional potential CO_2 from the Elk Hills 550 MW natural gas combined cycle power plant, direct air capture (DAC), renewable diesel refineries, and/or other sources in the area."[613] This CARB process, including the promise

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[608] *Gray v. Cnty. of Madera*, (2008) 167 Cal. App. 4th 1099, 1127–28 (emphasis added).
[609] Letter from Travis Hurst, CRC and CTV, to David Albright, Groundwater Protection Section (June 17, 2024) at 1–2.
[610] CRC letter to CARB, *RE: Proposed 2024 Low Carbon Fuel Standard Amendments* (Feb. 20, 2024) at 3. See also CRC's application to CARB under its CCS Protocol for LCFS certification.
[611] RDEIR, Vol. 1 at 4.6-5 to 4.6-6.
[612] RDEIR, Vol. 1 at 4.6-6; RDEIR, Vol. 2, App'x F: CARB LCFS Report #1, Site Based Risk Assessment at 1.
[613] CARB LCFS Report #3, *Storage Complex Delineation and Corrective Action Plan, CTV Elk Hills Oil Field (EHOF)* at 6-7.

of an SMR hydrogen plant, constitutes a regulatory review that the applicant devoted significant time and resources to prepare.

It should be noted that the CARB reports do not identify a specific hydrogen project, but "a blue hydrogen plant." Since the industrial process (methane steam reforming) is known, and the volume of production is disclosed in both regulatory processes,[614] the Recirculated Draft EIR must disclose and analyze the potential cumulative impacts, including impacts from co-pollutants, impacts on water resources, and safety hazards resulting from the anticipated "blue hydrogen" facility.

b. DAC Project

Similar to the hydrogen project, the Avnos DAC project is one of the three sources included in CRC's application to the EPA for a Class VI injection well permit and in the EPA's draft permits.[615] It was also removed in the recent permit revisions.[616] Direct air capture is also on the list of future Project sources added to the Recirculated Draft EIR.[617]

In its short discussion of the DAC project, the Recirculated Draft EIR states that "[i]t is unknown if there is an existing CDMA or other commercial agreement between CRC and Avnos. The applicant notes that CTV I is in preliminary commercial discussions with Avnos, Inc., to construct a DAC facility that would be designed to intake and process atmospheric air to separate out CO2."[618] On its face, the statement "[i]t is unknown if there is an existing CDMA or other commercial agreement" lacks credibility, since CRC could easily provide any information to the County regarding the existence of such agreements, much as CRC has provided all the other information it has provided to the County—including the statement in the sentence following.

Beyond that, this statement downplays the connections between the Project proponent and the DAC project as well as the DAC project status. First, in its 2023 operations updates, CTV describes the California DAC Hub as being "led by CTV's subsidiary CTV Direct, LLC" and states it was selected to receive approximately $12 million in DOE funding.[619] CTV I also describes itself as responsible for assembling "a consortium of organizations across industry, technology, academia, national labs, community, government, and labor, to pursue U.S. Department of Energy (DOE) funding under its Regional Direct Air Capture (DAC) Hubs

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[614] Up to 200,000 tonnes per annum per App'x E.2 – *U.S. Environmental Protection Agency Class VI Underground Injection Control (UIC) Permit Application Narratives for the Elk Hills 26R Storage Project and the A1A2 Storage Project* (Attachment C).
[615] RDEIR, Vol. 2, App'x E.3 – 26R Storage Project Draft Permits. The same language repeats in all four permit drafts included in the appendix.
[616] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* (July 2024) at 1.
[617] RDEIR, Vol. 1 at 3-13.
[618] RDEIR, Vol. 1 at 3-15.
[619] Business Wire, *Carbon TerraVault Provides 2023 Update* (Feb. 27, 2024), https://www.businesswire.com/news/home/20240227366330/en/Carbon-TerraVault-Provides-2023-Update.

Initiative to create the California DAC Hub, the state's first full-scale DAC plus storage (DAC+S) network of regional DAC+S hubs."[620]

In addition, in a quarterly report to the CPUC from January 31, 2024, SoCalGas discloses that it is a member of the California Direct Air Capture Hub Consortium working toward the DAC project in Kern County and that the consortium was awarded an $11.8 million grant from DOE. This report further states that the DAC facility's project manager "is currently in contract negotiations and expects to finalize the negotiation in early 2024, allowing for an expected project kickoff thereafter."[621]

Also similar to the hydrogen project, a DAC project is listed as a potential source in the reports CTV I filed with CARB under the CCS Protocol.[622]

The DAC project is not only a "reasonably probable future project," but also a "future project where the applicant has devoted significant time and financial resources to prepare for any regulatory review."[623] Its impacts must be analyzed cumulatively in order for the Recirculated Draft EIR to be legally and informationally sufficient.

The result of the Recirculated Draft EIR's failure to properly account for cumulative projects and their impacts is that its cumulative impacts analysis is deeply flawed, lacking any analysis of the environmental impacts expected to be produced by probable future projects, or an analysis of whether the impacts are cumulatively considerable.[624]

It is evident that the Project is completely dependent on its sources. The Recirculated Draft EIR states that "[t]he life of the project is dependent on the sources permitted for injection into the storage" and on "the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[625] The Recirculated Draft EIR should therefore include a cumulative impacts analysis of all the projects listed in Table 3-8, and in particular of potential CO_2 sources it lists as cumulative projects.[626]

Finally, cumulative impacts analysis cannot merely be a cursory description of probable future projects, without any analysis. The description and analysis of cumulative impacts should reflect their severity and the likelihood of their occurrence.[627] While this analysis does not have to reflect the same level of detail as the primary analysis of the Project's impacts, it still must be

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[620] CRC, *California DAC Hub*, https://www.crc.com/carbon-terravault/projects/california-dac-hub/default.aspx (last accessed Mar. 1, 2024).
[621] SoCalGas, *Quarterly Report on Status of Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), or Creating Helpful Incentives to Produce Semiconductors and Science Act (CHIPS) Projects Pursuant to Resolution E-5254* (Jan. 31, 2024) at 2.
[622] CARB LCFS Report #3, *Storage Complex Delineation and Corrective Action Plan, CTV Elk Hills Oil Field (EHOF)* at 6-7
[623] *Gray*, 167 Cal. App. 4th at 1127–28 (emphasis added).
[624] CEQA Guidelines, § 15065(a)(3).
[625] RDEIR, Vol. 1 at 4.8-24.
[626] RDEIR, Vol. 1 at 3-45.
[627] CEQA Guidelines, §15130(b); *City of Long Beach v. Los Angeles Unified Sch. Dist.* (2009) 176 Cal.App.4th 889.

reasonable and show a good faith effort to disclose the impacts.[628] As described under each impact area section in these comments, the Recirculated Draft EIR does not provide any meaningful analysis of the cumulative impacts attributable to the probable future projects, and ignores even the projects it lists as cumulative projects in Table 3-8.

The courts made clear that lead agencies have a duty to approach the issue of cumulative impact analysis in a way that will "afford the fullest possible protection to the environment within the reasonable scope of their language."[629]

The Recirculated Draft EIR must be revised to fully account for the cumulative impacts attributable to *all* of the CTV I Project's cumulative projects, including, but not limited to, the CarbonFrontier Project and the hydrogen and DAC CO_2 projects.

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For the reasons set forth above, we urge the County to re-do its analysis, prepare and circulate a revised Draft EIR, and, ultimately, reject the CTV I Project.

We reserve the right to identify new issues, provide additional information, and propose additional mitigation measures during the County's ongoing decisionmaking process for the CTV I Project.

If you have any questions about the foregoing comments, you may reach out to any of us directly or contact the Earthjustice contacts listed below, who helped prepare this submission.

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[628] *Citizens for Open Gov't v. City of Lodi* (2012) 205 Cal.App.4th 296, 320.
[629] San Franciscans for Reasonable Growth v. City & Cnty. of San Francisco, 151 Cal. App. 3d 61, 74, 198 Cal. Rptr. 634, 640 (Ct. App. 1984)

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ATTACHMENT A

Comment on the Air Quality and Greenhouse Gas (GHG) Analysis Provided in the Draft Environmental Impact Report (SCH# 2022030180) for the Carbon TerraVault 1 (CTV1) Project in Kern County, California Proposed by California Resources Corporation, December 2023

by

Dr. Ranajit (Ron) Sahu[1]

I provide the following technical comments based on my review of the air quality and GHG analyses provided for the proposed CTV1 project in the DEIR. The lead agency for the EIR is Kern County's Planning and Natural Resources Department (Mr. Keith Alvidrez).

The figure below, taken from the DEIR shows the two dis-jointed parcels (at the surface) where the proposed project will be implemented.

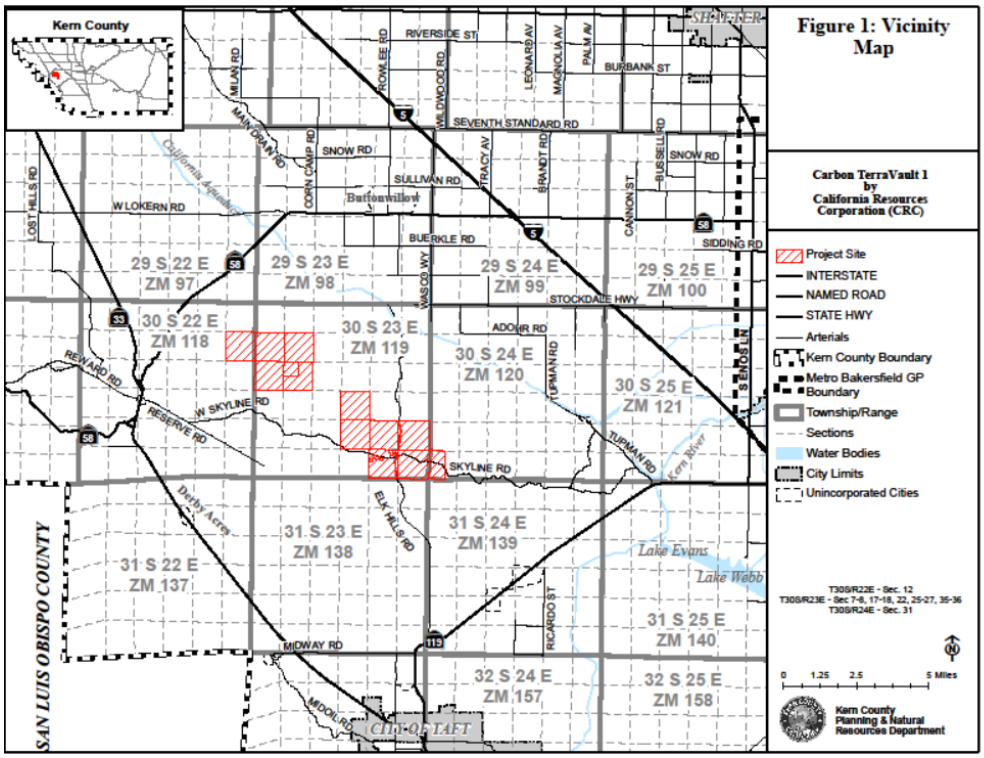

Figure 1: Regional Vicinity Map

[1] Resume provided in Attachment A.

My comments are based on information provided in the body of the DEIR (in Volume 1) and Appendix B (in Volume 2, specifically the report prepared by Trinity Consultants[2]) which contains the supporting information on the air quality and GHG analyses. My comments point out the deficiencies in the analysis, including the lack of support or rationale for critical inputs which should be addressed. Given the lack of publicly available information on the proposed project, I am unable to provide an independent, alternate set of analyses and results.

Comment 0 – Inconsistent Description of the Proposed Project

Page 1-1 (Introduction) and page 3-1 (Project Description) of the DEIR state:

> The Carbon TerraVault I (Kern County) Project (CTV I) proposed by California Resources Corporation (CRC, or project proponent) would request the approval of multiple Conditional Use Permits (CUPs)…for the construction and operation of an approximately 9,130-acre carbon capture and storage (CCS) facility with related capture facilities and pipeline for the initial source and request associated Zone Change Case (ZCC) No. 5, Map 119 and ZCC No. 4, Map 120 from A-1 (Limited Agriculture) to A (Exclusive Agriculture) on approximately 6,160 acres."[3]

Appendix B.1 of the DEIR states that:

> "…[T]he Project will involve a 5,332-acre carbon capture and sequestration field, associated sequestration injection wells and related improvements for storage of Carbon Dioxide (CO_2)."[4]

Yet, later in the same document, it states that:

> "[T]he Carbon TerraVault 1 Carbon Capture and Sequestration Project is consideration of the approval of multiple Conditional Use Permits (CUP) (CUP No. 13, Map no. 118, CUP No. 5, Map 119, CUP No. 3, Map 120) and related changes in zoning designations (ZCC No.5, Map No.118, ZCC No. 5, Map 119, ZCC No. 4, Map 120 for the construction and operation of a 7,385.67 acre carbon capture and storage (CCS) facility, with associated Class VI Underground Injection Control (UIC) wells, 13 miles of facility pipeline for capture from the pre-combustion gas and related infrastructure improvements for the capture, transfer, and storage of CO_2."[5]

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[2] DEIR, Appendix B.1. Air Quality Impact Analysis, May 2023 (revised November 2023), prepared by Trinity Consultants.

[3] DEIR, pages 1-1, 3-1.

[4] DEIR, Appendix B.1, p. 1-1. (emphasis added)

[5] DEIR, Appendix B.1, Section 2.2. (emphasis added)

Please clarify the discrepancies between the three very different acreages noted above.

Comment 1 – Missing Details and Energy/Air Quality Impacts of the Carbon Capture System

The DEIR contains no engineering information about specific design and/or details regarding the operations of the carbon capture (CC) system that is/will be implemented at the Elk Hills power plant or at the existing cryogenic and fractionation natural gas plant (CGP-1) facility (or any other sources of GHG) before those emissions are then managed, ultimately being injected into geologic formations for sequestration.

As an example, while CC systems naturally involve additional equipment such a blowers and ductwork, which incur energy penalties in order to operate, the DEIR does not provide the details supporting the approximately 31 MW per year[6] of energy it estimates that will be needed to operate the CC facilities and associated equipment.

In addition, while the DEIR notes that the energy/power needed to operate the CC facilities would be sourced from the Elk Hills Power Plant, it does not discuss how this additional power generation will change the load factor and other operating characteristics of the power plant. The DEIR, in summary fashion at Appendix B.1, simply states that "…[T]he Elk Hills Power Plant provides about one third of its power to the oilfield for operations and the remainder is distributed to the California power grid via the Pacific Gas and Electric (PG&E) substation in Buttonwillow." It does not discuss how the additional power/energy needed by the proposed CC facilities would be accommodated by the Elk Hills power plant. I note that the DEIR simply assumes that the power plant will continue to operate at an annual (and constant) capacity factor of 93%[7] for every single year of the 30 year duration of the proposed project. The justification for this capacity factor and whether or not it includes the additional energy needed for the CC system is not clear. That should be clarified.

In addition, given that the expected duration of the proposed project is 30+ years, it is presumed that the Elk Hills Power Plant will need to operate for the next three decades to support the project, whether or not the plant would have continued to run for all this additional time into the future without the project. As it stands, the Elk Hills Power Plant is approximately 20 years old already. So, that means the proposed project would require the power plant to operate till it is 50+ years old. Without significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project. The DEIR

[6] DEIR, p. 4.6-15.

[7] DEIR, Appendix B, tables on pdf pages 310-311.

should address whether or not the proposed project enables the life extension of the Elk Hills power plant and the impacts of any such extension.

Comment 2 – Cursory and Missing Aspects of GHG Leakage

There is little to no detail on the leakage of GHGs, including but not limited to the various types of potential leakage of CO_2 from different aspects of the entire project.

While the DEIR makes a gross assumption that the GHG capture will be 95%,[8] it is not clear if, therefore, the remaining 5% uncaptured GHG is presumed to be an annual leakage level for the duration of the project. If so, what specifically is included in this 5% leakage is not discussed. That should be clarified.

It appears however, that, at best, this uncaptured GHG might include losses during capture of the power plant's exhaust as well as certain fugitive losses in processing the exhaust waste gases containing GHG to and through the amine system, followed by its conveyance to the injection wells. Importantly, three additional potential loss mechanisms and their GHG losses (and associated leakage) do not appear to have been addressed or quantified:

(i) GHG losses associated with ruptures or failures of the additional new pipelines or pipeline components proposed as part of the project. Given the large geographic extent of CTV1, including the gathering and injection infrastructure and given the assumed three decades of operation, such failures are quite likely;

(ii) GHG losses associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance. Pipeline maintenance typically requires evacuation of pipeline sections in order to safely effect such maintenance. Such evacuation necessitates "blowdown" of the gas contained in the pipeline sections. Unless otherwise gathered or captured – which is not discussed in the DEIR – these events can result in emissions of waste gases, containing GHG and other pollutants to the atmosphere; and

(iii) GHG losses from the geologic formation itself due to the injected GHG/CO_2.[9] While the DEIR generally admits that there could be potentially significant leakage[10], the DEIR does not provide any details including the probabilities of such leakage, the circumstances

[8] Curiously, in Section 4.11 of Appendix B.1, this 95% capture is at the amine units. Why that is the case is not clear. The DEIR should clarify.

[9] DEIR, Appendix B.1, Section 2.2 notes that annually 1.5 million metric tons of CO_2 will be injected, with an overall total project injection of 48 million metric tons. This is roughly a 32 year time period.

[10] For example, DEIR at p. 4.8-26.

under which such leakage may occur, or any quantification of the leakage.

The DEIR does include a few monitoring wells but the logic of their placement (including depths) in the various locations and how just the small number of proposed monitoring wells will provide enough assurance that GHG once injected will not migrated from the intended injected formation, is not provided and is not supported by evidence. This un-sequestered GHG migration may not just be towards the surface (i.e., vertically upwards) but also laterally and even downwards from the formation, eventually manifesting themselves as leakage to the surface. While the timing of this subsurface leakage mechanisms may not occur just during the presumed thirty or so year project period (and its GHG accounting of the benefits of sequestration), that does not mean that leakage after (or long after) the thirty or so year time period should simply be assumed to be zero, with little to no support and little to no verification.

* * * * *

The remainder of my comments address specifics about the air quality and GHG analyses presented in the DEIR. For air quality, I focus mainly on the discussion provided in Chapter 4.3 (specifically Sections 4.3.4 and 4.3.5) and Appendix B (specifically Appendix B.1 – the Trinity Consultants report, from which much of the analysis in the body of the DEIR is drawn from), including certain mitigation measured proposed in the DEIR. For GHG, I have reviewed the analysis presented in Section 4.8 of the DEIR and also in Appendix B. I have also reviewed Appendix F in Volume 2 relating to a site-specific risk assessment.

Comment 3 – Air Quality Emissions Estimates

It is crucial that an air quality analysis fully support the assumptions underlying its emissions estimates, as those assumptions and resulting emissions estimates ultimately affect the DEIR's assessment of project impacts and feasible mitigation.

This is true for all types of air pollutants (i.e., criteria pollutants, air toxics or hazardous air pollutants, and GHG) and from all potential emissions generating sources and activities of the proposed project, including both construction and operational phases.

While it is customary in conducting EIR-type air quality analyses to rely on "standard" models to develop emission estimates as has been done in this DEIR,[11] those models typically only have emission factors (i.e., mass of emissions of pollutant X from a source Y – like piece of fuel-burning

[11] DEIR, Section 4.3.4.

equipment, for example). That such standard models have been used in the present instance is confirmed by the DEIR:

> "[T]he construction and operational emissions were estimated from several emissions models and associated spreadsheet calculations, depending on the source type and data availability. The primary emissions models used included CARB's on-road vehicle emission factor model (EMFAC) version 2021 and the California Emissions Estimator Model (CalEEMod) version 2021.1.13." In addition, the DEIR states that "[T]he capture facilities (new amine unit valve) fugitive emissions have been quantified using the California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities…"[12]

The user of the model or the analyst has to input the corresponding activity factor (i.e., how many and what types of equipment, of what sizes, hours of usage, etc.) in order to run the model and obtain estimates of the mass of emissions (i.e., pounds or tons) from those activities over the desired time period (hours, days, weeks, year, etc.).

An accurate analysis and robust evaluation of impacts is especially important here given that the proposed project will be located in an area that is already non-attainment for several criteria pollutants including: ozone (Federal and State); PM_{10} (State); and $PM_{2.5}$ (Federal and State).[13] I should note also that, for $PM_{2.5}$, the EPA has now proposed to make the primary (i.e., health based) annual National Ambient Air Quality Standard (NAAQS) more stringent from its current level of 12 ug/m^3 to a range between 9 – 10 ug/m^3, reflecting the current science on adverse health impacts of this zero-threshold air pollutant.[14] The adoption of the stricter standard means that the air quality in the area is even more unhealthy than understood previously and even further from attaining the health-based NAAQS than acknowledged in the DEIR.

Comment 3.1 – Emission Factors and Errors

I should note for the record that just because the "standard" models incorporate emission factors for various pollutants and for various types of equipment and activities, that does not mean that those emission factors do, in fact, accurately or conservatively represent the emissions of the respective pollutants from specific equipment and specific activities that are part of the project.

[12] *Id.*

[13] DEIR, Table 4.3-2.

[14] https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot

First, there are issues of representativeness of the emission factors, especially as they apply to not just new equipment but also to older equipment and the inevitable deterioration of their emissions (including deterioration of any air pollution controls) over time. This specifically applies to the emission factors that are included as part of the "standard" models used to develop emission estimates as noted prior.

Second, there are always issues of precision and error in emission factors (and activity factors, which I discuss later) and the resultant emissions estimates. The emissions estimates in the DEIR in many instances provide values to many significant digits (i.e., implying greater – and false – precision than warranted), thereby misleading the reader as to the accuracy of the air quality emissions estimated. The DEIR contains no estimates of the errors in any of the calculations. In fact, a proper analysis should provide some guidance of the error (or the range) of the emissions as opposed to misleadingly precise estimates for the reader. The DEIR fails completely on this score. To meaningfully inform the public and decision makers, the DEIR should quantify and disclose uncertainties in the emissions estimates.

Comment 3.2 – "Existing" Air Quality Information is Dated And May Not Be Representative

Section 3.2 of Appendix B.1 summarizes "existing" air quality – i.e., ambient monitoring concentrations of several pollutants. Yet, even though the report in Appendix B.1 was revised in November 2023, this "existing" ambient data is only provided for the years 2019 through 2021. Further, the description misleadingly states that these are "the last three years." Clearly that is not the case since no data is provided for 2022. There is also no mention of why 2022 data could not have been reported. That should be fixed. Notably, quality-assured data from 2022 is readily available.[15]

I also note that this "existing" three-year time period of 2019-2021 was substantially impacted by COVID-19 for the years 2020 and 2021. As such, due to changes in economic activities including transportation patterns, and many other factors, it is not assumable, without further discussion, that this impacted three-year period is representative of "existing" air quality. I suggest that a broader time period, say, 5 or even more years, including 2022, be included to describe existing air quality, with comments, as necessary, on any patterns in the data.

Comment 3.3 – None of the Assumptions Made For Estimating Project-Related Emissions Are Supported by Any Justification and/or Rationale

[15] See, https://www.arb.ca.gov/aqmis2/display.php?param=OZONE&units=007&statistic=DAVG&year=2022&mon=12&day=31&county_name=15-Kern&basin=--AIR+BASIN--&latitude=--PART+OF+STATE--&report=7DAY&order=basin%2Ccounty_name%2Cs.name&submit=Retrieve+Data&ptype=aqd&std15=

I will provide examples of these unsupported assumptions in this comment. I also note, that in each instance, there is no verification of any of these assumptions proposed in the DEIR either.

(i) for short-term construction emissions, it is assumed that the construction schedule will be 11 days per well pad, 18 days per well, 2 years for the capture facilities, and 1 year for the pipelines (later noted as 220 days). None of these timelines are supported.

Specifically, Table 4-12 in Appendix B.1 shows the details of the wells to be constructed/repurposed as part of the project. It is excerpted below for easy reference.

Table 4-12. Total Emissions on a Per Well Basis

Well Name	Description	Depth (ft)	Emissions (Tons)
26R Reservoir			
363C-27R	Injector	6290	4.55
353XC-35R (new)	Injector	6390	4.55
373-35R (new)	Injector	7010	5.36
345C-35R (new)	Injector	5690	3.98
341-27R	Plume monitoring	6981	4.55
328-25R	Plume monitoring	5268	3.98
376-36R	Plume monitoring	5832	3.98
355X-26R	Above-zone monitoring	4063	2.35
USDW Monitoring (new)	USDW monitoring	400	1.28
A1/A2 Reservoir			
355-7R	Injector	8387	6.17
357-7R	Injector	8420	6.17
353A-7R	Plume monitoring	8773	6.17
335X-7R	Plume monitoring	8737	6.17
327-7R-RD1	Above-Zone monitoring	3782	2.03
345-7R	A3+ Monitoring	8904	6.17
388X-7R	A3+ Monitoring	8800	6.17
342-17R	A3+ Monitoring	8844	6.17
USDW Monitoring (new)	USDW monitoring	740	1.28
Total			**81.08**

I note that the well depths, excluding the groundwater monitoring wells, in Table 4.12 range from as low as 3782 ft to as high as 8904 feet. Given this wide range of well depths and many other depths noted in Table 4-12, it makes no sense to presume that there will be 18 days required to construct each well. If the intent is to presume that 18 days is the "average" for all wells/various depths noted above, that should be justified. Clearly, the wells in the A1/A2 reservoir will be drilled to deeper depths as compared to the wells in the 26R reservoir. Since they are not expected to be drilled all at once, the construction schedule for the wells should be provided in greater detail, along with supported construction durations.

In addition, it is not clear how the well depths in Table 4-12 were so precisely estimated, right down to the last foot (for example, 6981 feet, 4063 feet, etc.). Please provide the rationale since the depths will affect construction timelines.

(ii) Section 4.2.1 of Appendix B.1 contains a number of mobile source activity assumptions. These include: a 40-mile trip distance; 160 average daily trips (ADTs) for workers during construction; 32 ADTs by 1-ton trucks and 20 ADTs using 5-ton trucks, in addition to 8 water trucks; 16 ADTs by workers and 2 ADTs by vendors during well pad construction; and 12 ADTs by workers and 10 ADTs by vendors during well construction. There is no justification provided for any of these assumptions. Thus, the emission estimation approach is nothing more than an algebraic exercise. As a simple example, it is not clear why there should be a 40-mile trip distance for both workers and vendors. Also, since there is no description of the work that will be done during construction of the well pad and the well, there is no context for understanding if the assumed numbers of workers/vendors, as well as equipment proposed, makes any sense.

These types of assumptions should be supported by actual data that is undoubtedly available to the project proponent since these are not the first well pads nor first wells that are going to be drilled in this area.

(iii) Similarly, there are numerous assumptions about the types, numbers, and operating hours of various construction equipment that will be used in developing the construction emissions. These are inputs to the emissions calculations in the standard models used to develop those estimated. I have excerpted Tables 4-3 through 4-6 from Appendix B.1 below that contain these assumptions.

Table 4-3. Facilities Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Hydro Crane	Cranes	5	1968.75	3.8
ForkLift	Forklifts	7	1968.75	3.8
Excavator	Excavators	1	1968.75	3.8
Backhoe	Tractors/Loaders/Backhoes	4	1968.75	3.8
Air Compressor	Air Compressors	20	246.09	0.5
Crane	Cranes	3	246.09	0.5
Loader	Rubber Tired Loader	3	246.09	0.5
Dozer	Rubber Tired Dozers	1	1968.75	3.8
Dump Truck	Off-Highway Trucks	2	1968.75	3.8
Welding Truck	Welders	8	1968.75	3.8

Table 4-4. Pipeline Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Average Daily Operating Hours
Crane	Cranes	3	5.0
Boom Truck	Other Construction Equipment	3	5.0
Crane	Cranes	3	2.5
Side Boom	Other Construction Equipment	6	5.0
Bending Machine	Other Material Handling Equipment	1	2.5
Air Compressor	Air Compressors	4	5.0
Air Compressor	Air Compressors	1	2.5
Welding Machines	Welders	8	5.0
DitchWitch	Off-Highway Trucks	1	2.5
Vacuum Truck	Other Construction Equipment	2	2.5

Table 4-5. Well Pad Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Grader	Graders	1	16	1.5
Front Loader	Tractors/Loaders/Backhoes	1	40	3.6
Excavator	Excavators	1	32	2.9
Water Truck	Other Construction Equipment	1	40	3.6

Table 4-6. Well Drilling Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Forklift	Forklifts	1	72.0	4.0
Drilling Rig Motor	Bore/Drill Rigs	1	275.4	15.3
Drilling Rig Motor	Bore/Drill Rigs	1	322.2	17.9
Drilling Rig Motor	Bore/Drill Rigs	1	216.0	12.0
Small Generator	Generator Sets	1	8.0	0.4
Light Tower	Generator Sets	2	216.0	12.0
Water Truck	Other Construction Equipment	1	144.0	8.0
Vacuum Truck	Other Construction Equipment	1	432.0	24.0

The DEIR/Appendix B.1 should provide justifications for the equipment type, the numbers of each equipment, and the expected operating hours in each instance. It is also clear that the operating hours are provided with a high degree of precision, with no rationale. For example, 3.8 hours of operation per day for several types of equipment (along with the equally precise annual operating hours (246.09, 1968.75), in Table 4-3. What is the basis of such precision? Similar comments also apply to the other tables above.

(iv) Long-term, i.e., operational emissions are discussed in Section 4.2.2 of the Appendix B.1 for fugitive (dust) emissions (Section 4.2.2.1) and mobile sources (Section 4.2.2.2). However, fugitive dust emissions are simply not quantified. Instead it is noted that these are "…not expected to present a substantial source of fugitive dust (PM_{10}) emissions…" What is the basis for this conclusionary assertion, with no supporting data or calculations?

In addition, the DEIR presumes that the main source of PM_{10} emissions would be from vehicular traffic associated with the project.[16] While this is true, PM_{10} also results from soil disturbance associated with land grading, including stockpiling of soils and also from the storage of other erodible construction materials.

Further, the DEIR does not address fugitive $PM_{2.5}$, for which the area is non-attainment at present and likely to be even more so when the NAAQS for $PM_{2.5}$ is revised downward per EPA's current proposed, as noted prior.

(v) As for mobile source exhaust emissions during operations, like in the case of construction, the DEIR/Appendix B.1 makes numerous unsupported assumptions, with the exception of a reference to a traffic study estimating 20 ADTs from workers. However, other assumptions such as: the 40-mile trip distance; the assumption for 10 additional workers; the complete lack of any vendor-related trips or emissions are not justified or

[16] DEIR, p. 4.3-65.

supported at all. The DEIR should provide that support or revise as needed. The DEIR should provide the justification for why no vendor support would be needed as operational support for the various injection and monitoring wells.

(vi) In addition to the fugitive and mobile source emissions during operations, the only stationary source emissions included in the analysis are from fugitives from component leaks from the two new amine units that will be installed are estimated (in Table 4-11 of Appendix B.1) using the previously mentioned Implelentation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities. However, the applicability of these estimates for "petroleum facilities" to the amine units is not clear. Please provide the justification. Also, please clarify what fractions of the components of each type are expected to be "leakers" at different levels of assumed leakage, i.e., 50 ppm, 100 ppm, 250 ppm, 500 ppm, 1000 ppm, 10,000 ppm, etc. And, how these leakers have been included (or not) in the current calculations.

(vii) Previously, I have excerpted Table 4-12 showing the depths of the 18 new wells that will be drilled, for the various purposes shown in that table. In connection with the drilling schedule, I have also provided a comment about the precisions of the well depths noted in Table 4-12. In addition, I have additional comments/questions:

- First, I note that the DEIR provided no justification provided for the well depths for just/only the two above-zone monitoring wells (i.e., one for each reservoir) noted in that table.
- Second, the DEIR provides no justification (geologic or otherwise) for the depths of these two monitoring wells, that are approximately 2000 feet or higher than the reservoirs themselves.
- Third, the DEIR does not state how such a single monitoring well will be placed exactly where some leakage might manifest itself, given the vast area/acreages in each reservoir.
- Finally, the DEIR does not discuss or address potential leakages that may occur from the formation in directions other than vertically, such as initially laterally or even downward from the formations, later finding their way to the surface. The DEIR does not address how these potential leakage paths will be monitored.

In sum, it appears that, at least as far as the monitoring of the injection/sequestration at each reservoir is concerned, there are too few wells. Of course including additional wells, at justified and proper depths, will increase construction (and operational) emissions that have not been properly included in the DEIR.

Comment 4 – Mitigation Measures

As an overall comment, none of the mitigation measures for air quality and GHG have verification or monitoring requirements that would provide even reasonable confidence that: (i) the proposed measures are, in fact, being implemented as promised in the DEIR; and (ii) that even if they are being implemented, their effectiveness is similar to that claimed. This includes, for example, monitoring to quantify GHG leakages via the various pathways and sources previously discussed as well as monitoring to address emissions of criteria and air toxic air pollutants from the facilities that are part of the proposed project.

Comment 4.1 – Emission Reduction Agreements and Their Limitations As Proposed Mitigation

The DEIR states repeatedly that, as mitigation, the proposed project will avail itself of a Development Mitigation Contract (DMC) or Voluntary Emission Reduction Agreement (VERA) to address the project's criteria pollutant emissions of NO_x, reactive organic compounds (ROGs) and particulate matter (PM). The goal is to "fully mitigate the project's air quality impacts such that development of the project could be considered to result in no net increase in the designated criteria pollutant emissions over the criteria pollutant emissions that would otherwise exist without the development of the project, all to be verified by the SJVAPCD." In addition, Section 4.10 of Appendix B.1 also makes a similar claim, justifying the lack of any air quality impact (or modeling).

First, this entire construct does not work if the emissions from the project are not properly estimated and/or verifiably and accurately measured. Without such accurate measurements, the amount of mitigation, to achieve "no net increase" using the DMC or similar mechanism is meaningless. Yet, there is nothing in the DEIR that provides any assurance of actual measurements of even these criteria pollutants from each of the project's activities.

Second, as noted in the DEIR, the DMC does not extend to other pollutants, including additional criteria pollutants such as carbon monoxide (CO) or sulfur dioxide (SO_2).

The DMC also does not extend to any of the air toxic compounds that will be emitted as a result of combustion sources and the amine system used for CO_2 concentration. This is true for such air toxics emissions during construction and operations.

Since none of the mitigations identified contain any verifiable measures of their effectiveness and the emissions estimates are simply not verifiable since no monitoring is required, there is a significant uncertainty as to the actual emissions and their impacts (mitigated or otherwise) of air toxic compounds.

Comment 4.2 – Lack of Verification and Effectiveness of PM_{10} Reduction Measures

These are listed in Mitigation Measure 4.3-2. I will not repeat all/both of them for the sake of brevity. But every single item on these lists is simply a promise, with no recordkeeping or

verification. At a minimum, such record-keeping and verification should be included in as part of an enforceable mitigation monitoring plan for PM_{10} (and $PM_{2.5}$) reduction.

Comment 4.3 – The 4,000-foot Setback in MM 4.3-5 Should Be Expanded, as Needed

A reasonable setback distance from any injection well to sensitive receptors is necessary. The DEIR proposes that the setback be 4,000 feet but provides no explanation for this distance.

However, while MM 4.3-5 addresses the setback from injection wells, it is not clear why similar setback distances are not also proposed for other physical infrastructure like pipelines, from which ruptures can cause CO_2 to also escape and could result in adverse impacts to humans and wildlife. For example, if any pipeline passes through a topographically low area, any CO_2 that might escape can accumulate locally and cause adverse impacts. For these reasons, setbacks should be provided from all physical infrastructure associated with the proposed project, based on a site-specific factors such as the locations of such infrastructure and nearby receptors in order to meet CEQA's requirement to provide all feasible mitigation for significant impacts.

Comment 4.4 – MM 4.3-7 and Additional Details of Fence Line Monitoring

While I agree with the goal of MM 4.3-7 that an Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project – including but not limited to criteria pollutants, CO_2, and H_2S – should be developed and implemented, MM 4.3-7 provides no details of how such fence line monitoring will occur. Even basic details of whether this will consist of periodic sampling at specific locations along the fence line (of, say, a well pad; or near the amine units, etc.) or continuous open-path measurements along the entire perimeter of such locations, is not provided in the DEIR. Without this, and additional detail, the efficacy of MM 4.3-7 is not clear. The DEIR should provide additional details, like, for example: (i) specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters; (ii) requirements for reporting monitoring results to the County and responsible agencies and for public disclosure of monitoring data and/or performance standards to be used to develop reporting and public disclosure requirements; (iii) any threshold levels (by pollutant) that, if detected at the fence line, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation; and (iv) mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

Attachment A
to Technical Comments of Dr. Ranajit (Ron) Sahu:
Qualifications and Experience

RANAJIT (RON) SAHU, PH.D, CEM (NEVADA)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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EXPERIENCE SUMMARY

Dr. Sahu has over thirty two years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over thirty years of project management experience and has successfully managed and executed hundreds of projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past three decades include various trade associations as well as individual companies such as steel mills, petroleum refineries, chemical plants, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, land development companies, and various entities in the public sector including EPA, the US Dept. of Justice, several states (including New York, New Jersey, Connecticut, Kansas, Oregon, New Mexico, Pennsylvania, and others), various agencies such as the California DTSC, and various cities and municipalities. Dr. Sahu has executed projects in all 50 US states, numerous local jurisdictions and internationally.

In addition to consulting, for approximately two decades, Dr. Sahu taught numerous courses in several Southern California universities as adjunct faculty, including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management). He also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental and engineering areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.), public sector (such as the US Department of Justice), and public interest group clients with project management, environmental

consulting, project management, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena, CA.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

“Thermodynamics and Heat Transfer,” Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-mid-1990s.

Air and Waste Management Association, West Coast Section, 1989-mid-2000s.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, 2000 - 2021.

CEM, State of Nevada (#EM-1699).

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

“From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada,” with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.,* C2-99-1181 (Southern District of Ohio).

4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).

6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).

7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc*., 5:04-cv-00034-KSF (Eastern District of Kentucky).

9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc*., 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions*, No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant*

Generation Company LLC, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority*, Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.*, Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.*, Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et. al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).

53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association*, Case No. 11-417-MJP (Western District of Washington).

54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency*, Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.*, Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Resppondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*

85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et. al., (Petitioners) v. EPA et. al., Utility Air Regulatory Group (Petitioners) v. EPA et. al., National Mining Association et. al., (Petitioner) v. EPA et. al.,* (Supreme Court of the United States).

87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.

89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;" Declaration (October 2015) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners' Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.

93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.

95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.*, ERAC Case No. 14-256814.

96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.

97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.

100. Declaration (December 2016) relating to EPA's refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180.* (D.C. Circuit Court of Appeals).

101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).

107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant), Case No. 4:16-CV-1544-BYP*, (US District Court for the Northern District of Ohio, Eastern Division).

108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant),* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.

111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.

113. Expert Report (Harm Phase) (January 2018), Rebuttal Expert Report (Harm Phase) (May 2018) and Supplemental Expert Report (Harm Phase) (April 2019) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).

115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

117. Direct Pre-filed Testimony and Affidavit (December 2018) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

118. Expert Report (February 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

119. Declaration (March 2019) on behalf of Earthjustice in the matter of comments on the renewal of the Title V Federal Operating Permit for Valero Houston refinery.

120. Expert Report (March 2019) on behalf of Plaintiffs for Class Certification in the matter of *Resendez et al v Precision Castparts Corporation* in the Circuit Court for the State of Oregon, County of Multnomah, Case No. 16cv16164.

121. Expert Report (June 2019), Affidavit (July 2019) and Rebuttal Expert Report (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

122. Affidavit/Expert Report (August 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

123. Expert Report (October 2019) relating to the appeal of air permit (Plan Approval) on behalf of Appellants in the matter of *Clean Air Council and Environmental Integrity Project (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection and Sunoco Partners Marketing and Terminals L.P.*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-057-L.

124. Expert Report (December 2019), Affidavit (March 2020), Supplemental Expert Report (July 2020), and Declaration (February 2021) on behalf of Earthjustice in the matter of *Objection to the*

Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

125. Affidavit (December 2019) on behalf of Plaintiff-Intervenor (Surfrider Foundation) in the matter of *United States and the State of Indiana (Plaintiffs), Surfrider Foundation (Plaintiff-Intervenor), and City of Chicago (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant),* Civil Action No. 2:18-cv-00127 (US District Court for the Northern District of Indiana, Hammond Division).

126. Declarations (January 2020, February 2020, May 2020, July 2020, and August 2020) and Pre-filed Testimony (April 2021) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

127. Expert Report (April 2020) on behalf of the plaintiff in the matter of Orion Engineered Carbons, GmbH (Plaintiff) vs. Evonik Operations, GmbH (formerly Evonik Degussa GmbH) (Respondent), before the German Arbitration Institute, Case No. DIS-SV-2019-00216.

128. Expert Independent Evaluation Report (June 2020) for *PacifiCorp's Decommissioning Costs Study Reports dated January 15, 2020 and March 13, 2020 relating to the closures of the Hunter, Huntington, Dave Johnston, Jim Bridger, Naughton, Wyodak, Hayden, and Colstrip (Units 3&4) plants*, prepared for the Oregon Public Utility Commission (Oregon PUC).

129. Direct Pre-filed Testimony (July 2020) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

130. Expert Report (August 2020) and Rebuttal Expert Report (September 2020) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

131. Expert Report (July 2020) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

132. Expert Report (August 2020) and Supplemental Expert Report (February 2021) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

133. Expert Report (August 2020) and Supplemental Expert Report (December 2020) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

134. Pre-filed Direct Testimony (October 2020) and Sur-rebuttal Testimony (November 2020) on behalf of petitioners (Ten Persons Group, including citizens, the Town of Braintree, the Town of Hingham, and the City of Quincy) in the matter of Algonquin Gas Transmission LLC, Weymouth MA, No. X266786 Air Quality Plan Approval, before the Commonwealth of Massachusetts, Department of Environmental Protection, the Office of Appeals and Dispute Resolution, OADR Docket Nos. 2019-008, 2019-009, 2019010, 2019-011, 2019-012 and 2019-013.

135. Expert Report (November 2020) on behalf of Protect PT in the matter of *Protect PT v. Commonwealth of Pennsylvania Department of Environmental Protection and Apex Energy (PA) LLC*, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2018-080-R (consolidated with 2019-101-R)(the "Drakulic Appeal").

136. Expert Report (December 2020) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

137. Pre-filed Testimony (January 2021) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

138. Expert Reports (March 2021 and May 2021) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, Central Planning Board, City of Newark, New Jersey.

139. Expert Report (April 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana, New Orleans Division).

140. Affidavit (April 2021) for *Clayton Faerber et.al., (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 20-CV-00328 01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

141. Expert Report (April 2021, June 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

142. Expert Report (April 2021) and Sur-Rebuttal Report (June 2021) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

143. Expert Report (May 2021) for *Clifford Osmer (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)* related to No. 18-CV-12557 (US District Court for the Eastern District of Louisiana).

144. Expert Report (May 2021) and Rebuttal Expert Report (January 2022) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

145. Expert Report (June 2021) and Declarations (May 2021 and June 2021) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division.)

146. Expert Witness Disclosure (June 2021) on behalf of the Plaintiffs in the matter of *Jay Burdick, et. al., (Plaintiffs) v. Tanoga Inc. (d/b/a Taconic) (Defendant)*, Index No. 253835, (State of New York Supreme Court, County of Rensselaer).

147. Expert Report (June 2021) on behalf of Appellants in the matter of *PennEnvironment and Earthworks (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection (Appellee) and MarkWest Liberty Midstream and resource, LLC (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2020-002-R.

148. Expert Report (June 2021) for *Antonia Saavedra-Vargas (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:18-CV-11461 (US District Court for the Eastern District of Louisiana, New Orleans Division).

149. Affidavit (June 2021) for Lourdes Rubi in the matter of *Lourdes Rubi (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)*, related to 12-968 BELO in MDL No. 2179 (US District Court for the Eastern District of Louisiana, New Orleans Division).

150. Expert Report (June 2021) for *Wallace Smith (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:19-CV-12880 (US District Court for the Eastern District of Louisiana, New Orleans Division).

151. Declaration (July 2021) on behalf of Plaintiffs in the matter of *Stephanie Mackey and Nick Migliore, on behalf* of *themselves and all others similarly situated (Plaintiffs) v. Chemtool Inc. and Lubrizol Corporation (Defendants)*, Case No. 2021-L-0000165, State of Illinois, Circuit Court of the 17th Judicial Circuit, Winnebago County.

152. Declaration (July 2021, August 2021) on behalf of Petitioners in the matter of the Petition for a Hearing on the Merits Regarding Air Quality Permit No. 3340-RMD issued to New Mexico Terminal Services, LLC by *Mountain View Neighborhood Association et. al., (Petitioners) v. City of Albuquerque Environmental Health Department*, AQCB Petition No. 2020-1 before the Albuquerque-Bernalillo County Air Quality Control Board.

153. Expert Disclosure (September 2021) and Affidavit (May 2023) on behalf of the Plaintiffs in the matter of *State of New York, Town of Hempstead, Town of Brookhaven, Incorporated Village of Garden City and Long Island Power Authority et. al., (Plaintiffs) v. Covanta Hempstead Company et. al., (Defendants)*, Index No. 7549/2013 before the Supreme Court of the State of New York, County of Nassau.

154. Expert Report (October 2021) for *John A. Battiste (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:21-CV-00118 (US District Court for the Southern District of Alabama, Mobile Division)

155. Declaration/Expert Report (October 2021) for *Charles K. Grasley et. al., (Plaintiffs) v. Chemtool Incorporated (Defendant)*, Case No. 2021-L-0000162 (State of Illinois, In the Circuit Court of the 17th Judicial Circuit, Winnebago County).

156. Declaration (October 2021) and Expert Report (November 2021) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

157. Expert Report (November 2021) and Declaration (September 2022) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

158. Declaration (November 2021) for the *United States of America and the State of Kansas, Department of Health and Environment (Plaintiffs) v. Coffeyville Resources Refining & Marketing, LLC (Defendant)*, Civ. No. 6:04-cv-01064-JAR-KGG (US District Court for the District of Kansas).

159. Expert Report/Affidavit (December 2021) on behalf of the City of Detroit in the matter of Marathon Petroleum Company (Claimant) v. City of Detroit Building Safety Engineering and Environmental Department, BSEED Case No. MCR 2018-2525, DAH Appeal No. 21-SWA-01, before the State of Michigan, City of Detroit Department of Appeals and Hearings.

160. Expert Report (December 2021) for *John Pabst (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 21-CV-00290 (US District Court for the Eastern District of Louisiana).

161. Expert Report (December 2021) for *Audrey Annette Tillery-Perdue individually and as person representative of the estate of Eddie Lewis Perdue (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendant)*, Civil Action No. 5:19-cv-00052-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

162. Expert Report (February 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

163. Expert Report (February 2022) and Rebuttal Expert Report (June 2022, in preparation) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

164. Expert Report (February 2022) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

165. Expert Report (March 2022), Affidavit (June 2022), Supplemental Expert Report (April 2023) in the matter of *Clean Air Council et. al., (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection (Appellee) and Renovo Energy Center (Permittee)* EHB Docket No. 2021-055-R before the Commonwealth of Pennsylvania Environmental Hearing Board.

166. Declaration (March 2022) in the matter of Max Midstream Texas LLC Air Quality Permit No. 162941 for the Seahawk Crude Condensate Terminal in Calhoun County Texas, TCEQ Docket No. 2022-0157-AIR, before the Texas Commission on Environmental Quality.

167. Expert Pre-filed Testimony (April 2022) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

168. Expert Report (April 2022) and Rebuttal Report (August 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

169. Rule 26 Disclosure (May 2022) in the matter of the *Water Works and Sewer Board of the City of Gadsden (*Plaintiff*) v. 3M Company, et. al., (Defendants),* Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

170. Expert Report (June 2022) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-011939 (Circuit Court of Cook County, Illinois.)

171. Expert Report (June 2022), Rebuttal Reports (August 2022, September 2022) for Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

172. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the 2019 South Africa Integrated Resource Plan in *African Climate Alliance et. al. v. The Minister of Mineral Resources and Energy et. al.,* in the High Court of South Africa, Gauteng Division, Pretoria.

173. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the Limpopo Mine (Lephalale Coal Mines Ltd.) in *Earthlife Africa v. The Minister of Forestry, Fisheries and Environment et. al.,* in the High Court of South Africa, Gauteng Division, Pretoria, Case No. 9149/2022.

174. Pre-filed Testimony (July 2022) and Rebuttal Testimony (September 2020) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

175. Expert Report (September 2022) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain Watershed Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor*, Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

176. Expert Affidavit (October 2022) for *Concerned Citizens of Cook County GA (Petitioner) v. Georgia Department of Natural Resources (Respondent) and Spectrum Energy Georgia, LLC (Respondent Intervenor)* before the Office of State Administrative Hearings, State of Georgia, Docket No: 2303405-OSAH-BNR-AQ-37-Barnes.

177. Expert Rebuttal Report (January 2023), Supplemental Rebuttal Expert Report (March 2023, May 2023, November 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

178. Expert Report (January 2023) and Rebuttal Expert Report (April 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant)*, Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

179. Affidavit (January 2023) for *Richard Dufour (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-cv-00591-HSO-BWR (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

180. Expert Report (January 2023) and Supplemental Expert Report (July 2023) on behalf of Plaintiffs in the matter of *Stephanie* Mackey *et. al., (Plaintiffs) v. Chemtool Inc. et. al., (Defendants) and Holian Insulation Company Inc. (Third-party Defendant)*, Case No.: 3:21-cv-50283, U.S. District Court, Northern District of Ilinois, Western Division.

181. Expert Report (February 2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

182. Expert Report (February 2023) for *Carol Davis (Plaintiff) v. Lockheed Martin Corporation (*Defendant*)*, Case No. 6:22-cv-81-RBD-EJK, U.S. District Court, Middle District of Florida, Orlando Division.

183. Expert Report (February 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

184. Affidavit (March 2023) on behalf of plaintiffs in the matter of the *State of New Mexico, ex rel. Raul Torrez, Attorney General (Plaintiffs) v. Sterigenics US LLC, Sotera Health Holdings, LLC, Sotera Health LLC and Sotera Health Company (Defendants)*, Case No.: D-307-CV-2020-02629, State of New Mexico, Third Judicial District Court, County of Dona Ana

185. Pre-filed Direct Testimony (March 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

186. Declaration (April 2023) in the matter of Sierra Club (Plaintiff) v. Tennessee Valley Authority in the matter of the Johnsonville Aeroderivative Combustion Turbines Project, Case No.: 3:22-cv-1054, U.S>, District Court, Middle District of Tennessee, Nashville Division.

187. Expert Report (May 2023/June 2023), Affidavit (April 2023) and Declaration (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

188. Affidavit (May 2023) for *Lawrence Tucei (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00078-HSO-BWR (US District Court for the Southern District of Mississippi).

189. Expert Report (May 2023/June 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

190. Expert Report (June 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

191. Declaration (June 2023) in support of public commenters relating to the Michigan Department of Environment Great Lakes and Energy (EGLE)'s Annual Network Monitoring Plan 2024.

192. Expert Report (July 2023) and Rebuttal Expert Report (September 2023) relating to Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

193. Pre-filed Direct Testimony (July 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

194. Declaration (August 2023) in support of comments by Environmental Defense Fund in connection with the "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards, published at 88 Fed. Reg. 36,654 (June 5, 2023) ("Final Rule"), Docket ID No. EPA-HQ-OAR-2021-0668.

195. Expert Report (August 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

196. Pre-filed Testimony (September 2023) and Cross Answering Testimony (October 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

197. Expert Report (December 2023) on behalf of plaintiffs in the matter of *PennEnvironment and Sierra Club (Plaintiffs) v. PPG Industries, Inc. (Defendant).* Case No.: Civil Action Nos. 2:12-cv-00342, 2:12-cv-00527, 2:13-cv-01395, 1:13-cv-01396, 2:14cv-00229 (consolidated). U.S. District Court Western District of Pennsylvania.

C. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

198. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

199. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

200. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

201. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

202. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

203. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

204. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

205. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

206. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

207. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

208. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

209. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al*.

210. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

211. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

212. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

213. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

214. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

215. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

216. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

217. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

218. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

219. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

220. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

221. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

222. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

223. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

224. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

225. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

226. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

227. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

228. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

229. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

230. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

231. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

232. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

233. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

234. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation*

Company LLC, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

235. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

236. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

237. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

238. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

239. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

240. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

241. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

242. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

243. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

244. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

245. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).

246. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

247. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

248. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

249. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

250. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

251. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

252. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

253. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

254. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

255. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

256. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.

257. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

258. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

259. Deposition (June 2018) (harm Phase) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

260. Trial Testimony (July 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

261. Deposition (January 2019) and Trial Testimony (January 2019) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

262. Deposition (February 2019) and Trial Testimony (March 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric

Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

263. Deposition (June 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

264. Deposition (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

265. Deposition (December 2019) on behalf of the Plaintiffs in the matter of David Kovac, individually and on behalf of wrongful death class of Irene Kovac v. BP Corporation North America Inc., Circuit Court of Jackson County, Missouri (Independence), Case No. 1816-CV12417.

266. Deposition (February 2020, virtual) and testimony at Hearing (August 2020, virtual) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

267. Hearing (July 14-15, 2020, virtual) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

268. Hearing (September 2020, virtual) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware* Operating – *NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

269. Deposition (December 2020, March 4-5, 2021, all virtual) and Hearing (April 2021, virtual) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE)*, before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

270. Hearing (September 2020, virtual) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

271. Deposition (December 2020, virtual and Hearing February 2021, virtual) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

272. Deposition (January 2021, virtual) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

273. Deposition (February 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (*Defendants*)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

274. Deposition (April 2021, virtual) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

275. Deposition (June 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division).

276. Deposition (June 2021, virtual) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

277. Testimony (June 2021, virtual) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, (Central Planning Board, City of Newark, New Jersey).

278. Testimony at Hearing (October 2021) on behalf of Evraz Rocky Mountain Steel in the matter of Colorado's Proposed Revisions to Regulation 22, the Greenhouse Gas Emissions and Energy Management for the Manufacturing Sector in Colorado (GEMM Rule), before the Colorado Air Quality Control Commission.

279. Deposition (November 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana).

280. Testimony at Hearing (November 2021) on behalf of *National Parks Conservation Association, et. al*., in the matter of the Proposed Revisions to Colorado's Regional Haze State Implementation Plan (SIP) and Colorado Regulation 23, before the Colorado Air Quality Control Commission.

281. Deposition (December 2021) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

282. Deposition (December 2021) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

283. Testimony at Hearing (February 2022, virtual) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant)*, No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

284. Deposition (March 2022) and Rebuttal Deposition (July 2022) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois.)

285. Deposition (April 2022, virtual) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

286. Deposition (May 2022, virtual) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (*Defendants*)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

287. Deposition (June 2022 and September 2022, both virtual) for *Teresa* Fornek *(Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

288. Deposition (June 2022, virtual) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

289. Deposition (July 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

290. Trial (August 2022) on behalf of the Plaintiffs in the matter of Modern *Holdings, LLC, et al. (Plaintiffs) v. Phillips (Defendants),* Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

291. Trial (August 2022, in person) for *Susan Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

292. Deposition (September 2022, virtual) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

293. Deposition (September 2022) on behalf of Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

294. Deposition (September 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

295. Hearing (October 2022) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

296. Trial (October 2022, in person) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

297. Depositions (March 2023, June 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

298. Depositions (March 2023, April 2023, May 2023) for Quinn Buczek (Plaintiff) v. Sterigenics US, LLC, Sotera Health, LLC, Prologis First US Properties, LP, et. al., (Defendants) before State Court of Gwinnett County, State of Georgia, Case No. Civil Action File No. 20-C-05918-S1.

299. Deposition (May 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant),* Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

300. Deposition (May 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

301. Testimony at Hearing on behalf of Evraz North America In the Matter of Colorado Air Quality Regulation Proposed Revisions to Regulation Number 3 to establish enhanced Modeling, monitoring and permitting requirements for Stationary sources in disproportionately impacted communities 5 CCR 1001-5, before the Air Quality Control Commission, State of Colorado.

302. Deposition (2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

303. Testimony at Hearing (July 2023) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain* Watershed *Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor, *Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

304. Deposition (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

305. Deposition (August 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

306. Deposition (August 2023) on behalf of petitioners in *Doreen Carey et; al., (Petitioners) v. Fulcrum Centerpoint LLC. (Permittee/Respondent) and Indiana Department of Environmental Management (Respondent)*, Permit Number 089-44042-00660, before the Indiana Office of Environmental Adjudication.

307. Deposition (August 2023) on behalf of the Plaintiff in the *Water Works and Sewer Board of the Town of Centre, Alabama v. 3M Company, et. al.*, Civil Action No.: CV-2017-900049. Circuit Court of Cherokee County, State of Georgia.

308. Deposition (August 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

309. Deposition (September 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

310. Testimony at Hearing for Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

311. Testimony at Hearing (October 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

312. Testimony at Hearing (August 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

313. Testimony at Hearing (September 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

314. Testimony at Hearing (November 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

ATTACHMENT B

Evaluation of Recirculated Draft Environmental Impact Report on Geological Storage of Carbon Dioxide at the Carbon TerraVault I Facility in Kern County, California

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Center for Applied Environmental Science

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About the Author: Dr. DiGiulio is a retired geoscientist from the U.S. Environmental Protection Agency's Office of Research and Development. He has conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. He assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide (Tier II Committee). He has served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. His consulting services to non-government organizations have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

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Background

In December 2023, Volume I and Volume II of a Draft Environmental Impact Report (DEIR, 2023a, 2023b) was prepared by Kern County as the Lead Agency under the California Environmental Quality Act (CEQA). County staff has determined, following a review of the written comments and release of the EPA Class VI Permit for Reservoir 26R, that changes should be made in the previously circulated DEIR (DEIR, 2023a). In June 2024, Volume I and Volume II of a Draft Environmental Impact Report (RDEIR, 2024a, 2024b) was recirculated for comment.

This evaluation incorporates by reference and builds on the report I prepared on the December 2023 DEIR. The DEIR report is included as an attachment to comments submitted by Earthjustice on behalf of the Center for Biological Diversity et al. on March 1, 2024.

Carbon TerraVault 1 LLC (CTV), a wholly owned subsidiary of the California Resources Corporation, proposes to inject supercritical carbon dioxide (CO_2) at two locations (26R and A1-A2 reservoirs) in the Monterey Formation at the Elk Hills Oil Field in Kern County, California (RDEIR, 2024a). The source of CO_2 for injection is pre-combustion Elk Hills Oil Field gas, from which CO_2 is captured and processed at the existing cryogenic and fractionation natural gas plant facility and the Elk Hills Power Plant within the Elk Hills Oil Field (RDEIR, 2024a). Currently, the Elk Hills Power Plant provides electricity for both oilfield operations and the California wide power system (RDEIR, 2024a). The project would consist of six injection wells - four (one converted Class II well, three new) within the 26R reservoir and two converted Class II wells within the A1 - A2 reservoir.

At the 26R reservoir, the Monterey Formation is approximately 6,000 feet deep with oil and gas production from turbidite sands (RDEIR, 2024a). Turbidite deposited sands are interbedded with siliceous shale. Sand porosity and permeability averages 25% and 45 millidarcy (mD), respectively (RDEIR, 2024b). At the A1 - A2 reservoir, the Monterey Formation is approximately 8,500 feet deep with oil and gas production also from turbidite sands. Turbidite deposited sands are interbedded with and bound above and below by siliceous shale. Sand porosity and permeability averages 16% and 60 mD, respectively (RDEIR, 2024b).

The 26R reservoir was discovered in the 1940s while the A1 - A2 reservoir was discovered in the 1970s (RDEIR, 2024b). In addition to primary extraction, oil and gas wells have been used for enhanced recovery using water and gas injection over the past 40 years (RDEIR, 2024b).

The Reef Ridge Shale is present over the southern San Joaquin Basin and serves as the primary confining layer for both the 26R and A1 - A2 reservoirs (RDEIR, 2024a). The Reef Ridge Shale is dominated by gray to grayish-black silty or sandy shale with rare silty and clay beds. The Reef Ridge Shale is continuous and ranges from 750 to 1,600 feet thick and has a permeability of less than 0.01 mD and 7% porosity (RDEIR, 2024b).

At full operation, the project is designed to inject up to 1.46 million tons of CO_2 per year into the 26R reservoir (up to 26 years) and up to 0.75 million tons per year in the A1-A2 reservoir, for a total capacity of 2.21 million tons per year (RDEIR, 2024a). Additionally, 10 existing wells will be converted to monitoring wells, and six existing wells would be converted into seismic monitoring wells (RDEIR, 2024a).

Setbacks and Encroachment

Leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2 (Jordan and Benson, 2009, Zhang and Bachu, 2011). There is interest in using depleted oil and gas reservoirs for geological storage of CO_2 due to extensive preexisting geological characterization and infrastructure but the presence of a large number of well penetrations increases the possibility of leakage (Celia et al., 2005).

From a health and safety perspective, if large-scale leakage were to occur at the surface, asphyxiation and suffocation are of concern. Continued exposure to CO_2 concentrations above 20–30% is associated with suffocation to humans and most air-breathing animals (Damen et al., 2006). Since CO_2 is denser than air, topography and prevailing meteorologic conditions would largely govern risk from a large-scale release with gas buildup being greater in valleys and low-lying areas.

As discussed in Volume II of the DEIR (RDEIR, 2024b), in 2008 in Mönchengladbach, Germany, over 100 residents suffered from respiratory problems due to a CO_2 release, of which 19 were hospitalized. The incident involved the release of about 15 metric tons of fire suppression CO_2 inside a factory, which leaked out of the building. At the time there was no wind, so the dense CO_2 cloud drifted down hill to the lowest lying region where there was a village about 1,500 feet away (RDEIR, 2024b).

Probably the best-known anthropogenic release of CO_2 occurred in February 2020 from a CO_2 pipeline rupture in proximity to Satartia, MS. The rupture followed heavy rains that resulted in a landslide, creating excessive axial strain on a pipeline weld (RDEIR, 2024b). Pipeline operators are required to establish atmospheric models to prepare for emergencies. Denbury's model did not contemplate a release that could affect the Village of Satartia (RDEIR, 2024b). Local emergency responders were not informed by Denbury of the rupture and the nature of the unique safety risks of the CO_2 pipeline. As a result, responders had to guess the nature of the risk, in part making assumptions based on reports of a "green gas" and "rotten egg smell" and had to contemplate appropriate mitigative actions (RDEIR, 2024b). Fortunately, responders decided to quickly isolate the affected area by shutting down local highways and evacuating people in proximity to the release (RDEIR, 2024b). Denbury reported that 200 residents surrounding the rupture location were evacuated, and forty-five people were taken to the hospital. No fatalities were reported (PHMSA, 2022).

Following this incident, a large release of CO_2 to the atmosphere occurred later in 2020 in Yazoo County, Mississippi due to a blowdown valve freezing open (RDEIR, 2024b). Work was being conducted to reconnect the pipeline that had ruptured near Satartia. An 8-inch valve froze in the open position due to internal dry-ice formation as CO_2 flashed across the valve (RDEIR, 2024b). A total of approximately 5,299 metric tons of CO_2 were released over about 24 hours until the pipeline segment pressure had reduced enough to allow the valve to thaw and be closed. A large CO_2 cloud formed, and the nearby highway closed. Air monitoring was conducted in the surrounding area (RDEIR, 2024b).

A clearly unacceptable release from a wellbore would be a CO_2 well blowout. A CO_2 well blowout is considered a low probability high consequence incident (Oldenburg and Budnitz, 2016) that could cause an immediate danger to public health in the vicinity of an abandoned well. The Sheep Mountain CO_2 blowout in March 1982 is a well-documented case in the literature (GEM Wiki, 2024). The leakage rate was estimated to be 13,000 metric tons CO_2 per day (GEM Wiki, 2024). 100% CO_2 flow was observed in the well with chunks of dry ice occasionally ejected hundreds of feet into the air. Other examples of CO_2

well blowouts include the Travale geothermal field, Italy in 1972 having a CO_2 release rate of 113 kg/s and the Torre Alfina geothermal field, Italy in 1973 (Lewicki et al., 2007) having a CO_2 leakage release rate of 76 kg/s (Lewicki et al., 2007; Aines et al., 2009).

Another example of CO_2 release via a wellbore is Crystal Geyser in Utah (the largest cold geyser in the world). The geyser was unintentionally created in the 1930s after a prospective oil well was drilled about 2,600-foot-deep into a fault zone above a natural CO_2 reservoir (RDEIR, 2024b). Shortly after drilling, the well was improperly abandoned allowing CO_2 to be released through the well (RDEIR, 2024b). Crystal Geyser eruptions last from 7 to 98 minutes with a release rate between 2.5 and 6 kg/s. Downwind CO_2 concentrations have been measured during eruptions, averaging about 4,000 parts per million (ppm) (0.4 percent) at 160 feet, and 800 ppm at 330 feet (RDEIR, 2024b).

In 2011, an improperly plugged and abandoned well failed at the Tinsley Field, Mississippi during CO_2 enhanced oil recovery (EOR) (RDEIR, 2024b). There were incomplete records of abandoned wells at the site (RDEIR, 2024b). A 2,000-foot-deep well failed when the reservoir pressure increased on injection of CO_2. The blowout took 37 days to bring under control, sickened one worker and suffocated deer and other animals (RDEIR, 2024b).

In 2013, an underground CO_2 blowout occurred at the CO_2-EOR Delhi field in Louisiana, when two or more plugged and abandoned wells failed underground (RDEIR, 2024b). Methane, CO_2, oil, water, brine and sands migrated to the surface in a sparsely populated, marshy area. The release lasted for more than six weeks and contaminated the air with CO_2 and methane (RDEIR, 2024b).

Comment: As evidenced in the Satartia, MS CO_2 pipeline release and other documented incidences of CO_2 release, including those from wellbores, release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions. In Volume I of the recirculated DEIR (RDEIR, 2024a), CTV states that the closest sensitive receptor to the project site is McKittrick Elementary School, which is 4.47 miles southwest of the facility pipeline and injection well 357-7R. The nearest residence is approximately 4.4 miles southeast of the injection line and 4.4 miles from injection well 345-36R. Buttonwillow Recreation and Park District is approximately 7 miles northeast of injection well 355-7R and 6.9 miles from the injection pipeline. Based on project-specific and site-specific considerations, the County should determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s).

Comment: Another issue of concern is future development encroaching near land used for CO_2 storage. The land area containing wellbores and vicinity of this land area (e.g., within 1 mile) could conceivably not be suitable for public use for hundreds of years if not longer. In generations to come, it is conceivable that buildings or homes could be constructed overlying plugged well penetrations which could leak highly pressurized CO_2 into indoor air. The recirculated DEIR does not address restrictions on future land use.

Mineralization of Injected CO_2

In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that computational modeling indicates that CO_2 injected into the Monterey Formation 26R reservoir will be soluble in both water and oil. Due to remaining saturation of oil and water in the depleted reservoir, total dissolved CO_2 in oil and water is estimated to be 20% and 8% of the CO_2 injected, respectively. Hence, 72% of injected CO_2 is

expected to remain in a supercritical state for an extended period of time (e.g., thousands of years). In the A1 - A2 reservoir, CTV states that because of low water saturation within the Monterey Formation, greater than 98% of the CO_2 injectate will remain in a supercritical phase (RDEIR, 2024b). The phase (supercritical fluid, dissolved in water or oil) and form (mineralization) of CO_2 is important because storage as a supercritical fluid is the least secure phase of storage while formation of carbonates during mineralization is by far the most secure form of storage.

Comment: In Volume I of the original DEIR (DEIR, 2023a), CTV stated that full mineralization of CO_2 is expected to occur in two to five years - a gross misstatement. If this were true, there would be little concern with geological storage of CO_2 at the CTV facility. Research is ongoing in formations having high divalent cation concentrations (iron, calcium, magnesium) (e.g., basalt) where mineralization is much more rapid. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV appears to have revised its position and now states that based on previous studies on reactive transport modeling and geochemical reactions during geological storage, the amount of CO_2 predicted to be trapped by mineralization reactions at the TerraVault 1 Project is small over a 100-year post injection time frame. For this reason, CO_2 mineralization was not included as a part of the compositional simulation modeling. The importance of this discussion is the realization that at the TerraVault I facility, CO_2 will be stored primarily as a highly pressurized supercritical fluid (the least secure form of CO_2) and must be retained for hundreds if not thousands of years with little or no hope of transition of CO_2 to more stable forms of storage (e.g., dissolution, mineralization).

Lateral Confinement to Storage Areas

The Elk Hills Oil Field is a large WNW-ESE trending anticlinal structure, approximately 17 miles long and over seven miles wide (RDEIR, 2024b). With increasing depth, the structure subdivides into three distinct anticlines, separated at depth by inactive high-angle reverse faults (RDEIR, 2024b). The project would be developed in two phases. In Phase 1, three new wells and one modified existing well used for enhanced oil recovery will be used to inject CO_2 into the Monterey Formation in the 26R reservoir portion of 31S anticline (RDEIR, 2024a). In Phase 2, two modified wells used for enhanced oil recovery would be used to inject CO_2 into the Monterey Formation in the A1 - A2 reservoir portion of the Northwest Stevens anticline (RDEIR, 2024a). CTV states that it plans to maintain the reservoir pressure at or beneath the discovery pressure of the reservoir to ensure that CO_2 does not migrate beyond the edges of the anticline structure (RDEIR, 2024a).

Comment: The isolation of injected CO_2 in anticlinal structures is of concern. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that the Monterey Formation in the 26R and A1 - A2 storage reservoirs have "*minimal*" connection outside the Area of Review. The DEIR is vague about what this means for the project and lacks support for this assumption. Do anticlinal structures provide full containment or not? The 26R Reservoir is located within the 26R sands of the 31S anticline while the A1-A2 reservoir is located in the western portion of the Northwest Stevens (NWS) anticline. As discussed by Zumberge et al. (2005), the Northwest Stevens anticline and the 29R anticline share some of the same turbidite sand bodies (24Z and 26R sand bodies) (Figure 1). Also, the Northwest Stevens anticline shares the 26R sand body with the 31A anticline (Figure 1). After filling of the Northwest Stevens anticline reservoirs, oil appears to have spilled into and filled the 24Z trap (Figure 1). This same oil family may also have reached the 2B trap on the east nose of the 29R anticline and the 26R reservoir at the west end of the 31S anticline (Figure 1), again moving within turbidite sand bodies from the Northwest Stevens

(NWS) structure. It appears then that there is hydraulic communication between the Monterey Formation inside and outside of the 26R and A1 - A2 reservoirs and injection must be carefully managed to avoid migration of injected CO_2 outside of these reservoirs (exceedance of spill point). From schematics provided by CTV, there are a large number of wellbores screened in the Monterey Formation outside of storage areas (Figure 2). At least some of these wellbores should be converted to monitoring wells to monitor for both pressure perturbation and CO_2 leakage during injection.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that the Area of Review will be reevaluated if unexpected changes in fluid constituents or pressure outside the Monterey Formation 26R reservoir that are not related to well integrity are detected. The recirculated DEIR also states the Area of Review will be reevaluated if unexpected changes in fluid constituents or pressure outside the A1 – A2 reservoir that are not related to well integrity are detected. These statements are meaningless since there is no planned monitoring outside the 26R and A1 – A2 reservoirs.

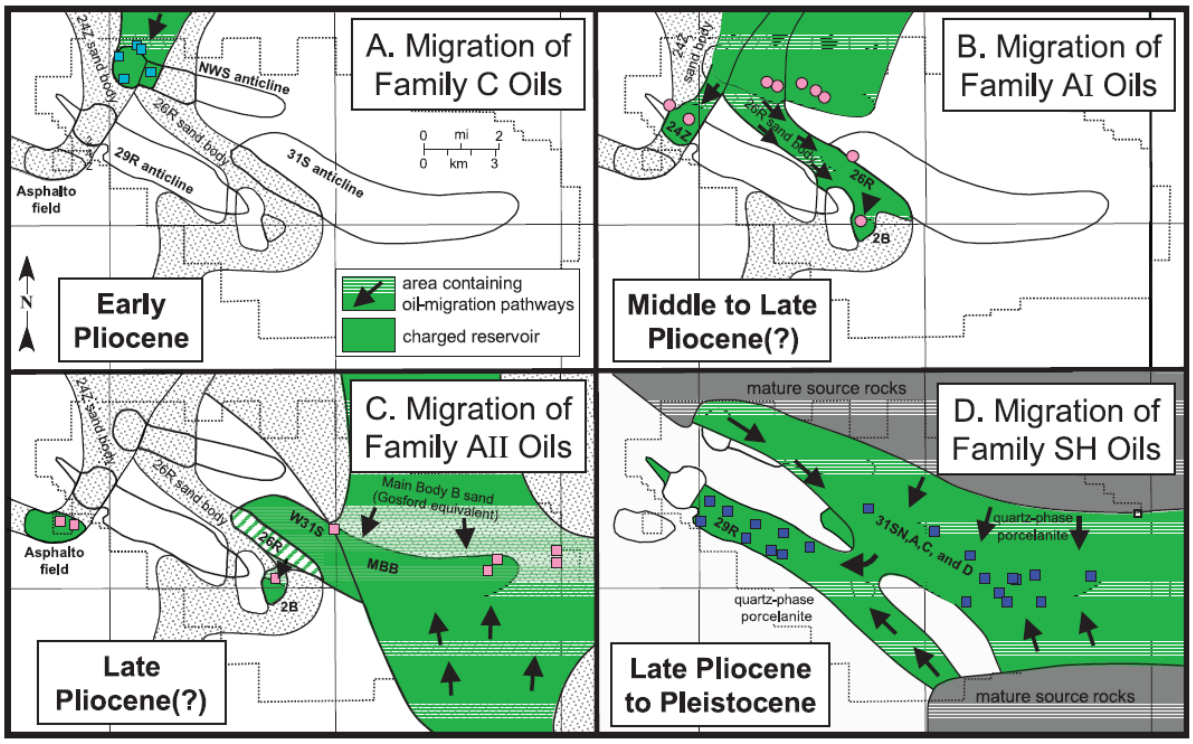

Figure 1. Migration of oil into major Stevens turbidite and porcelanite reservoirs at the Elk Hills Oil Field. (A) Family C oils are restricted to the western end of the Northwest Stevens anticline and are the least mature of the sampled oils. They may have migrated into the earliest formed traps in the Northwest Stevens anticline along turbidite sand bodies updip from the Buttonwillow subbasin. (B) Oils of family AI are likely derived from the Buttonwillow subbasin and filled reservoirs in the central and eastern Northwest Stevens anticline. Oil spilled from the Northwest Stevens traps and followed turbidite sand bodies updip into the 26R, 2B, and 24Z reservoirs. (C) Family AII oils probably are from both the Buttonwillow and Maricopa subbasins and migrated into the 31S reservoirs following the Main Body B submarine-fan complex. Oil possibly leaked into the 26R sand body and spilled into the 2B trap. The occurrence of family AII oil in the Asphalto field remains a dilemma. (D) Family SH oils occur in porcelanite reservoirs across the entire field and are sandwiched stratigraphically between families AI and

AII reservoirs. Migration likely occurred after filling of the turbidite reservoirs and after development of more favorable porosity because of transition of porcelanite from opal-CT to quartz phase. Figure from Zumberge et al. (2005).

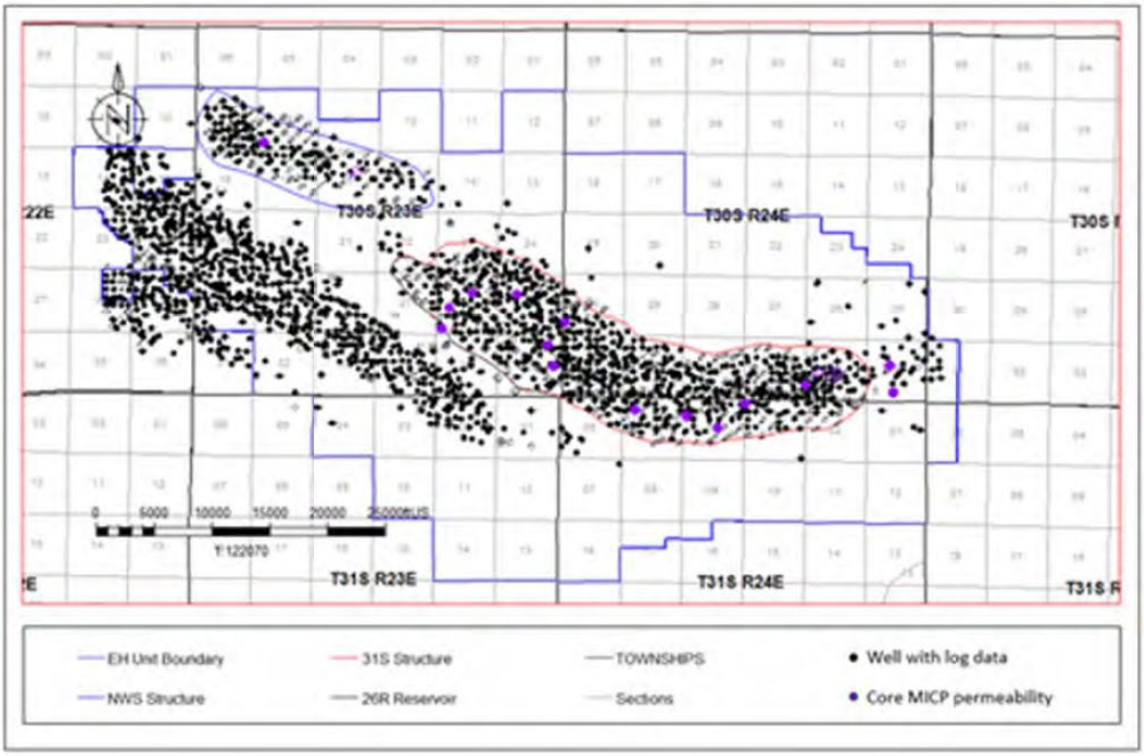

Figure 2. Wells drilled in the Elk Hills Oil Field (EHOF) that penetrate the confining Reef Ridge Shale. All wells shown have open-hole well logs. Wells with MICP core data from the Monterey Formation are shown in purple. Figure from Volume II of recirculated DEIR (RDEIR, 2024b). Note the poor resolution of the figure is due to poor resolution in the recirculated DEIR.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that confinement of the Reef Ridge Shale has been demonstrated in the 26R reservoir by the injection of 841 billion cubic feet of gas and 114 million barrels of water with no leakage. CTV states that confinement of the Reef Ridge Shale has been demonstrated in the A1 - A2 reservoir by the injection of 175 billion cubic feet of gas and five million barrels of water with no leakage. Referring to the work by Zumberge et al. (2005), CTV further states that geochemical analysis of reservoirs confirms compartmentalization through several million years and effectiveness of the Reef Ridge Shale to contain the CO_2 injectate (RDEIR, 2024b). However, as discussed in the previous comment, this geochemical analysis also confirmed migration of oil between anticlinal traps, which the DEIR does not discuss. More importantly, there is no evidence of how and if leakage was monitored. It does not appear that CRC used monitoring wells in the Monterey Formation outside the 26R and A1 - A2 reservoir areas to evaluate migration of injected fluids beyond anticlinal structures associated with these formations. It also does not appear that CRC monitored oil and gas wells for gas leakage during enhanced oil recovery operations. Hence, the veracity of these claims cannot be independently verified, and they are not supported by arguments provided. Again, CTV should

convert several existing oil and gas wells screened in the Monterey Formation outside storage reservoirs into additional monitoring wells.

Permanence Criteria

The primary purpose of geological storage of CO_2 is mitigation of climate change. Leakage of CO_2 from a storage formation through wellbores will occur to at least some extent (Celia and Bachu, 2003). Hence, the important question is not whether there will be leakage, but whether the extent of leakage is acceptable (Celia and Bachu, 2003) and how leakage will be monitored and quantitated.

A leakage rate of less than 1% to the atmosphere over 1,000 years is necessary for geological storage of CO_2 to achieve the same climate benefits as renewable energy sources (Shaffer, 2010). This metric for effective storage is more stringent than that of Hepple and Benson (2005) who considered leakage over a shorter time frame and concluded that leak rates of 0.01% per year to the atmosphere, equivalent to 99% retention of the stored CO_2 after 100 years, may be adequate to ensure the effectiveness of CO_2 storage.

In a Special Report on Carbon Dioxide Capture and Storage, the Intergovernmental Panel on Climate Change (IPCC, 2005) stated that for a well selected, designed, operated and appropriately monitored system, the balance of available evidence suggests that it is very likely the fraction of stored CO_2 retained is more than 99% over the first 100 years and it is likely the fraction of stored CO_2 retained is more than 99% over the first 1,000 years.

To assess the risk of leakage of CO_2 through wellbores, Callas et al. (2022) used a storage security calculator developed by Alcalde et al. (2018) to estimate the percent of CO_2 leaked for different densities of wells per square kilometer (km) in a well-regulated environment. Callas et al. (2022) determined that a well density greater than 8 wells/km^2 would result in more than 1% cumulative CO_2 leaked in 1,000 years in a well-regulated environment. They categorize the density of existing or abandoned wells as >8 wells/km^2, 6–7 wells/km^2, 4–5 wells/km^2, 2–3 wells/km^2, and <1 well/km^2 as worst to best for wellbore leakage concerns. Given the presence of 354 well penetrations (204 in 26R reservoir and 150 in A1 - A2 reservoir) through the confining layer and a total storage area of 9,104 acres (36.85 km^2) (RDEIR, 2024a), a well penetration density of 9.6 wells/km^2 represents a worst-case scenario for permanence for geologic storage of CO_2. The presence of a large number of well penetrations necessitates a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection and raises serious concerns about the permanence of storage in the 26R and A1- A2 reservoirs.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV stated that computational modeling results calibrated with monitoring data (e.g., pressure) will be used to support that the plume has stabilized and that the pressure change is negligible (less than 10 psi per year) and poses no risk for potential vertical migration after cessation of injection in the A1 - A2 reservoir.

A pressure loss of 10 psi per year is not negligible. A simple back of the envelope calculation indicates that a pressure loss of 10 psi per year starting at 4000 psi (final target pressure) results in complete pressure loss in 400 years (Figure 3) resulting in appreciable CO_2 loss. In reality, the rate of pressure loss will decrease somewhat as pressure decreases in the formation (i.e., reduction in driving force) as illustrated in loss in percent per year (Figure 3). This metric of leakage verification is not sufficiently protective and should be rejected. A target of 0.01% pressure loss per year is more reasonable if permanent storage of CO_2 is actually the goal of this project.

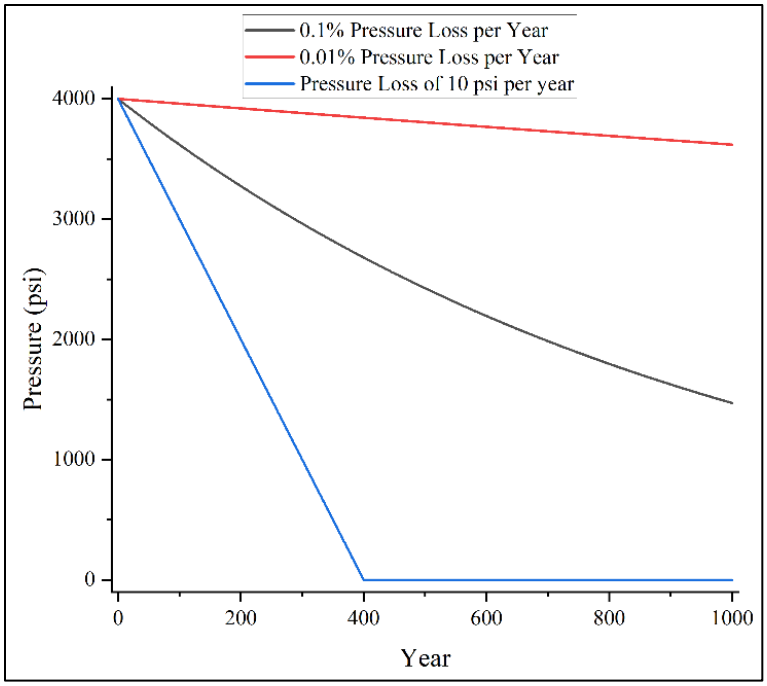

Figure 3. Simulation of 10% pressure loss per year, 0.1% pressure loss per year, and 0.01% pressure loss per year for 1000 years starting at 4000 psi.

Comment: A permanence standard should be established in the recirculated DEIR to determine the effectiveness and impact of the project. In the absence of a permanence standard, there is no metric to determine whether CO_2 is permanently retained. As part of an application for Sequestration Site Certification to receive tax credits, the California Air Resources Board (CARB) requires a greater than 90% probability of occurrence that 99% of CO_2 will be retained in the *"storage complex"* over 100 years post-injection to be eligible to receive Permanence Certification required for operation in California (CARB, 2018). CARB defines a *"storage complex"* as a *"three-dimensional subsurface volume that is characterized, modified by corrective actions, and monitored so that the CCS Project is able to meet the requirements for carbon sequestration under the Permanence requirements…For saline and depleted oil and gas reservoirs, the storage complex includes the injection zone (in which the CO_2 is emplaced), a sequestration volume, which is expected to contain the CO_2, and overlying and possibly underlying geologic formations that are required to provide assurance of storage. The storage complex must include a multilayered confining system that retards vertical migration of CO_2. The storage complex must extend laterally over (1) the volume from which CO_2 (as a free or dissolved phase) could escape from storage in the subsurface if a permeable pathway exists, and (2) the area over which the plume may migrate."* Hence, for the TerraVault I project, the storage complex would include the Etchegoin Formation. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV refers to the Etchegoin Formation as a *"dissipation interval."* or an allowable zone for migration from the storage formation. However, in the Class VI permit applications for the 26R Reservoir, EPA states that *"The objective of this permit is to prevent the movement of fluids into or between USDWs or into any unauthorized zones consistent with the requirements at 40 CFR 146.86(a)."* There is no allowance or tolerance for leakage outside the storage reservoirs and leakage into the Etchegoin Formation constitutes the movement of fluids into an unauthorized zone. Hence, in EPA regulations, there is no concept of a storage complex and a permanence

standard must be framed in terms of leakage from a storage formation. It is recommended for this project that a permanence criterion be specified as a 95% probability of occurrence that 99% of CO_2 will be retained in the 26R and A1 - A2 reservoirs over a period of 100 years. Based on the research of Shaffer (2010), a criterion for leakage to the atmosphere should be specified as a 95% probability of occurrence that 99% of CO_2 will be retained within all subsurface media over a period of 1,000 years.

Comment: Information presented in Volume II of the recirculated DEIR (RDEIR, 2024b) does not support a finding that the project will have greater than 95% probability that 99% of CO_2 will be retained in the storage reservoirs over a period of 100 years or even a 90% probability that 99% of CO_2 will be retained in a "*storage complex*" over a period of 100 years as required by CARB for tax credits. These retention findings are not credible because: (1) the large number of wellbores (354) penetrating the Reef Ridge Shale serving as primary pathways for leakage, (2) the high pressure (~4,000 psi) (the driving force for leakage) of storage, (3) storage occurring primarily as a separate phase of supercritical fluid resulting in direct contact of supercritical CO_2 with all 354 well penetrations, and (4) the high probability of elevated magnitude seismic activity in the vicinity of the project area capable of inducing levels of peak ground acceleration that would likely induce wellbore damage after plugging. These issues are discussed in more detail below.

Comment: In Volume I of the recirculated DEIR (RDEIR, 2024a), Impact statement 4.8-1 (Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment), the level of significance before mitigation is categorized as potentially significant (RDEIR, 2024a). In mitigation measure MM 4.8-1, CTV states that "*Prior to any injection of CO_2 the owner/operator shall submit a monitoring plan that complies with all requirements of the EPA UIC permit issued for the project to demonstrate the retention of CO_2 in the injection/hydrocarbon reservoir zone. The plan shall be submitted to the Kern County Planning and Natural Resources Department concurrent with submittal to the EPA for review. A copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department"* (RDEIR, 2024a). The monitoring plan submitted in Volume II of the recirculated DEIR does not directly (e.g., soil-gas monitoring) consider leakage from well penetrations – the most likely source of loss of retention of CO_2. Hence, MM 4.8-1 is deficient and should be rejected. It will be necessary to combine continuous areal monitoring of leakage with periodic monitoring of individual well penetrations to ensure retention of CO_2 and to quantify leakage.

Emergency and Remedial Response Plans

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) in the Emergency and Remedial Response Plan for the 26R and A1 - A2 reservoirs, CTV outlines emergency and remedial steps to be taken in the event of impact to an Underground Source of Drinking Water (USDW) but argues earlier in the document that no USDWs exist at the 26R and A1 - A2 reservoirs because of an aquifer exemption. In this section, CTV should substitute the term USDW with Lower Tulare Formation.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) in the Emergency and Remedial Response Plan for the 26R and A1 - A2 reservoirs, CTV outlines steps to be taken in the event of well integrity failure. These steps are limited to injection wells. The Emergency and Remedial Response Plan for both the 26R and A1 - A2 reservoirs should include consideration for well integrity loss in monitoring

wells and plugged abandoned wells. For the A1 - A2 reservoir, unplugged wells used for injection in the A3 - A11 reservoir should also be considered.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) in the Emergency and Remedial Response Plan for the 26R and A1 - A2 reservoirs, CTV discussed venting CO_2 from surface facilities in the event of an emergency. There is no discussion how loss of CO_2 will be quantified during venting.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) in the Emergency and Remedial Response Plan for the 26R and A1- A2 reservoirs, CTV does not directly address steps to be taken in the event of leakage into the Lower Etchegoin Formation. Instead, when addressing release into the overlying USDW, CTV states that *"Monitoring of the Lower Etchegoin dissipation interval that overlies the confining Reef Ridge Shale [will be used] to establish leakage before migration to USDW."* At a minimum, leakage into the Lower Etchegoin Formation as determined by pressure perturbation or sample analysis should trigger installation of additional monitoring wells in this formation to evaluate the magnitude and spatial extent of leakage. As previously discussed, in the Class VI permit applications for the 26R Reservoir, EPA states that *"The objective of this permit is to prevent the movement of fluids into or between USDWs or into any unauthorized zones consistent with the requirements at 40 CFR 146.86(a)."* The Etchegoin Formation is not purposeful "*dissipation interval*." Leakage into the Etchegoin Formation constitutes the movement of fluids into an unauthorized zone. Hence, detection of leakage into this zone should necessitate installation of additional monitoring wells and development of a separate monitoring plan for this formation.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) for the A1 - A2 reservoir, CTV states that in case of an induced seismic event having **M** > 2.0, it will initiate gradual shutdown of the injection wells if it is determined "*appropriate.*" The word "*appropriate*" is vague and does not provide a measurable performance criterion per CEQA requirements. After initially using the word *"appropriate"* in Volume II of the original DEIR for the 26R reservoir (DEIR, 2023b), in Volume II of the recirculated DEIR (RDEIR, 2024b), CTV now states that for induced seismic events having **M** > 2.0, that it will initiate a "rate reduction plan" in the 26R reservoir. Why is there an inconsistency here? A rate reduction plan is clearly more appropriate.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) for both the 26R and the A1 - A2 reservoirs, CTV states that shutdown will not be initiated unless a seismic event greater than **M** 3.5 has occurred or a seismic event having **M** > 2.0 accompanied by local observation or report of damage. CTV defines the onset of damage as cosmetic damage to structures, such as bricks dislodged from chimneys and parapet walls, broken windows, and fallen objects from walls, shelves, and cabinets. CTV states that it will monitor well pressure, temperature, and annulus pressure of injection wells to verify well status and determine the cause and extent of any failure, and identify and implement appropriate remedial actions in consultation with the UIC Program Director. There is no mention of evaluation of any other wellbores - a critical oversight. This response action is also inconsistent with CARB requirements. The CARB protocol for CO_2 sequestration requires that the operator continuously monitor for indication of an earthquake of **M** 2.7 or greater occurring within a radius of one-mile of injection operations. If an earthquake of **M** 2.7 or greater is identified, CARB, in consultation with the project operator and the California Geological Survey, or local geological survey or equivalent, must conduct an evaluation of the following: (a) whether there is indication of a causal connection between the injection activity and the earthquake; (b) whether there is a pattern of seismic activity in the area that correlates with nearby injection activity; and (c)

whether the mechanical integrity of any well, facility, or pipeline within the radius specified in subsection C.4.3.2.3(b) has been compromised (CARB, 2018). Hence, if induced seismicity having a magnitude of **M** 2.7 or larger occurs, the operator must conduct an evaluation of the integrity of all wellbores including those plugged and abandoned.

Evaluation of Well Penetrations from Legacy Oil and Gas Wells

As EPA states in the Class VI permit applications for the injection wells for the 26R reservoir, *"the permittee shall not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of injection, annulus or formation fluids into underground sources of drinking water (USDWs) or any unauthorized zones. The objective of this permit is to prevent the movement of fluids into or between USDWs or into any unauthorized zones consistent with the requirements at 40 CFR 146.86(a)"* (EPA, 2024). Hence, even in the absence of a USDW in the 26R and A1 - A2 reservoirs, as a result of an aquifer exemption, the permittee cannot allow migration of CO_2 or other fluids (brine, oil) into overlying or underlying formations.

In 40 CFR 146.84(c)(2), EPA states, *"Using methods approved by the Director, identify all penetrations, including active and abandoned wells and underground mines, in the area of review that may penetrate the confining zone(s). Provide a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require."* In 40 CFR 146.84(c)(3), EPA states *"Determine which abandoned wells in the area of review have been plugged in a manner that prevents the movement of carbon dioxide or other fluids that may endanger USDWs, including use of materials compatible with the carbon dioxide stream."* In 40 CFR 146.84(d), EPA states, *"Owners or operators of Class VI wells must perform corrective action on all wells in the area of review that are determined to need corrective action, using methods designed to prevent the movement of fluid into or between USDWs, including use of materials compatible with the carbon dioxide stream, where appropriate."*

Federal requirements for evaluation of legacy oil and gas wells essentially consist of providing a tabulation of wells penetrating the primary confining layer and a subjective evaluation that plugged legacy wells and wells that will be plugged will not provide a conduit for leakage. These minimal requirements are in sharp contrast to specific internal and external mechanical integrity tests required for injection wells even though legacy wells will be directly exposed to supercritical CO_2 similar to injection wells.

However, in its guidance document on Area of Review and Corrective Action, EPA (EPA, 2013) provides an extensive set of recommendations for evaluation of artificial penetrations. Evaluation commences with review of available information including drilling logs, well completion and plugging reports, casing and cementing records, records on internal and external mechanical integrity tests, cement bond/variable density logs, information on well deviation, and wellbore diagrams (EPA, 2013). EPA states that if available records cannot establish wellbore integrity prior to plugging (e.g., corrosion in well casing and competent cement outside casing at critical locations such as at the interface of the injection zone and confining layer), additional testing is recommended (EPA, 2013). Additional testing could include multi-finger caliper logging, cement evaluation logging, internal and external mechanical integrity testing, and sidewall coring (EPA, 2013).

Logically, additional testing should include testing for sustained casing pressure and surface casing vent flows which are indicators of wellbore integrity failures and increase the potential for gas emissions and groundwater contamination (Ingraffea et al., 2014, 2020; Lackey and Rajaram, 2019; Soares et al., 2021). Leak testing using procedures developed by Kang et al. (2016) could also be utilized to evaluate well integrity.

Wellbore integrity failure is common. Rates of wellbore integrity failure range from 2 to 75% (Davies et al., 2014). Recent analysis of state and provincial databases show that wellbore integrity issues are widespread in oil and gas well populations in Canada and the U.S. and are likely under-reported or not reported at all depending on the jurisdiction (Wisen et al., 2020; Lackey et al., 2021; Ingraffea et al., 2014, 2020; Abboud et al., 2021).

Wellbore integrity failures are not necessarily addressed through well plugging and can persist after the well is "properly" plugged (Bowman et al., 2023; Kang et al., 2021; Wisen et al., 2020). Surface casing vent flow or sustained casing pressure in an oil or gas well may be due to annular gas flow which may not have been properly addressed during plugging. Importantly, regulations for plugging oil and gas wells in California do not require assessment of the cement sheath outside casing. Hence, gas flow in the annulus outside casing will persist after plugging.

For instance, DiGiulio et al. (2023) found that approximately 9 of 27 (33%) of plugged oil and gas wells were leaking gas through vent pipes at the surface and 3 of 26 (10%) of plugged wells examined were leaking gas through soil at the surface in western Pennsylvania, clearly demonstrating that oil and gas wells can and do leak gas after plugging. Kang et al. (2016, 2017) and DiGiulio et al. (2023) found mean emission rates of leakage of methane from plugged wells in western Pennsylvania were 360 and 390 g/d, respectively. However, the computation of the mean emission rate from plugged wells in the dataset from DiGiulio et al. (2023) excluded an outlier, a plugged well leaking at a rate of 83 kg/d. It is important to realize that these rates are from depleted oil and gas fields. Higher emission rates of gas (in this case CO_2) would be expected if reservoirs were repressurized as is the case for geological storage of CO_2 in depleted oil and gas fields such as at the TerraVault I Project. DiGiulio et al. (2023) and other investigators have found that emission rates from both unplugged and plugged oil and gas wells follow a distribution whereby leakage from a relatively small number of wells accounts for the majority of total leakage. It is plausible, if not likely, that leakage of CO_2 from abandoned wells will follow a similar distribution.

Addressing gas migration via the annulus outside casing requires treatments such as cement squeezes and casing repair (Hachem et al., 2023; Ingraffea et al., 2014; Yousuf et al., 2021). However, the process of investigation and then remediating annular gas leakage is more complex and expensive than the average plugging procedure (Raimi et al., 2021) whereby plugs are simply placed inside casing, as will be the case at the TerraVault I project.

Comment: Neither the State of California nor EPA in its Class VI regulations require investigation or remediation of the cement sheath outside casing prior to plugging legacy oil and gas wells within the Area of Review to support geological sequestration of CO_2. Because these plugged wells at TerraVault I are expected to contain highly pressurized supercritical CO_2 for hundreds if not thousands of years, the County should not ignore the serious gaps in the existing regulatory framework and must require full investigation and remediation.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that there are 150 wellbores in the A1 - A2 storage reservoir penetrating the Reef Ridge shale. There are 41 active, 70 idle, and 39 plugged and abandoned wells. Of active and idle wells, 79 wellbores produce oil and gas while 32 wellbores are used for gas or water injection. CTV states further that 33 wells in the A1 - A2 have been identified for abandonment. Since there are 79 currently unplugged wellbores, 3 wellbores that will be reconfigured for injection, and 3 wellbores that will be reconfigured as monitoring wells, what is the status of the remaining 40 wellbores? How many of these wellbores will be used for continued production in the underlying A3 - A11 reservoir? The RDEIR should account for these wells.

Comment: The recirculated DEIR is replete with vague terms that lack definitions and measurable standards. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that in the A1 - A2 reservoir, all wells within the Area of Review are protective of the USDW because there is *"sufficient"* annular cement within the confining Reef Ridge Shale. What precisely does *"sufficient"* mean? The word *"sufficient"* is vague and does not provide a measurable performance criteria per CEQA requirements. Does cement in the annulus cover the entire extent of the Reef Ridge Shale? How was the integrity of the cement evaluated? What standards were utilized?

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), Appendix 1 for the A1 - A2 reservoir (page 3421) does not have a column on evaluation of annular cement in the 20-foot A2 shale between the A1- A2 reservoir and A3 - A11 reservoir. CTV states that all wellbores in the A1 - A2 reservoir that are not planned for abandonment have been determined to be "*adequately*" isolated from A1-A2 sands. What precisely does *"adequate"* mean? The word *"adequate"* is vague and does not provide a measurable performance criteria per CEQA requirements. Does annular cement extend completely through the A2 shale? How was the integrity of the cement evaluated?

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), appendices (page 3221 for the 26R reservoir and page 3421 for the A1 – A2 reservoir) provide a tabulation of wells by well name, API number, wellbore type (producer, injector, abandoned), wellbore status (active, idle, plugged), date drilled, surface latitude, surface longitude, wellbore total measured depth, wellbore total vertical depth, well construction method (vertical cased cemented, directional cased cemented, original hole cased cemented with sidetrack, sidetrack - open hole with sidetrack, sidetrack - directional cased cemented), completion record within injection zone (open, not opened, abandoned, isolated), USDW isolation (no USDW), annular isolation within injection zone (adequate, adequate with P&A, no annulus, not drilled to injection zone, plug/isolation within the injection zone (adequate, adequate with P&A, unplugged), plug/isolation within the upper confining layer (adequate, adequate with P&A, unplugged), pre-operational testing requirement (none, abandon, convert to monitoring well), corrective action requirement (none). A number of descriptors in this appendix are confusing. For instance, while the term sidetrack is generally understood, what does "sidetrack - open hole with sidetrack" and "sidetrack - directional cased cemented" mean? Example diagrams of each well construction method should be provided to facilitate transparent review and full participation by the public and expert agencies. For completion record within the injection zone, it is not clear what "not opened and isolated" means. Again, each descriptor should have some sort of explanation.

Comment: In these appendices, what does *"adequate"* annular isolation within the injection zone mean? The word *"adequate"* is vague and does not provide a measurable performance criteria per CEQA

requirements. Does this mean that there is cement outside casing at these locations? It is unclear how this could be the case for wells completed in the 26R reservoir.

Comment: In these appendices, what does *"adequate"* with P&A mean for these wellbores? Again, the word *"adequate"* is vague and does not provide a measurable performance criteria per CEQA requirements. Importantly, for plug/isolation within the injection, for plugged wells, does *"adequate"* mean that a cement is placed across the entire production interval and > 100 feet into the Reef Ridge Shale by CalGEM regulations? If this is not the case, plugs within these wellbores should not be considered *"adequate"* and at least potentially necessitate corrective action. For plug/isolation within upper confining layer, does *"adequate"* mean that a competent cement sheath outside casing extends entirely through the Reef Ridge Shale? How would "competent" be defined? Use of cement bond/variable density logs conducted shortly after well completion are not representative of current conditions, especially in injection wells with countless pressure cycles which are known to debond cement from casing and cause microannuli.

Comment: Wellbore schematics are absolutely vital in understanding the need or potential need for corrective action. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that the corrective action assessment included the generation of detailed wellbore/casing diagrams for each wellbore. The wellbore diagrams include depths and dimensions of all hole sections, casing strings, cement plugs and other wellbore equipment that isolates portions of the wellbore or otherwise establishes plugback depth. Perforated intervals are apparently described with depth and status of perforations. Top of Cement determination results were apparently provided to support review for annular isolation. Depths to relevant geologic features such as formation tops and injection zone are provided in both measured and true vertical depths. CTV states further that the depth of the confining zone in each of the wells penetrating the Reef Ridge shale was determined through open hole well logs and utilized the deviation survey to convert measured depth along the borehole to true vertical depth from surface. CTV then states that CTV can demonstrate that the USDW is protected and that, with well abandonment and monitoring, the CO_2 injected will be confined to the Monterey Formation 26R reservoir. CTV has claimed that these wellbore schematics are business confidential information. Unfortunately, the EPA agreed with CTV that disclosing the wellbore diagrams *"would result in reasonably foreseeable harm to the Company's commercial interests"* (EPA, 2024b). It is difficult to reconcile this statement with the fact that wellbore diagrams are commonly publicly posted on state oil and gas internet sites (e.g., Wyoming Oil and Gas Commission). This unjustified lack of transparency can and indeed should erode public confidence in this project. In addition to wellbore diagrams, CTV should make all information associated with wellbores relevant to wellbore integrity publicly available (e.g., internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, cement squeeze operations, etc.). Information on plugging locations now provided in Appendix 2 in the recirculated DEIR is not a substitute for wellbore schematics.

Comment: In the recirculated DEIR, CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1 - A2 reservoirs (RDEIR, 2024b). No wellbores were deemed deficient in either reservoir and none require corrective action, according to the document. This 0.0% wellbore barrier failure rate for 354 wellbores is at odds with the published rates of wellbore failure rates ranging from 2 - 75% in the literature. Since no information (sustained casing pressure, surface casing vent flow, gas migration in soil, internal and external mechanical integrity testing, cement evaluation logs, wellbore diagrams, drilling logs, etc.) was provided, it is impossible to verify the accuracy of this statement, which

should be regarded with a considerable degree of skepticism. Did Kern County or EPA actually conduct an independent evaluation of wellbore integrity of each well penetration? A statement of no wellbore barrier failure cannot be accepted without supporting information. Again, all supporting information (wellbore diagrams, cement evaluation logs, internal and external mechanical integrity tests, etc.) should immediately be made available to the public to enable an independent evaluation of wellbore integrity.

Comment: In Volume II of the recirculated DEIR, CTV states that, "all wellbores within the AoR will, *if necessary*, be mechanically pressure tested, abandoned, reabandoned, monitored or have a technical demonstration showing *adequate* zonal confinement prior to the commencement of CO_2 injection or based on an agreed upon phased scheduled post CO_2 injection if conditions allow." Again, the words *"if necessary"* and *"adequate"* are vague and do not provide a measurable performance criteria per CEQA requirements. It is unclear what conditions would preclude pressure testing. Since all wellbores penetrating the confining layer will be in direct contact with supercritical CO_2 at high pressure, prior to plugging, all wellbores should have a standard annular pressure test (SAPT) in casing above and between screened intervals to evaluate the integrity of casing as will be conducted for injection and monitoring wells. All testing factors should be similar to what is specified for monitoring wells: Testing surface pressure should be 1000 psi, isolation of pressure should be maintained for no less than one hour, and if the change (gain or loss) in pressure is greater than 3% of test pressure, the well has failed to demonstrate internal mechanical integrity. It is unclear what happens if a well fails a SAPT. Will the well be entered to investigate parted or corroded casing? Also, what is a demonstration of *"adequate zonal confinement"?* To evaluate the cement sheath outside casing, a cement evaluation log should be conducted on all wellbores prior to plugging. Statements in the Corrective Action Plan are too vague to be of any use. Hence, the Corrective Action Plan is unacceptable. Under CEQA, all feasible mitigation is required. The terms of the Corrective Action Plan do not constitute all feasible mitigation.

Comment: In Volume II of the recirculated DEIR, CTV states that the Etchegoin Formation consists of a lower silty shale member and an upper sandy interval. The sand dominated sequences consist of multiple sands that are 10 feet in thickness, 29 – 37% porosity, 32 – 826 mD permeability and can contain oil. Between sand reservoirs are laterally continuous shales that are sealing and prevent hydraulic communication from above and below. The Etchegoin Formation is dominated by laterally continuous shales which limit hydraulic communication between sand lenses. In the recirculated DEIR, CTV states that the Etchegoin Formation will dissipate CO_2 injectate that may migrate upward from the injection zone. According to the recirculated DEIR, in both the 26R and A1 - A2 reservoirs, the Etchegoin will be monitored continuously for pressure and temperature changes using one monitoring well to provide confirmation of the confinement of CO_2 to the injection zone by also continuously measuring temperature changes in the Etchegoin (via DTS). In both areas, CTV states that a monitoring well in the Etchegoin Formation will continuously measure pressure and temperature providing continuous direct measurements to assess the confinement of the injected CO_2 and provide adequate spatial coverage across the Area of Review to evaluate confinement of CO_2 in the storage reservoir. One monitoring well in each reservoir cannot provide adequate coverage. Heterogeneity as described above will affect detection of increase in pressure during leakage. The presence of shale lenses will likely dramatically affect measurement of pressure in the Etchegoin Formation. CTV needs to stipulate the minimum magnitude of leakage that would be detected from pressure perturbation from the injection well located at the greatest distance from each monitoring well. CTV needs to justify the existence of only one monitoring well in the Etchegoin Formation.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2023b), CTV states that a laterally continuous 20-foot thick A2 shale having an average permeability of 0.05 millidarcies separates the A1 - A2 and underlying A3 - A11 reservoirs. This is in comparison to the Reef Ridge shale overlying the A1 - A2 reservoir having an average thickness of 1,555 feet and an average permeability of 0.0084 millidarcies. The A3 - A11 reservoir is currently undergoing waterflooding which will continue during injection of CO_2 into the A1 - A2 reservoir. CTV states that the A1 - A2 reservoir is hydraulically isolated from the A3 - A11 reservoir because: (1) the A1-A2 reservoir was previously pressure supported by gas injection (175 billion cubic feet injected) while the A3-A11 reservoir is currently pressure supported by waterflood (449 million barrels of water injected) and (2) the Monterey Formation A1 - A2 reservoir is at 200-300 PSI and the A3-A11 reservoir is much higher at approximately 1,700 PSI. CTV states that it will monitor the Monterey Formation A3 - A11 reservoir and wellbores for CO_2 migration from the A1 - A2 reservoir. Waterflood producers will be monitored via fluid sampling once per quarter for changes in composition. In addition, Monterey Formation A3 - A11 waterflood injectors will have mechanical integrity tests (MIT) and standard annular pressure tests to ensure internal and external mechanical integrity. Additionally, in one portion of the recirculated DEIR, CTV states that due to its waterflood infrastructure and high reservoir pressure, the A3 - A6 reservoir is considered a viable future target for CO_2 miscible enhanced oil recovery. In another portion of the recirculated DEIR, CTV states that due to its waterflood infrastructure and high reservoir pressure, the A3 - A11 reservoir is considered a viable future target for CO_2 miscible enhanced oil recovery. It is not clear where the A3 - A6 reservoir is located or if it even exists. Since pressure in the overlying A1 - A2 reservoir will have a much higher pressure during CO_2 injection, migration through the thin A2 shale and wellbores penetrating the A2 shale constitute a major potential leakage pathway. Leakage into the A3 - A11 reservoir would constitute loss of containment.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that surface air monitoring, including broad aerial monitoring and targeted monitoring at wells and pipelines, will be conducted using eddy covariance towers. In regard to leakage to the atmosphere, under 40 CFR Part 98 Subpart RR, an operator must submit a proposed monitoring, reporting, and verification (MRV) plan to EPA within 180 days of receiving a final Class VI permit (§98.448(b)(2)). As part of the MRV plan, the operator must: (1) "identify potential surface leakage pathways for CO_2 in the maximum monitoring area and the likelihood, magnitude, and timing, of surface leakage of CO_2 through these pathways" (§98.448(b)(2)); (2) develop "a strategy for detecting and quantifying any surface leakage of CO_2" (§98.448(b)(3)); and (3) develop "a strategy for establishing the expected baselines for monitoring CO_2 surface leakage" (§98.448(b)(4)). Hence, leakage to the atmosphere will be considered at some point. However, a monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage. It is unclear what the magnitude of leak detection from plugged and unplugged wells would be from eddy covariance towers and whether eddy covariance towers would provide comprehensive coverage of all well penetrations. MM 4.8-1 needs to include specific monitoring for leakage from plugged and unplugged well penetrations. Methods employed by Kang et al. (2016) can be used for CO_2 monitoring at both plugged and unplugged wells.

Seismic Risk Evaluation

Of particular concern at the TerraVault I project is the effect of natural or induced seismicity on wellbores. After a well is permanently plugged and abandoned, natural or induced seismicity can damage wellbores. For example, hundreds of oil well casings were sheared in the Wilmington oil field in Los Angeles during

five or six earthquakes of relatively low seismic moment magnitude (**M** 2 to **M** 4) during a period of maximum subsidence in the 1950s (Dusseault et al., 2001). The seismic moment magnitude is the product of the area of rupture, the average displacement on the fault (a fracture or zone of fracture between two blocks of rock), and the shear modulus, a parameter related to the rigidity of rocks in the fault zone measured on a logarithmic scale (GWPC, 2021). Recently, Pozzobon et al. (2023) documented increased leakage of gas from plugged oil and gas wells resulting from seismic activity due to injection of produced water into disposal wells and hydraulic fracturing.

Impacts of earthquakes on buildings and pipelines, including those that are buried, have long been an active area of civil engineering research. There are empirical estimates of pipeline damage that relate the number of repairs to peak ground acceleration, peak ground velocity, maximum ground strain, and other factors. There is a need to extend this existing body of research to subsurface wellbore leakage caused by earthquakes (Kang et al., 2019), especially in regard to geological storage of CO_2.

USEPA's Class VI regulations require permit applicants to provide a determination that seismic activity will not compromise subsurface containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)). The Class VI rule provisions do not address potential damage to buildings and infrastructure (including wellbore cement sheaths of active and abandoned wells) associated with geologic storage of CO_2. However, as part of its permanence requirements for geologic sequestration, the California Air Resources Board (CARB) has developed requirements which include consideration of natural and induced seismicity (CARB, 2018). In the California Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard (CARB, 2018), if an earthquake of $\mathbf{M} \geq 2.7$ is detected within a radius of one mile of CO_2 injection operations, a determination must be made whether the mechanical integrity of any well, facility, or pipeline within this radius has been compromised. This protocol however does not consider a naturally occurring major seismic event at distance from an injection well which could induce ground movement damaging wellbores. In addition, the California Energy Commission has developed guidelines to evaluate the potential for induced seismicity during geological storage of CO_2 (CEC, 2017).

Given uncertainty in potential impact due to natural and induced seismicity during geological storage of CO_2, protocols developed by U.S. Department of Energy's (DOE) Recommended Practices for Managing Induced Seismicity Risk Associated with Geologic Carbon Storage (Templeton et al., 2021, 2023) should be used when permitting a facility for geological storage of CO_2. This integrated and risk-based protocol is a product of the DOE's National Risk Assessment Partnership, a multi-year collaborative research effort of Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, National Energy Technology Laboratory, and Pacific Northwest National Laboratory. This protocol specifically addresses the risk of seismicity at a geologic carbon storage facility and is relevant to CO_2 injection at Carbon TerraVault I. Recommendations by Templeton et al. (2021, 2023) and regulatory requirements and guidelines by EPA and the State of California are used here as the basis of evaluation for the seismicity portion of the permit application.

Review of Applicable Local, State, and Federal Laws and Requirements on Seismicity

Relevant local, state, and federal laws and regulations should be reviewed to determine how induced seismicity, however minor or unlikely, is regulated and its effects prevented or mitigated (Templeton et al., 2021). In California, the Alquist-Priolo Earthquake Fault Zoning Act (1972) and the Seismic Hazards Mapping Act (1990) direct the State Geologist to delineate regulatory "Zones of Required Investigation"

to reduce the threat to public health and safety and to minimize the loss of life and property posed by earthquake-triggered ground failures and other hazards. Cities and counties affected by the zones must regulate certain development projects within them, based on the CA CGS Information Warehouse: Regulatory Map Portal (https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/). As stated in the recirculated DEIR, the Carbon TerraVault I project does not appear to be within a Zone of Required Investigation. Kern County reviewed compliance with other applicable laws and regulations for this project in the document.

Review of Naturally Occurring Seismic Events and Delineation of a Region of Concern

To support a Class VI rule application, an owner/operator is required to submit a narrative description and information on the seismic history of the area, including the presence and depths of seismic sources, and a determination that seismicity will not interfere with containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)).

CARB requires an evaluation of the seismic history of the proposed sequestration site, including the date, magnitude, depth, and location of the epicenter of seismic sources and a determination that the seismicity would not cause a catastrophic loss of containment, either by breaching the integrity of the well or the sequestration formation (CARB 2018).

To evaluate the impact of a major naturally occurring seismic event distant from a site on a site, it is necessary to define a Region of Concern (ROC). The ROC is defined as the area in which a ground motion threshold over the lifetime of a project could be exceeded causing impact to infrastructure (Templeton et al., 2021), which in this case includes wellbores. An assessment or literature search should identify any tectonic events that may have occurred in the region and a map and catalog should be created for seismic events which have occurred within at least 200 km from the reservoir (Templeton et al., 2021).

Previous seismic activity should be characterized within a region of at least 200 km radius around planned injection operations to ensure that wider regional trends are considered in the seismic hazard assessment (Templeton et al., 2021, 2023). This consideration reduces the possibility of overlooking infrequent but possibly large events that could impact the local hazard. Elements of the seismicity characterization should include:

- Catalogs of instrumentally recorded earthquakes from national, state, or regional agencies.
- Historical records of earthquakes and observed fault ruptures, including but not limited to, historical earthquake catalogs, and newspaper and other contemporary records, and published reports of field geological investigations. Historic reports of significant earthquakes can provide important information on time periods that predate instrumental recording. For rare events that occur once every few hundred to thousands of years, this may be the only evidence of seismic activity.
- Fault maps and fault characterizations, including but not limited to, scientific maps and publications.
- Paleoseismic fault displacement data, including but not limited to, published trenching studies.
- Previous induced earthquake activity, including but not limited to, earthquake catalogs and scientific publications investigating possible induced activity. If the targeted region has a history of induced seismicity, this would be a strong indication of a critically stressed crust.

In Volume II of the original DEIR (2023b) and recirculated DEIR (RDEIR, 2024b), Soils Engineering Inc. conducted a review of naturally occurring seismic events since 1852. Their identified Region of Concern however was limited to 100 km from the Carbon TerraVault I project. Major faults within this area are illustrated in Figure 4.

From 1852 through 2020, southern California has experienced at least 20 major earthquakes with estimated Richter scale magnitudes ranging from 5.9 to 8.0. As Soils Engineering Inc. discuss, the nearest major active faults in the western portion of the CTV Project are the San Andreas Fault located approximately 23.0 to 23.3 km to the southwest, the Kern Front Fault located approximately 39.7 to 39.9 km to the northeast, the Pleito Fault located approximately 48.3 to 48.7 km to the southeast, the White Fault located approximately 48.6 to 48.9 km to the east-southeast, and the Buena Vista Fault (minor active fault) located approximately 15.42 km to the southeast. The nearest major active faults in the eastern portion of the CTV Project are the San Andreas Fault located approximately 23.9 to 24.6 km to the southwest, the Kern Front Fault located approximately 35.5 to 36.8 km to the northeast, the White Fault located approximately 39.2 to 42.5 km to the east-southeast, the Pleito Fault located approximately 40.0 to 42.9 km southeast, and the Buena Vista Fault located approximately 9.41 km to the southeast.

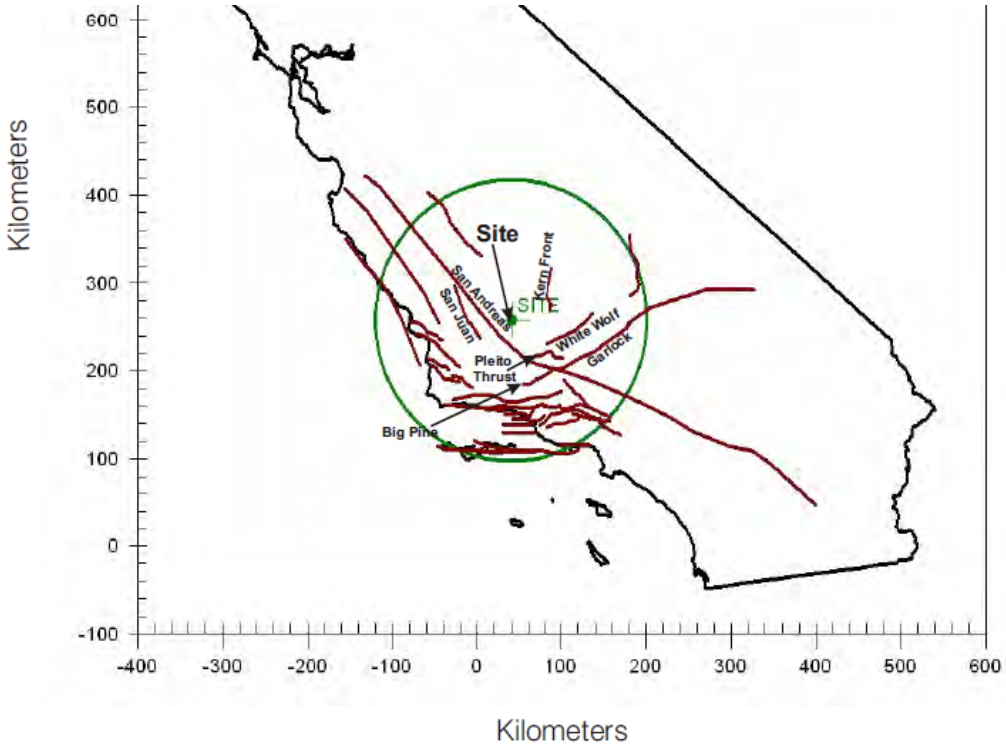

Figure 4. Identification of major faults in the vicinity of the TerraVault 1 Project. Figure from Soils Engineering, Inc. in Volume II of the recirculated DEIR (RDEIR, 2024b).

Some of these faults have produced earthquakes in excess of seismic moment magnitude **M** 7 (Figure 5). The San Andreas fault is a strike-slip fault (two blocks slide horizontally past each other). The 1857 **M** 7.9 Fort Tejon earthquake along the San Andreas fault, with an epicenter (the surface location directly

above the depth or hypocenter where rupture is initiated) in Parkfield, CA (Figure 6) was one of the greatest earthquakes ever recorded in the United States. The San Andreas fault broke the surface continuously for at least 350 km (220 miles), possibly as much as 400 km (250 miles). In Figure 6, the estimated earthquake intensity using the Modified Mercalli (MM) scale (Table 1) is estimated with distance from the epicenter. Intensity is a qualitative measure of the strength of shaking at a specific place and is characterized in terms of impact of shaking on individuals as well as on objects and structures. It is not a measure of the size of the earthquake.

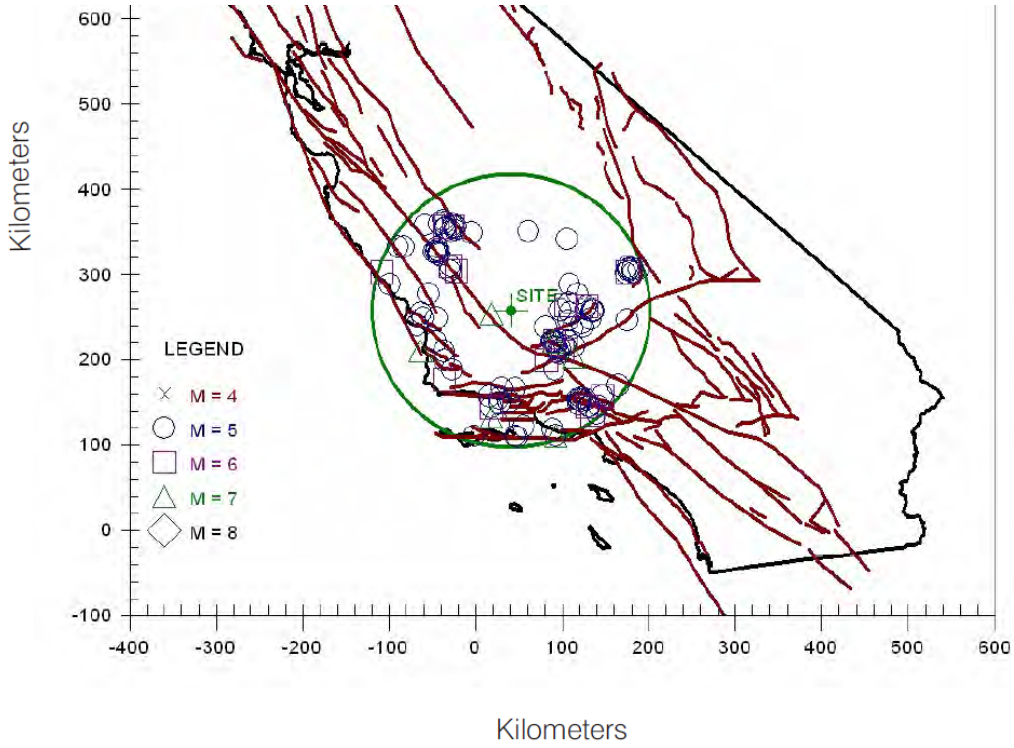

Figure 5. Magnitude of earthquakes along major faults in the vicinity of the CTV project. Figure from Soils Engineering, Inc. in Volume II of the recirculated DEIR (RDEIR, 2024b).

During the Fort Tejon earthquake, horizontal displacement as much as 9 meters was observed on the Carrizo Plain. As a result of the shaking, the current of the Kern River was turned upstream, and water ran four feet deep over its banks. The waters of Tulare Lake were thrown upon its shores, stranding fish miles from the original lake bed. The waters of the Mokelumne River were thrown upon its banks, reportedly leaving the bed dry in places. The Los Angeles River was reportedly flung out of its bed, too. Some of the artesian wells in Santa Clara Valley ceased to flow, and others increased in output. New springs were formed near Santa Barbara and San Fernando (USGS, 2023).

At the time of the earthquake, California was sparsely populated, especially in the regions of strongest shaking. Were the Fort Tejon shock to happen today, the damage would easily run into billions of dollars, and the loss of life would likely be substantial (USGS, 2023). Strong shaking was reported to have lasted for at least one minute but possibly lasted two or three minutes. The portion of the fault that ruptured in 1857 has settled into a period of dormancy and this has given rise to suggestions that future slip along that zone may be characterized by a very large 1857-type event followed by another period of inactivity (Sieh, 1978).

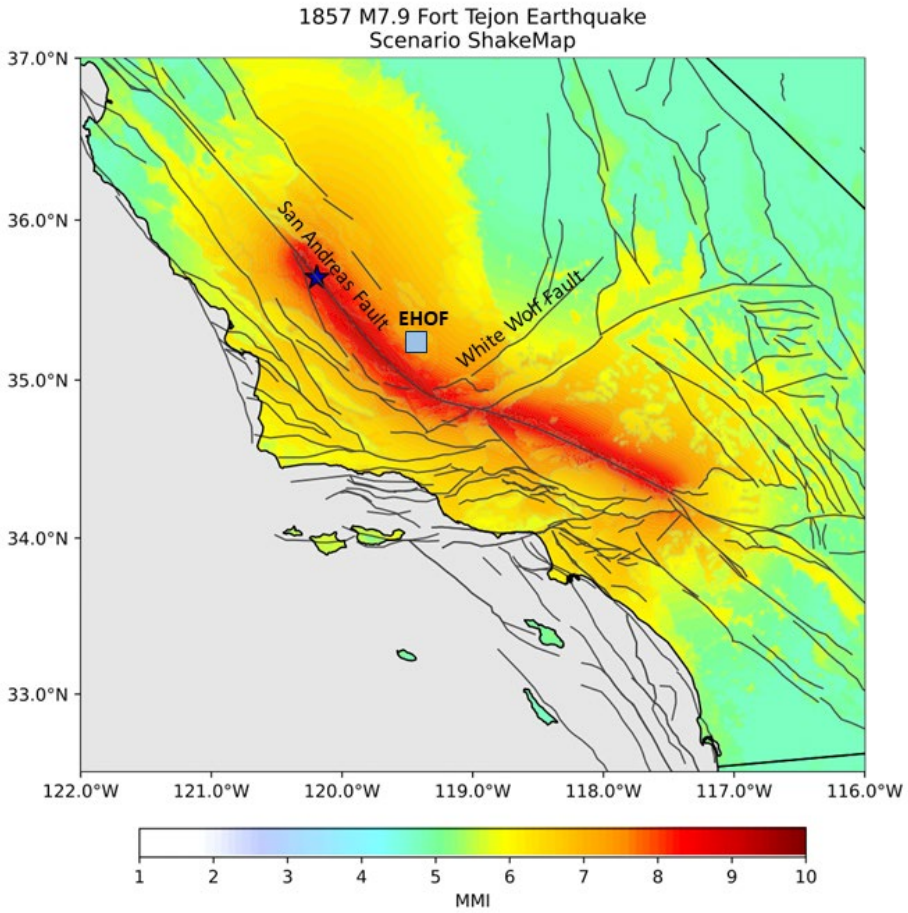

Figure 6. Location of faults in southern California and of the 1857 Tejon earthquake on the San Andreas Fault and estimated Modified Mercalli Intensity. The Epicenter illustrated by dark blue star. Approximate location of EHOF illustrated by light blue box. San Andreas and White Wolf Faults identified. Figure modified from Southern California Earthquake Data Center.

The Elkhorn Thrust, a thrust fault (reverse fault having a shallow or low angle dip) near the San Andreas fault, may have slipped simultaneously in the 1857 Fort Tejon quake indicating that future movements along the San Andreas fault zone might produce simultaneous rupture on thrust faults causing a "double earthquake" (Southern California Earthquake Center). Reverse faults (hanging wall moves up and over the foot wall) are common in southern California and other areas experiencing tectonic compression (GWPC, 2021).

As discussed by Soils Engineering, Inc. in Volume 2 of the recirculated DEIR (RDEIR, 2024b), an earthquake of **M** 8.0 has been estimated for this segment of the San Andreas Fault having a conditional probability of occurrence of 0.1 (10%) over the 30-year period of 1988 to 2018. Other segments of the San Andreas fault include the Cholame (north) and Mojave (south) segments. Their respective distances from the site and characteristic magnitudes are 58 miles and **M** 7.3 (Cholame) and 78 miles and **M** 7.8 (Mojave). The associated conditional probabilities of occurrence, for the 30-year period of 1988 to 2018 were 0.3 (30%) for both segments.

Table 1. Modified Mercalli Intensity, peak ground acceleration (PGA), and peak ground velocity (PGV) for the central United States. Source: GWPC (2021).

MMI	Description	PGA (g)	PGV (cm/sec)	Observations (Richter 1958)
I	Not felt	< 0.00007	< 0.003	Not felt except by a few under especially favorable circumstances.
II to III	Weak	0.0008	0.04	Felt by only a few people, often indoors. Hanging objects swing. May not be recognized as an earthquake.
IV	Light	0.01	0.5	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frames creak.
V	Moderate	0.05	3.0	Felt outdoors; direction estimated. Sleepers awakened, liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Strong	0.09	6.5	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken.
VII	Very strong	0.15	14	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices, un-braced parapets, and architectural ornaments. Some cracks in masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII	Severe	0.27	30	Steering of motor cars affected. Damage to masonry; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

The White Wolf Fault is a high-angle reverse fault with a small component of left-lateral slip. Movement along this fault was the cause of the **M** 7.5 1952 Bakersfield Earthquake, which most consider to be the third largest historic quake in California, after the 1857 Tejon and 1906 San Francisco quakes. The White Wolf fault is traceable for only about 48 km (34 miles), much less than the fault length typically thought necessary to produce such a major earthquake. The earthquake caused severe damage as far away as Las Vegas. In addition, there were at least 20 aftershocks of **M** 5 or greater associated with the initial **M** 7.5 event (San Joaquin Valley Geology).

Ground motion can cause structural and nonstructural damage to buildings as well as to civil structures, such as dams, bridges, highways, railroads, tunnels, pipelines, tanks, and airport runways. It is commonly accepted that structural damage to modern engineered structures generally happens for earthquakes larger than **M** 5.0 (GWPC, 2021). For example, for the National Seismic Hazard Maps, which are the basis for the building codes in the U.S. (International Building Code), the U.S. Geological Survey (USGS) uses a minimum magnitude of **M** 5.0 in the western U.S. and **M** 4.75 in the central and eastern U.S. in their hazard calculations (Petersen et al. 2014). Poorly designed or constructed buildings, such as unreinforced masonry, for example, brick and adobe, and buildings built before modern building codes can be subject to nonstructural damage at magnitudes as low as **M** 4.0 and, in some rare cases, as low as **M** 3.0 (GWPC, 2021). It is unclear what magnitude seismic event would be sufficient to cause damage to wellbores.

However, as previously stated, seismic events below **M** 3 or 4 can damage wellbores. Hence, the California Carbon Capture and Sequestration Protocol requirement for a determination of integrity of any well, facility, or pipeline when an earthquake of **M** ≥ 2.7 has been detected within a radius of one mile of CO_2 injection operations is reasonable.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) for both the 26R and A1 - A2 reservoirs, CTV states that during the 1952 Kern County earthquake, there were no reservoir containment issues associated with oil and gas operations at the Elk Hills Oil Field. However, as stated in both the DEIR and recirculated DEIR, while the 26R reservoir was discovered in the 1940s, it was not developed until the 1970's. Also, the A1-A2 reservoir was not discovered until the 1970s. Hence, CTV's statement in this regard is misleading and should be removed from the recirculated DEIR.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b) for both the 26R and A1 - A2 reservoirs, CTV states that the Area of Review will be reevaluated if seismic "events reasonably associated with CO_2 injection that are greater than **M** 3.5." The document fails to properly explain the basis of this determination. In the California Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard (CARB, 2018), if an earthquake of **M** ≥ 2.7 is detected within a radius of one mile of CO_2 injection operations, a determination must be made whether the mechanical integrity of any well, facility, or pipeline within this radius has been compromised. The County should consider this measure in its analysis.

Comment: Seismic risk is calculated from four main contributing factors. The first factor is seismic hazard, which is the probability of exceedance of a specified ground motion intensity. The second factor is exposure, which is the infrastructure or population potentially affected by seismicity. The third factor is fragility, which is the susceptibility of each element of exposure to damage from ground motion intensity. The fourth factor is consequence, which is the metric chosen to quantify the risk (e.g., economic impact, loss of CO_2 containment) (Mitchell and Green, 2017). The seismic risk analysis conducted in the recirculated DEIR is deficient because it fails to consider all four factors, especially for legacy wells which were not considered at all. In the document, hazard curves were generated, however, legacy wells were not identified as part of exposure to seismicity. Fragility functions were not identified for any infrastructure including legacy wells and the consequences of leakage through legacy wells were not quantified. Hence, a comprehensive seismic risk analysis was not conducted in the recirculated DEIR.

Hazard Evaluation of Natural Seismic Events

Hazard curves can be generated to evaluate a given percent probability of exceedance of a peak ground acceleration or spectral acceleration level over a period of time (e.g., 10% probability of exceedance in 50 years). Peak ground acceleration is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake. It is an index to hazard for short stiff structures. Spectral acceleration is a measure of the maximum force experienced by a mass on top of a rod having a particular natural vibration period. Short buildings (e.g., less than 7 stories) have short natural periods (e.g., 0.2-0.6 sec). Tall buildings have long natural periods (e.g., 0.7 sec or longer) (USGS). Peak ground acceleration appears to be the appropriate metric to evaluate potential to wellbores.

Templeton et al. (2021) state that a site-specific probabilistic seismic hazard analysis should be conducted in accordance with current practice of earthquake hazard estimation to evaluate the baseline hazard from

natural tectonic seismicity. Input into the site-specific probabilistic seismic hazard analysis should include the following:

- A database of potentially damaging earthquake sources that may impact the ROC, that experienced activity during the Quaternary Period (past 1.6 million years), including fault-specific sources and areal sources where appropriate. Areal seismic sources are distinct volumes within the Earth's crust that encompass concentrated zones of seismicity,
- Spatial, temporal, and frequency-magnitude distribution models for each seismic source.
- Region appropriate ground motion models for tectonic earthquakes as a function of at least earthquake magnitude and travel path. A ground motion model relates a ground motion parameter such as peak ground acceleration or peak ground velocity to magnitude, distance, and site condition. There are numerous models for tectonically active regions, such as the western U.S. (GWPC, 2021). The models for the western U.S. rely on empirical motion data obtained from instrumental records of earthquakes or numerical modeling in the absence of adequate strong motion data. Empirical models are often developed by performing a statistical regression on a ground motion parameter from the recorded data to find the best fitting model. Current ground motion models do not extend below **M** 3.0 (GWPC, 2021). Common inputs into a ground motion model include magnitude, distance, and site condition. For small earthquakes generally less than **M** 4, hypocentral distance is an adequate distance metric. For larger events, a distance metric that accounts for the finite dimensions of the fault rupture area is desirable. For most models, rupture distance (the shortest distance to the fault plane) is used (GWPC, 2021). Site condition inputs also are required to accurately predict ground shaking, particularly at a soil site (GWPC, 2021).
- Information from geological, geophysical, and topographical studies within the ROC should be included to incorporate local site responses.

Templeton et al. (2021) state a seismic hazard report should be prepared by a licensed professional having demonstrated competence in the field of seismic hazard assessment. The seismic hazard report should contain site-specific assessments of the seismic hazard affecting the project and relevant sites within the ROC. The report should identify any known seismic hazards that could adversely affect relevant sites within the ROC in the event of an earthquake. Results from the probabilistic seismic hazard analysis should include multiple hazard curves and hazard maps to report the results from the baseline seismic hazard analysis due to natural seismicity before injection operations commence. Federal and state permitting agencies should then independently review the seismic hazard report to determine the adequacy of the hazard evaluation. The reviews should be conducted by licensed professionals having demonstrated competence in the field of seismic hazard assessment.

Volume II of the recirculated DEIR (RDEIR, 2024b) contains a report entitled "Preliminary Soil and Geologic Evaluation Terra Vault 1 Carbon Capture Project Elk Hills" completed by Soil Engineering Inc. that contains a probabilistic seismic hazard analysis for the facility. Soils Engineering Inc. used the computer modeling program EQSEARCHWIN version 3.0 (Thomas Blake) to evaluate historical earthquakes in the area of the site over the last 200 years. The largest estimated site accelerations are 0.221g (Section 36) to 0.295g (Section 7/18) from a 7.9 magnitude earthquake on January 9, 1857.

A number of active faults are located within a 50-mile radius of the subject site. Soils Engineering Inc. used the computer modeling program EQFaultwin vers. 3.0 (Thomas Blake) to evaluate the effect that a major earthquake within a 50-mile radius might have on the site. The program computed the maximum

peak site ground accelerations resulting from an earthquake. Results of this analysis are presented in Table 2.

Table 2. Identification of faults near the site and associated maximum earthquake magnitude, estimated maximum peak ground acceleration at the site, and associated site intensity. Table from Soils Engineering, Inc. in Volume II of the recirculated DEIR (RDEIR, 2024b).

FAULT	Approximate Distance (Km)	Maximum Earthquake Magnitude (Mw)	Maximum Peak Ground Acceleration	Estimated Site Intensity (MM)
San Andreas (Other Segments)	**23 to 24.6**	7.4 to **8.0**	0.128 to **0.258**	VIII to **IX**
Kern Front	35.5 to 39.9	6.3	0.085 to 0.093	VII
White Wolf	39.2 to 48.9	7.3	0.123 to 0.146	VIII
Pleito Thrust	40.0 to 48.7	7.0	0.105 to 0.122	VII
San Juan	42.6 to 47.6	7.1	0.093 to 0.101	VII
San Luis Range	72.8 to 76.2	7.2	0.083 to 0.086	VII
Big Pine	64.9 to 73.4	6.9	0.060 to 0.066	VI
Great Valley 14	79.6 to 85.7	6.4	0.050 to 0.052	VI
Garlock (west)	70.3 to 73.6	7.3	0.069 to 0.076	VI to VII

This analysis estimates that a maximum peak ground acceleration of up to 0.258g would be felt at the site as a result of a maximum earthquake of **M** 8.0 on the San Andreas Fault approximately 23 to 24.6 kilometers away (Table 2). A maximum probable earthquake of **M** 7.3 on the White Wolf Fault approximately 39.2 to 39.9 kilometers away would create a peak site ground acceleration of up to 0.146g at the site.

Soils Engineering Inc. then utilized USGS's Unified Hazard Tool (USGS, 2024) to generate hazard curves for the site which was re-produced for this report in Figure 7. The USGS program calculates peak ground and spectral acceleration at a site for all the earthquake locations and magnitudes believed possible in the vicinity of the site. Each of these magnitude-location pairs is believed to happen at some average probability per year. Small ground motions are relatively likely, large ground motions are very unlikely. Beginning with the largest ground motions and proceeding to smaller, probabilities are summed to calculate a total probability for a particular period of time (USGS).

For the project location, a peak ground acceleration rate of 0.4363g was estimated having a 5% probability of exceedance in 50 years with an annual rate of exceedance = 1.025E-03 or a return period of 475 years (RDEIR, 2024b). The return period or time horizon is the inverse of the annual rate of exceedance. Using the USGS "rule of thumb" for calculating return period, this is approximately equivalent to a 9.8% probability of exceedance in 100 years, a 42% probability of exceedance in 500 years, and a 69% probability of exceedance in 900 years. A further examination of the hazard curves

(Figure 8) (not included in the recirculated DEIR) indicates a peak ground acceleration of 0.3175g having a 10% probability of exceedance in 50 years, 19% probability in 100 years and a 64% probability of exceedance in 400 years. Care was taken in these calculations to ensure that r* ≤ 1 where r* = r(1+0.5r) and r = probability as recommended by USGS (USGS, 2024).

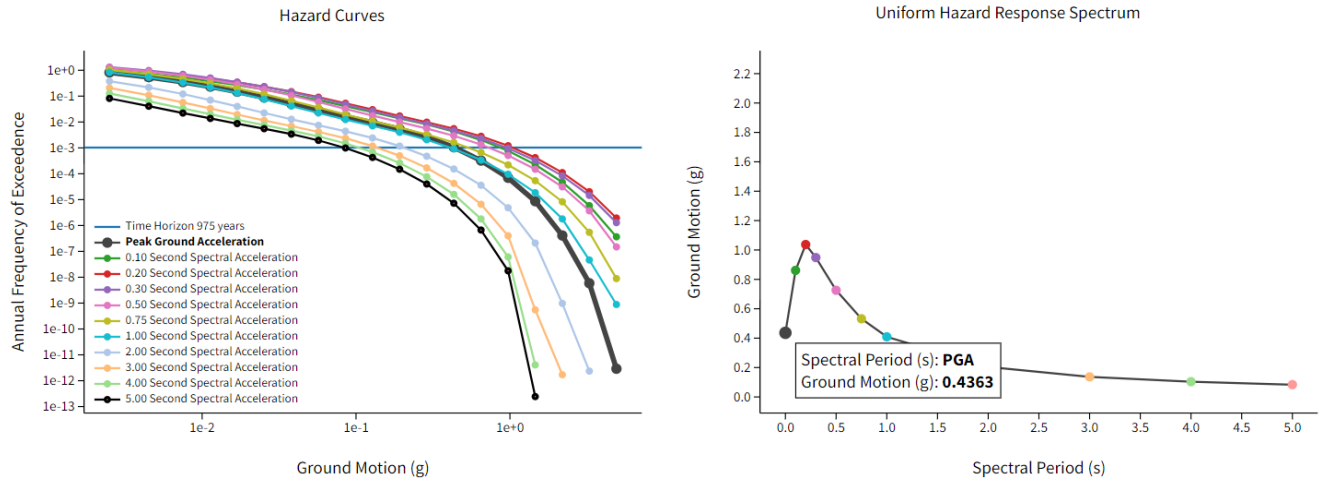

Figure 7. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 5% in 50 years. For an annual frequency of exceedance of 1.025E-03 or return period (inverse of frequency of exceedance) of 975 years, peak ground acceleration = 0.4363g (43.63% of the gravitational constant).

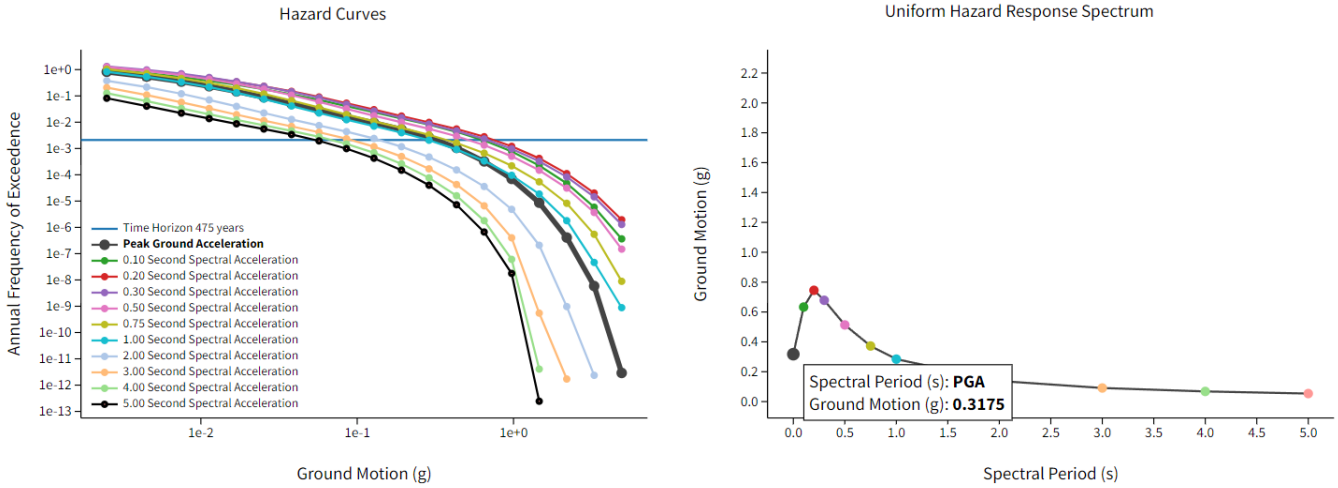

Figure 8. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 10% in 50 years. For an annual frequency of exceedance of 2.105E-03 or return period (inverse of frequency of exceedance) of 475 years, peak ground acceleration = 0.3175g (31.75% of the gravitational constant).

Comment: In Volume 1 of the recirculated DEIR (RDEIR, 2024a), in Impact 4.7-1, it is stated that an earthquake may, *"Directly or Indirectly Cause Substantial Adverse Effects, Including the Risk of Loss,*

Injury, or Death Involving the Rupture of a Known Earthquake Fault, as delineated on the most recent Alquist-Priolo earthquake fault zoning map issued by the state geologist for the area based on other substantial evidence of a known fault." This impact is considered potentially significant. Mitigation measure 4.7-1 consists of preparing *"a comprehensive seismic activity monitoring plan that includes, but is not limited to, connection to the Statewide seismic monitoring program of California Seismic Network (CISN)… The final plan shall be approved by the California Air Resources Board and include all requirements of State law including but not limited to: Appropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; Identification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures. All requirements for seismic monitoring adopted by the California Air Resources Board – "Carbon Capture, Removal, Utilization and Storage Program" shall be implemented."*

While a seismic monitoring plan would be able to detect an earthquake, a seismic monitoring program would not reduce damage to surface and subsurface facilities (e.g., wellbores). Unlike induced seismicity as a result of injection of CO_2, monitoring of natural seismicity is not mitigation. Cement used outside of well casing is a brittle material susceptible to damage from ground motion. Hence, a seismic monitoring program would not mitigate damage from a natural major earthquake within 100 km of the Carbon TerraVault I project to a less-than-significant level. In the presence of moderate seismic activity at the project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores. The Level of Significance for Impact 4.7-1 should be changed from Less than Significant to Significant and Unavoidable.

Comment: In Volume II of the recirculated DEIR (RDEIR, 2024b), Soils Engineering Inc. states, that *"Project proponent will design structures in accordance with state and county code requirements for seismic ground shaking and geotechnical and geohazard constraints. Designs shall comply with seismic, soil response at the site, and structural dynamic characteristics contained in the Kern County Code of Building Regulations and the California Building Code and State of California design standards Chapter 16 and 18. These design standards are required by law for all new structures in Kern County and were established to reduce the potential impact to structures from strong seismic shaking to a less than significant level."*

These regulations do not address wellbore integrity. It is not clear whether wellbores can withstand a peak ground acceleration of 0.258g, let alone peak ground accelerations of 0.3175g or 0.4363g. A peak ground acceleration of 0.27 g is associated with a Modified Mercalli Intensity of VIII with observations including: steering of motor cars affected; damage to masonry and some masonry walls; twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks; frame houses moved on foundations if not bolted down; loose panel walls thrown out; changes in flow or temperature of springs and wells; and cracks in wet ground and on steep slopes. Hence, this mitigation measure is not appropriate, at least for wellbores like those that would be impacted at Elk Hills. Also, Templeton et al. (2021) state that an evaluation of the anticipated losses as a function of ground motion intensity can be achieved either directly by using vulnerability functions or indirectly through the use of fragility functions. Vulnerability functions directly relate ground motion intensity to anticipated losses. Fragility functions relate ground motion intensity to the probability of damage and are often expressed as either loss ratio curves, damage probability matrices, or fragility curves (Templeton et al., 2021). There does not appear to be vulnerability and fragility functions associated with oil and gas wellbores. However, based on a Modified Mercalli

Intensity of at least VIII, wellbore damage would reasonably be expected from a major seismic event within 100 km of the Carbon TerraVault I project. The Level of Significance for Impact 4.7-2 should be changed from Less than Significant to Significant and Unavoidable. In the presence of moderate seismic activity at the project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores.

Comment: CARB requires that an operator use appropriate tools to characterize potential risks of adverse impacts on the environment, health, or safety, by combining the assessment of the probability of occurrence and the magnitude of the adverse impacts of identified project risk scenarios. Risk scenarios identified as part of this assessment must be classified high risk, medium risk, or low risk, according to the combination of probability of occurrence during a 100-year period and the severity of potential consequences (Table 3). Given an approximately 10% and 20% probability of a major seismic event inducing a peak ground acceleration of 0.44 g and 0.32 g, respectively, at the TerraVault I Project area, risk should be classified as high. At a minimum, this high-risk classification should mandate robust evaluation and monitoring of wellbore integrity.

Table 3. CARB Risk scenario classification.

	Insubstantial[2]	**Substantial**[2]	**Catastrophic**[2]
> 5%[1]	Medium risk	High risk	High risk
1-5%[1]	Low risk	Medium risk	High risk
< 1%[1]	Low risk	Medium risk	Medium risk

1 Probability of occurrence over 100 years
2 Severity of potential consequences

Additional Hazard from Induced Seismicity

Induced seismicity is of concern for faults that are optimally oriented, critically stressed, and of sufficient size to cause damage sufficient to induce leakage of sequestered CO_2. Leakage of CO_2 could occur through a damaged confining layer, from activation of faults penetrating a confining layer, or through wellbore damage.

Induced seismicity considerations in the Class VI regulations are largely limited to CO_2 migration through faults penetrating the confining layer. EPA (2013) states that use of seismic hazard maps to demonstrate the reasonable expectation that no induced seismic events would occur during the course of a CCS project may fulfill the requirements at 40 CFR 146.82(a)(3)(v). However, if such maps indicate a substantial likelihood of seismic activity, other required geologic information, such as geomechanical data, depth to confining zones, and fault stability analysis may be needed to demonstrate that seismic activity will not compromise subsurface containment (EPA, 2013). An owner/operator is required to determine the

“location, orientation, and properties of known or suspected faults and fractures that may transect the confining zone(s) in the Area of Review, along with a determination that they will not interfere with containment” (40 CFR 146.82(a)(3)(ii)). The owner/operator is also required to demonstrate the presence of a “confining zone(s) free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced fluids” (40 CFR 146.83(a)(2)).

It is stated in the Class VI permit applications that in 2019 three-dimensional (3D) seismic survey data was re-processed to allow a more focused structural image around tight folds and faults (EPA, 2024). Offsetting the 31S anticline are high-angle reverse faults that are oriented NW-SE. It is stated that these inactive faults penetrate the lowest portions of the Monterey Formation but not the lower Reef Ridge Shale above the Monterey Formation in the 26R reservoir. It is also stated the 26R reservoir is continuous across the Area of Review and the sands pinch-out up-dip and on the channel edges. As such, the 26R reservoir has minimal connection outside the Area of Review creating a reservoir with no connection to regional saline aquifers (EPA, 2024). The emphasis of EPA regulations are on upward migration of brine and CO_2 as opposed to downward propagation of pressure. The concern with faults in the Monterey Formation may be uncertainty associated with potential propagation of pressure below the storage formation, such as has occurred during disposal of produced water in Class II disposal wells and during hydraulic fracturing.

Increased subsurface fluid injection activity has led to increased seismicity at some sites, including near oil and gas wastewater (produced water) disposal sites, hydraulic fracturing sites, and engineered geothermal systems (Ellsworth, 2013; Keranen and Weingarten, 2018; Templeton et al., 2020). Induced seismicity has raised concerns about the scalability of geologic storage of CO_2 considering the seismic hazard and risk associated with far-reaching subsurface pressurization and adjacent basement rocks (Zoback and Gorelick, 2012; White and Foxall, 2016). Even in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of **M** 4 (Templeton et al., 2023).

Seismogenic response to fluid injection may vary strongly from site to site and between different injection intervals (Templeton et al., 2023). Weingarten et al. (2015) and Schultz et al. (2018) show that the potential for inducing earthquakes in wastewater disposal and hydraulic fracturing, respectively, correlates positively with the total injected fluid volume and the rate of injection. However, the causative mechanisms of induced seismicity and geomechanical conditions at injection sites are diverse and involve many poorly constrained or unknown parameters. Significant uncertainties on the likelihood of inducing seismicity can persist even after careful characterization. It is not fully understood why some operations can cause significant induced seismicity while others do not (Templeton et al., 2021).

Before 2011, the **M** 4.8 event in 1967 near Denver, Colorado, was the largest event widely accepted in the scientific community as having been induced by fluid injection. The Rocky Mountain Arsenal earthquakes demonstrated how the diffusion of pore pressure within an ancient fault system can initiate earthquakes many kilometers from the injection point, delayed by months or even years after injection ceased (Hermann et al. 1981). The **M** 5.7 event in November 2011 in central Oklahoma is now the largest known induced seismic event (Kerenan et al., 2013). This earthquake damaged homes and unreinforced masonry buildings in the epicentral area and was felt as far as 1000 km away in Chicago, Illinois.

Seismicity may be induced tens of kilometers away from large-scale injection. The occurrence of seismicity farther away from injection implies that stress changes much smaller than 1 MPa may be

sufficient to trigger seismicity even in naturally quiescent areas. Recent studies indicate that effective stress changes on the order of 100 kPa (14.5 psig) or less can found near earthquake hypocenters (Keranen et al., 2014; Barbour et al., 2017; Norbeck and Rubinstein, 2018; Zhai et al., 2020).

Even faults capable of **M** 5 earthquakes may be previously unknown. In many of the induced seismicity cases, faults that hosted even the largest events > **M** 5 were not known beforehand (Templeton et al., 2023). Even natural events, such as the 2014 Napa, California earthquake, often occur on blind faults (Brocher et al., 2015). This can be related to the difficulty of imaging faults in basement rocks or the lack of vertical offset in the sedimentary overburden from subvertical strike-slip faults.

The largest injection-induced events have all involved faulting that is considerably deeper than the injection interval (Horton, 2012), suggesting that transmission of increased pressure into the basement elevates the potential for inducing earthquakes. Hence, during geologic storage of CO_2, it is important that pressure perturbation from injection not be transmitted below depths of injection.

Few commercial scale geologic CO_2 storage sites exist that can be used as prototypes to study induced seismic response. The Cogdell CO_2 enhanced oil recovery project has been associated with felt earthquakes. The seismicity in the Cogdell project has been attributed to the very high injection rates and the presence of faults in the reservoir (Gan and Frohlich 2013). At the Illinois basin–Decatur project and the associated Illinois Industrial Carbon Capture and Sequestration Sources project, as of 2022, 2.8 million metric tons of CO_2 have been injected into the Mt. Simon saline sandstone reservoir with detection of nearly 20,000 seismic events with **M** up to 1.2, although none have been felt at the surface (Williams-Stroud et al., 2020). As a result of seismic activity, injection was moved to a shallower zone within the Mt. Simon sandstone resulting in fewer seismic events (Williams-Stroud et al., 2020).

Dvory and Zoback (2021) state that since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

One study of particular relevance to the Carbon TerraVault I project is a potentially injection-induced earthquake swarm in 2005 associated with the WhiteWolf Fault (Goebel et al., 2016). It was comprised of a **M** 4.5 event on 22 September, followed by two **M** 4.7 and **M** 4.3 events the same day. The White Wolf swarm is suspected to be connected to fluid-injection activity at the Tejon Oil Field based on a statistical assessment of injection and seismicity rate changes (Goebel et al., 2015). Injection wells at the Tejon Oil Field targeted a 25–30 m thin, highly permeable stratigraphic zone within the Monterey formation composed of turbiditic sand lenses with maximum lateral extents of 1 to 2 km (Goebel et al., 2016). Recall that turbiditic sand lenses are targeted for CO_2 storage at the Carbon TerraVault I project.

Based on geological mapping, seismicity, and well-log data, Goebel et al. (2016) identified a seismically active normal fault referred to as “Tejon Fault” in proximity to the Tejon Oil Field which deepened (7.7 km) toward the northwest below the Wheeler Ridge fault before intersecting with the White Wolf Fault 8 km from injection wells (Figure 9). Pressure diffusion was likely influenced by an 11 km high permeability pathway along the seismically active part of the Tejon fault (Goebel et al., 2016). Numerical modeling indicated that for a fault zone permeability above ~300 mD and fault width below ~800 m, a pressure increase of just 0.01 MPa (1.5 psi) was sufficient to induce seismicity on a fault favorably

oriented to slip (Goebel et al., 2016) as also observed by Keranen et al. (2014) and Hornbach et al. (2015). Given the discussion here, the primary concern at the Carbon TerraVault I project is pressure transmission below the Monterey Formation, not above it. Investigative studies have demonstrated that pressure propagation can occur over large distances and depths during injection of fluids and that a very small pressure differential can induce seismicity. Hence, analysis conducted by CTV in the recirculated DEIR and Class VI permit applications does not eliminate the potential for inducted seismicity at the Carbon TerraVault I project.

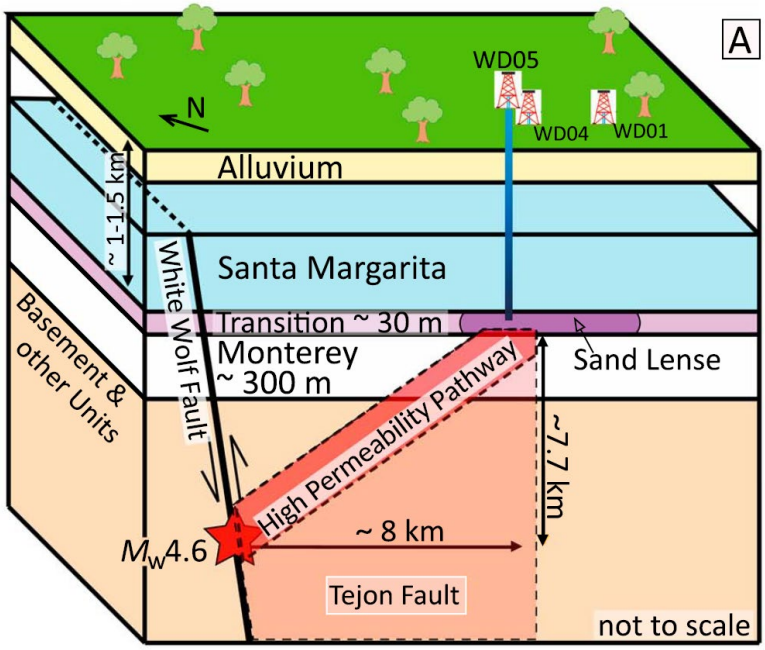

Figure 9. Schematic representation of pressure migration along a high-permeability fault between the Tejon Oil Field and a M 4.6 seismic event along the White Wolf Fault.

Comment: For induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the recirculated DEIR adequately consider induced seismicity. Callas et al. (2022) state that lack of a lower confining seal (permeability > 100 nanodarcy) is a disqualifying threshold for geologic storage of CO_2 because of potential pressure propagation to basement rock capable of producing seismic activity. According to schematics provided in Volume II of the recirculated DEIR (RDEIR, 2024b), the Reef Ridge Shale bounds both the upper lower Monterey Formation and has an average permeability of 0.01 millidarcy or 10,000 nanodarcy. As discussed, in the 26R and A1 - A2 Storage Areas, CTV states that final pressure will target the initial reservoir pressure at the time of discovery. Hence, this would decrease but not eliminate the possibility of induced seismicity.

Seismic Monitoring Network Design

The Class VI regulations do not include an explicit requirement for a seismic monitoring plan. However, in its Class VI Implementation manual for UIC Program Directors, EPA states that concerns about

seismicity or uncertainties about the seismic history of the site raised during site characterization may necessitate the inclusion of passive seismic monitoring (EPA, 2013).

Seismic data needs to be gathered, analyzed, and archived during the lifetime of a project for geologic storage of CO_2. These data are needed to accurately assess and periodically reassess the natural and induced seismic hazard and risk associated with the project and to aid in the rapid and effective detection and characterization of the seismicity at the site. This data is especially needed as input into induced seismicity mitigation plan protocols (e.g., traffic light systems). In general, the National Earthquake Information Center (NEIC) and other national or state monitoring systems are not sufficient for monitoring induced seismicity at a facility for geologic storage of CO_2 (Templeton et al., 2021). Routine detection of small events in the immediate vicinity of the injection site is necessary to detect problematic developments as early as possible.

The California Carbon Capture and Storage Review Panel recommended that seismic risks be considered during the operation and monitoring of CO_2 storage projects and stated that specialized seismic monitoring may be warranted (California Institute for Energy and Environment, 2010). The CARB protocol for CO_2 sequestration requires that the operator deploy and maintain a permanent, downhole seismic monitoring system to determine the presence or absence of any induced micro-seismic activity associated with all wells and near any discontinuities, faults, or fractures in the subsurface (CARB, 2018). Templeton et al. (2023) state that to record seismicity within the ROC, it is expected that the footprint of the seismic network would need to extend beyond the ROC. In the 26R Reservoir and A1 - A2 Area of Review areas, CTV will monitor seismicity with a network of surface and shallow borehole seismometers. Specifically, CTV will deploy 6 sensor locations (borehole and near surface) most of which are outside the Area of Review. CTV states that this data will help establish historical natural seismic event depth, magnitude, and frequency in order to distinguish between naturally occurring seismicity and induced seismicity resulting from CO_2 injection.

The Technical Advisory Committee to the California Carbon Capture and Storage Review Panel recommended that monitoring for induced seismicity should begin during the site selection and assessment phase to establish a baseline record of the natural background seismicity in the region encompassed by the project using the state's existing seismometer network augmented by a local network. Templeton et al. (2023) recommend that prior to commencing injection operations, a seismic monitoring network should be operated for at least 6 months but preferably 1 year or longer and be designed to detect and characterize seismicity occurring in the ROC down to at least **M** 1. CTV states in the Class VI permit application that a seismic monitoring network will establish an understanding of baseline seismic activity within the area of the project and that historical seismicity data from the Southern California Seismic Network will be reviewed to assist in establishing the baseline.

Comment: Templeton et al. (2023) state that a local seismic monitoring network should include a combination of high-gain sensors, which can optimally record weak ground motions from small local earthquakes, and low-gain accelerometers, which can optimally record strong ground motions from nearby larger earthquakes. Templeton et al. (2023) also state that each seismic station should measure ground motion in three orthogonal directions (e.g., up-down, north-south, and east-west) to fully capture the movement of the seismic waves as they travel through the earth. In Volume II of the recirculated

DEIR (RDEIR, 2024b), CTV states that high-sensitivity 3-component geophones will be utilized for seismic monitoring. The system will be designed with the capability of detecting and locating events > 0.0 **M** within the project area. Additionally, CTV will monitor data from nearby (~5-8mi) existing broadband seismometers and strong motion accelerometers of the Southern California Seismic Network. The California Geological Survey should ensure that the seismic monitoring network is of sufficient robustness.

Comment: Templeton et al. (2023) state that the seismic monitoring network should be able to record and locate seismicity in the ROC with at least a 2-sigma location accuracy of 0.5 km in the horizontal direction and 1.0 km in the vertical direction. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV states that the seismic monitoring network will be sufficient to resolve events greater than 0 magnitude, with a 1,000 ft. vertical resolution at the injection depths and above. The California Geological Survey should ensure that the seismic monitoring network is of sufficient resolution.

Comment: Templeton et al. (2023) state that seismic monitoring networks should be designed, and stations located, such that ground velocities of 600 nm/s can be recorded with a signal-to-noise ratio of at least 6 in the frequency range 5–40 Hz within the ROC. In Volume II of the recirculated DEIR (RDEIR, 2024b), CTV also states that borehole sensors have been deployed to ensure a good quality signal to minimize noise and that a velocity model will be derived from vertical seismic profiles, sonic well logs, and check shots. Information on the signal-to-noise ratio in the seismic network should be provided in the recirculated DEIR.

Comment: Templeton et al. (2023) state that the data should be recorded using at least a 24-bit digital data acquisition system and a global positioning system-based field timing system to achieve the required timing accuracy of at least 1 ms. In Volume II of the recirculated DEIR (DEIR, 2024b), CTV states that waveform data is to be transmitted near real-time via cellular modem or other wireless means and archived in a database. Timing accuracy was not specified in the recirculated DEIR, but should be.

Seismicity Mitigation Plan

If the project operator obtains evidence that an earthquake has caused a failure of the mechanical integrity of wells, facilities, or pipelines, which may cause potential CO_2 emissions to the atmosphere, the project operator must implement an Emergency Remedial Response Plan (CARB, 2018). The operator should create a site-specific induced seismicity mitigation plan for the DEIR based on a Traffic Light System (TLS) framework (Templeton et al., 2023). Templeton et al. (2023) state that the TLS framework should include at least three response levels, indicating operation as usual (green), heightened awareness and reassessing and modifying as appropriate of injection operations (yellow), and stopping injection (red). In the Class VI permit application, CTV created a five-response level (green, yellow, orange, magenta, red) seismicity mitigation plan.

Comment: The preliminary results of the seismic evaluation must be reported to CARB within 30 days following the earthquake, with a final report submitted within 120 days (CARB, 2018). The report must include, at a minimum: (1) the date, time, and magnitude of the earthquake; (2) the location and distance of the epicenter from the CCS project; (3) the results of the investigation into the link between the

injection activity and the earthquake or pattern of seismicity; (4) any emergency and remedial actions taken; (5) a description of any investigations and tests conducted to assess the mechanical integrity of wells and other surface equipment, and a demonstration that the well and equipment were either not damaged by the earthquake or that mechanical integrity was restored prior to the re-initiation of injection; and (6) any identified changes necessary to the CCS project Testing and Monitoring Plan (CARB, 2018). There is no mention of reporting of seismic events to CARB in the seismicity mitigation plan in Volume II of the recirculated DEIR

Comment: Of perhaps greater concern are naturally occurring seismic events at distance from the facility. In these cases, a seismic mitigation plan specified in terms of peak ground velocity or ground acceleration would be more useful in the DEIR.

Conclusions and Recommendations

There is interest in using depleted oil and gas reservoirs, such as the Carbon TerraVault I project for geological storage of CO_2 due to extensive preexisting geological characterization and infrastructure. Also, since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

However, well penetrations are widely recognized as a primary pathway for leakage during geologic storage of CO_2. There are an extraordinarily large number of wellbores (354) penetrating the primary confining layer (Reef Ridge Shale) at the Carbon TerraVault I project. Leakage through wellbores will be facilitated by the high pressure of storage (~4,000 psi) and storage occurring primarily as a separate phase supercritical fluid. All 354 wellbores will eventually be in direct contact with highly pressurized supercritical CO_2 – a highly corrosive medium.

Complicating matters further is the fact that that the Carbon TerraVault I project is located in an area of high natural seismicity. The probability of a natural seismic event capable of causing wellbore damage in the project area is quite high (~20% within 100 years). Given the large number of well penetrations, high pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. The success or failure of geologic storage of CO_2 at the Carbon TerraVault I project will largely depend on minimizing leakage from well penetrations.

The importance of properly evaluating wellbores prior to plugging to determine the need for corrective action and evaluating wellbores that have been plugged sometime in the past cannot be stressed enough. Unfortunately, tables provided for the 26R and A1- A2 reservoirs in Volume II of the recirculated DEIR do not provide sufficient information on wellbore integrity. CTV claims that no wellbores require corrective action – a claim that must be viewed with considerable skepticism since wellbore integrity failure rates published from oil and gas sites in the literature range from 2 to 75%.

In one column of the tables provided in the recirculated DEIR, annular isolation of wellbores within the upper confining later is subjectively described as "*adequate.*" No proof of adequacy of any wellbore beyond those used for injection was provided in the DEIR or Class VI permit applications. CTV should immediately submit all supporting information (drilling logs, well completion and plugging reports,

casing and cementing records, records on internal and external mechanical integrity testing, cement bond/variable density logs, and wellbore diagrams) to the public record.

In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, the recirculated DEIR should not be approved.

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Attachment A
to Technical Comments of Dominic DiGiulio, PhD:
Qualifications and Experience

Dominic DiGiulio

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Background

I am a retired geoscientist from the U.S. Environmental Protection Agency. I have conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. I assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide. I have served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. My consulting services have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

Education

B.S., Environmental Engineering, Temple University, Philadelphia, PA (1982)
M.S., Environmental Science, Drexel University, Philadelphia, PA (1988)
Ph.D., Soil, Water, and Environmental Science, University of Arizona, Tucson, AZ (2000)

Employment

Independent Consultant: Feb 2023 - present

Research Affiliate: University of Colorado, Boulder, CO: October 2020 - present. I conduct research on the impact of abandoned wells on air, surface water, and groundwater quality.

Senior Research Scientist: PSE Healthy Energy, Oakland, CA: Jan 2017 – Feb 2023. My research focused on evaluating the impact of oil and gas development on water resources and air quality. In addition to publishing findings of my research in peer-reviewed journals and reports, I provided testimony on oil and gas development rule-making, served as an expert witness in litigation against oil and gas corporations, and have testified before Congress on the impact of oil and gas development on water resources.

Research Associate: Stanford University, Stanford, CA: Apr 2014 – May 2019. I conducted research on the impact of oil and gas development to groundwater.

Environmental Engineer: U.S. Environmental Protection Agency, Office of Research and Development, Ada, OK: Sep 1988 – Mar 2014 (retired). Duties included providing regulatory oversight assistance to

EPA remedial project managers and conducting research related to subsurface gas flow and vapor transport. Research included: (1) Development of methods to improve the effectiveness of soil vapor extraction, bioventing, and air sparging subsurface remediation systems including lead authorship of EPA's primary technical resource document in these areas; (2) Co-development of analytical solutions and associated codes for estimation of gas permeability and gas flow in soil; (3) Development of analytical solutions to simulate combined solute and vapor transport in soil including lead authorship of the model *VFLUX;* (4) Development of field methods to improve active soil-gas sampling especially pertaining to leak and purge testing; (5) Development of forensic techniques (use of hydrocarbon degradation products and radon) and assistance in development of EPA guidance to evaluate vapor intrusion (migration of organic compounds from ground water to indoor air); (6) Development of ground water and soil gas monitoring strategies including assistance in development of EPA's Class VI rule on geologic sequestration of carbon dioxide; (7) Development of methods to evaluate impact to Underground Sources of Drinking Water (USDWs) under the Safe Drinking Water Act and stray gas migration due to hydraulic fracturing. Research activities included conducting seminars, workshops, and short courses to States.

Environmental Engineer (Remedial Project Manager: U.S. Environmental Protection Agency, Region III, Philadelphia, PA: Jun 1980 – Dec. 1981 and Sep 1982 – Jan 1988. Duties included: conducting investigations (e.g., remedial investigations, risk assessments, feasibility studies, sample collection) under the Comprehensive Environmental Response and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA), federal contractor oversight, preparation of consent orders and initiation of enforcement actions.

Military Service: U.S. Marine Corps: Active duty 1975-1978, Camp Pendleton, CA, Honorable Discharge in 1981.

Scientific Awards

5 EPA Bronze Medals: (1) Development of EPA Guidance Document on Soil Vacuum Extraction, (2) Technical Support to EPA's Program and Regional offices on Subsurface Gas Flow and Vapor Transport, (3) Development of EPA Guidance on Vapor Intrusion, (4) Research on Vapor Intrusion, (5) Development of Class VI Rule on Geologic Sequestration of Carbon Dioxide

3 EPA Honor Awards: (1) Development of a National Risk Management Research Laboratory Strategic Research Plan, (2) Development of a Protocol to Assess Vapor Intrusion; (3) Technical support at Leaking Underground Storage Tank Sites

3 EPA Scientific and Technological Achievement Awards: (1) Innovative Design of Soil Vacuum Extraction Systems, (2) Development of Analytical Model to Simulate Transient Flux of Volatile Organic Compounds in Soil to Ground Water and the Atmosphere, (3) Simulation of Geochemical Impacts to Ground Water from Leakage of Carbon Dioxide

Peer-Reviewed Journal Publications, Reports, and Book Chapters

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Kang, M.; Boutot, J.; McVay, R.; Roberts, K.; Jasechko, S.; Perrone, D.; Tao T.; Lackey, G.; Raimi, D.; DiGiulio, D.C.; Shonkoff, S.B.C.; Carey, J.W.; Elliott, E.G.; Vorhees, D.J.; Peltz, A.S. **2023.** Environmental risks and opportunities of orphaned oil and gas wells in the United States. *Environmental Research Letters*, 18, 7, 074012.

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DiGiulio, D.C. **2018**. Examination of Groundwater Resources in Areas of Glacier, Liberty, Hill, Chouteau, Blaine, Phillips, and Valley Counties in Montana Proposed for the March 2018 BLM Lease Sale, Jan 10, 2018

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ATTACHMENT C

Accufacts Inc.
"Clear Knowledge in the Over Information Age"

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July 17, 2024

Attn: Earthjustice
Michelle Ghafar
50 California Street, Suite 500
San Francisco, CA 94111

Re: Observations concerning Kern County's Recent Recirculated Draft Environmental Impact Report ("RDEIR") on the TerraVault I Carbon Capture and Storage Project ("Project").

Accufacts Inc. ("Accufacts") has reviewed the latest Kern County submission for the above Project, retitled Recirculated Draft Environmental Impact Report.[1] Accufacts has the following brief major observations that are by no means an inclusive listing of the many deficiencies concerning the RDEIR:

1. **As with the original DEIR, the RDEIR is vague and misleading throughout the document and does not properly address the major shortcomings provided in previous comments submitted on the original DEIR. (See attached report submitted on the original DEIR on March 1, 2024.)**

2. **The RDEIR lists possible new sources to supply CO_2 to the Elk Hills reservior without identifying how such sources will be transported to the Elk Hill facilities—a critical omission.[2]**

3. **The addition of the CPUC process in the RDEIR should be raising serious concerns about possible efforts to move CO_2 in converted existing pipelines as a gas to circumvent the moratorium on development of intrastate gas pipelines within the state.[3]**

How additional CO_2 sources will be transported to the Elk Hills facilities, and in what phase (i.e., gas or liquid), is an important safety jurisdiction matter for such pipelines. Severe deficiencies in current CO_2 pipeline safety regulations, both at the federal and state level, leave major regulatory safety gaps needed to protect the public from this mode of CO_2 pipeline transportation, liquid or gas. Pipeline safety regulations are even weaker for CO_2 gas phase pipelines (new or converted

[1] Kern County Planning and Natural Resources Department, "Recirculated Draft Environmental Impact Report, Volumes 1 and 2," June 2024.
[2] *Ibid.,* Volume 1, p. 4.11-53 & 4.11-54.
[3] *Ibid.,* Volume 1, p. 4 – 11 to 54.

existing) than that for liquid CO_2 pipelines. The RDEIR remains incomplete regarding these important details.

As in the original DEIR, the Project continues to disregard badly needed safety regulatory efforts, either at the state or federal level, before prudent safety regulations can be developed and implemented.

Richard B. Kuprewicz

Richard B. Kuprewicz,
President,
Accufacts Inc.

Attachment A
to Technical Comments of Richard Kuprewicz:
February 26, 2024 Technical Comments of
Richard Kuprewicz

Accufacts Inc.
"Clear Knowledge in the Over Information Age"

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Redmond, WA 98052
Ph (425) 802-1200
kuprewicz@comcast.net

February 26, 2024

Attn: Earthjustice
Michelle Ghafar
50 California Street, Suite 500
San Francisco, CA 94111

Re: Observations concerning Kern County's Draft Environmental Impact Report ("DEIR") on the TerraVault I Carbon Capture and Storage Project ("Project").

A. Summary of DEIR.

The above referenced DEIR makes many statements that are confusing or misleading, lacking critical information to allow decision makers, including the public, to make an informed evaluation and decision about the proposed Project from this document. It appears that many of these statements relate to safety jurisdiction of various agencies, which based on my extensive experience, are confusing, if not misleading. It appears that the Project is getting ahead of badly needed safety regulatory efforts, either at the state or federal level before prudent safety regulations can be developed and implemented. Section 3 below identifies eight areas where the DEIR needs to be supplemented with important details before this Project is allowed to proceed. Lack of such detail has served to be a recurring problem across the U.S. as states and local governments wrestle with serious gaps in pipeline safety regulations for CO_2 pipelines as a result of an onslaught of multibillion dollar proposals incentivized by recent federal tax credits. A 2022 paper identifies at least eight serious deficiencies in current federal minimum pipeline safety regulations concerning liquid CO_2 pipelines summarized as follows:[1]

1. The definition of carbon dioxide needs to be updated.
2. Scientifically based regulation on impact areas for CO_2 pipeline ruptures needs to be promulgated.
3. Regulatory reference to industry recommended practices should be avoided.
4. Fracture propagation protection on CO_2 pipelines needs to be codified.
5. The use of odorant in CO_2 pipelines should be mandated.
6. Pipeline operations and maintenance manuals should require specific coordination with local emergency response personnel.
7. Maximum contaminant impurities for CO_2 pipelines should be specified.
8. Regulations for conversion of existing pipelines to CO_2 service should be developed.

[1] Richard B. Kuprewicz, President of Accufacts Inc., prepared for the Pipeline Safety Trust, "Accufacts' Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.," March 23, 2022, pp. 12 &13.

B. The TerraVault 1 Carbon Capture and Storage Project DEIR - a simple synopsis.

The TerraVault 1 Project proposes to capture CO_2 from the existing Elk Hills oil field, produced by separating a portion of the pre-combustion field gas production into "high-purity" CO_2 streams at two existing or relocated cryogenic and fractionation natural gas plant facilities identified as "CGP-1." The term high purity is not defined in the DEIR, but is a critical parameter given that existing federal minimum pipeline safety jurisdiction currently establishes a CO_2 purity of more than 90% in a poorly worded definition of carbon dioxide.[2]

The high-purity CO_2 streams will then be transported from the two CGP-1 processing/treating locations by "Facility Pipelines" which will be newly constructed pipelines.[3] The DEIR also uses the term Injection Pipelines. The definition of both Facility Pipelines and Injection Pipelines needs to be clarified as well as their transition boundaries as these terms have specific meaning in the industry and affect regulatory safety jurisdictions, if any, of various federal and state agencies that might become involved.

The DEIR indicates that new pipelines of up to 16-inches in diameter, approximately 5.61 miles long for phase 1, and approximately 7.59 miles long for phase 2, will transport CO_2 to six injection wells at two sequestration reservoir sites within the site plan (to 26R Monterey Formation Reservoir at an approximate depth of 6,000 feet for phase 1's four injection well sites, and to A1-A2 Monterey Formation Reservoir, approximately 8,500 feet deep for phase 2's two injector well sites).[4]

C. Critically important and needed pipeline information is missing in the DEIR.

Important pipeline information is missing in the DEIR that will not permit decisionmakers to make an informed decision about this Project. For example, some of the many major shortcomings in the DEIR related to pipeline issues are:

1. The purity of the claimed "high-purity" CO_2 stream has not been provided.

The CO_2 purity sets a simple bar as to whether the Pipeline and Hazardous Materials Safety Administration, or PHMSA, the federal agency chartered with transportation pipeline safety regulations, or for that matter the California Office of the State Fire Marshal, or OSFM, the state agency chartered with intrastate liquid transportation pipeline safety oversight in California, has any pipeline safety jurisdiction under current transportation pipeline safety regulations. The DEIR needs to provide the minimum purity of the CO_2 stream for reinjection and how this minimum will be controlled/maintained and assured. If the CO_2 purity is not above 90 %, the pipeline facilities are not regulated as transportation pipelines under current federal pipeline safety regulations.

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[2] 49CFR§195.2 Definitions - *Carbon Dioxide*.
[3] DEIR, Volume 1, pp. 3-18 & 3-19.
[4] DEIR, Volume 1, pp. 3-21 & 3-22.

Since the CO_2 will be produced from the oil/gas field, the DEIR also needs to present how possible impurities in the CO_2 stream will be limited and controlled. This is especially important for water as water in CO_2 pipelines is not tolerated well in carbon steel pipeline systems. Water in such CO_2 systems can experience extremely unpredictable and high corrosion rates that can quickly result in pipeline rupture failure.

2. **The DEIR discussion of Facility Pipelines and Injection Pipelines is not clear.**

   Facility Pipelines and Injection Pipelines usually have special meaning/distinction within the industry and whether any pipeline safety agency has any jurisdiction. The DEIR is very confusing on this important issue, labeling for example Injection Pipelines under the heading Facility Pipelines in the figures' legends.[5] PHMSA, or for that matter the OSFM, may not have any jurisdiction on this Project or parts of this Project.

3. **The DEIR indicates that the Facility Pipelines will operate at pressures roughly 1,700 to 2,100 psig for "dense phase" transport.[6]**

   Psig, or pounds per square inch gauge, is a pressure measurement used in the industry. The pressure range for this system, while higher than conventional liquid transportation pipelines, is not unusual for dense phase CO_2 pipelines. Dense phase is a term used to mean either liquid **or** supercritical CO_2 phase for a liquid pipeline, and is not defined in either Federal or California pipeline safety regulations.[7] What phase a specific CO_2 liquid pipeline segment is in (liquid or supercritical) at the time of a pipeline rupture can have a significant impact on rupture release dynamics, the tonnage of pipeline inventory that will be vented even after mainline valves are closed, and associated attempts to model possible rupture impact zones and attempts at establishing realistic safety buffer zones.

4. **The DEIR does not provide important pipeline parameters.**

   At this stage of the Project, the pipeline operator should be able to provide the pipeline specifics such as: pipe grade, thickness, diameter, and maximum operating pressure, or MOP, a term defined in federal pipeline safety regulation having a specific meaning related to pipeline safety. As previously mentioned, the DEIR should also clearly delineate the general pipeline route, possible pipeline safety jurisdictional boundaries, and approximate location of main equipment such as pump/compressor stations. The lack of such basic information makes it difficult to determine a simple process flow scheme for the Project. This lack of such basic information also prevents decisionmakers from assessing impacts and to develop feasible mitigations for the Project. Not only does the DEIR lack such critical basic pipeline information, what information is supplied is also confusing. It appears the Project is being rushed and

[5] DEIR, Volume 1, p. 3-20, Figures 3-8 and 3-9, Location of Phase 1 Wells: 373-35R, 353X-35R, 345-36R, and 363-27R, and Location of the Phase 2 Wells: 357-7R and 355-7R, respectively.
[6] DEIR, Volume 1, p. 3-16.
[7] 49CFR§195 and California Code, Chapter 5.5. The Elder California Pipeline Safety Act of 1981.

missing basic information to permit independent evaluation and verification of the Project.

5. The location of compressor equipment is not well defined.

The DEIR states "Two new CO_2 compressor packages are proposed for installation at the facility. Compressors would be of the reciprocating type and driven by electric motors."[8] The general location and specific phase of the CO_2 feeding into such equipment is very important to the safe operation of the system and, more importantly, the compressors. One way to blow up a reciprocating compressor is to inadvertently introduce liquid into the compressor. I cannot determine from the limited and confusing information provided in the DEIR whether the location of the proposed compressors will be safely placed within the system to assure liquid CO_2 cannot be inadvertently introduced into the compressors.

6. The placement of mainline valves along the pipelines are not defined.

The DEIR states: "New valves would be installed based on regulatory and owner requirements."[9] As should become obvious from reading this report, such important valve determinations have not been clearly defined, so this DEIR citation is meaningless. Also, the DEIR does not identify whether mainline valves will be manually operated or remotely operated. Manually operated valves can take considerable time to reach and then close (especially for larger diameter pipelines such as a 16-inch mainline valve) increasing the tonnage of CO_2 released upon pipeline rupture.

As a point of reference, a 16-inch diameter CO_2 pipeline, depending on whether the CO_2 inventory is in a supercritical or liquid phase and its associated density, will release approximately 110 to 200 tons per mile of CO_2 upon a pipeline rupture once pipeline mainlines have been closed. What makes transportation pipelines unique, especially for CO_2, is the amount of tonnage undergoing phase change from cooling, that can be de-inventoried from a ruptured pipeline, releasing tons of CO_2 between mainline valves once such valves have been closed. The lack of timely closure of valves was a significant contributing factor for the Satartia, MS rupture CO_2 release as discussed later in this report.

7. The CO_2 temperature along the pipelines is not provided.

An important variable in the DEIR, approximate CO_2 temperature along the pipelines, dictates the CO_2, whether liquid or supercritical phase (which can change) along the pipelines as temperature changes at the expected pipeline operating pressure. This important temperature parameter is not mentioned nor discussed anywhere in the DEIR. What phase a segment of a pipeline is transporting CO_2 in can have serious significance on issues such as safety jurisdiction, design/operation, and pipeline rupture

[8] DEIR, Volume 1, p. 3-17.
[9] DEIR, Volume 1, p. 3-18.

release dynamics and safety buffer zones. For example, current federal minimum pipeline safety regulations do not regulate pipelines operating in liquid CO_2 phase. I have previously mentioned the importance of assuring that reciprocating compressors do not inadvertently receive liquid. Without understanding the initial phase CO_2 will most likely be in in a specific pipeline segment, attempts to establish safe buffer or impact zones are meaningless. Two temperature extreme boundary cases for CO_2 are usually necessary; a high temperature season and a low temperature season to assist in defining the range of CO_2 phases (liquid or supercritical), and associated release modeling/pipeline buffer safety margins for the operation.

8. The DEIR misses the importance of CO_2 phase.

The DEIR also misses the important differences associated with varying phases of CO_2 in a liquid pipeline operation that are not properly addressed in current pipeline safety regulations, leaving such pipelines basically unregulated in many critically important areas. While the DEIR attempts to address certain environmental impacts related to the Project, the real issue relates to pipeline safety and the possible impact to public safety. The DEIR is incomplete in this important area and needs to be supplemented with this missing information before this Project can move forward.

While not mentioned in the DEIR, at the expected pressures and temperatures of the proposed Project's pipelines, I would anticipate the Project's pipelines to be operated in either liquid CO_2 or supercritical CO_2 phases, with the phases changing somewhat with time depending on the temperature of the buried pipelines. Whether a pipeline segment is liquid or supercritical phase at the time of rupture affects the expected phase change occurring at the rupture site, the rate of release, the tonnage that will be released between closed valves, and expected buffer impact zones.

D. The California OSFM is limited in what pipeline safety regulations it can enforce for intrastate liquid carbon dioxide transportation pipelines.

Despite the best of recent intentions to enact improvements in carbon dioxide pipeline safety regulations within California, the California Legislature has failed to pass meaningful improvements in pipeline safety regulations as it applies to intrastate carbon dioxide pipelines. Without such new legislation, the California OSFM can only implement and enforce pipeline safety regulations for intrastate CO_2 liquid pipelines within the state as codified in federal minimum pipeline safety regulations (49CFR§195) intended for liquid transportation pipelines. Based on my extensive experience in California liquid pipeline operation and many pipeline investigations within the state, it is my understanding that the OSFM can only enforce federal pipeline safety regulations for CO_2 liquid pipelines codified in current federal regulations.

Federal regulations for carbon dioxide pipelines are currently woefully inadequate as discussed in more detail in my recently referenced March 23, 2022 CO_2 public paper. In addition, announcements by PHMSA to move forward with carbon dioxide safety regulations may miss many of the safety issues and concerns related to carbon dioxide liquid pipelines

which can take some time to properly address, given the highly unusual restrictive regulatory process imposed on PHMSA.[10]

E. The DEIR attempts to minimize the impact of the Satartia rupture on the public.

Some additional information might be helpful to add to the February 22, 2020 Satartia, MS 24-inch pipeline rupture discussion in the DEIR.[11] Depending on the density one assumes in the pipeline, the rupture released 3,000 to 5,000 tons of carbon dioxide after the mainline valves were eventually closed on the 24-inch pipeline, which took considerable time to isolate the ruptured segment**.** The CO_2 plume went beyond the Town of Satartia, crossing the Yazoo River, extending well over a mile from the pipeline release site which was basically downhill from the rupture releasing heavier than air CO_2. The DEIR fails to mention that the Town of Satartia was not identified as a high consequence area in the pipeline operator's integrity management program and the air dispersion model was unfit for the 24-inch pipeline. The high rain situations and steep terrain should not come as a surprise in this challenging location, and the wording in the DEIR appears to try to downplay that the rupture threat was a unique situation in that area of Mississippi. PHMSA's corrective action order requiring review of geohazard potential along the pipeline should dispel any illusion that breakaway landslide was an unusual threat. Despite the release of a PHMSA Advisory following the Satartia rupture, PHMSA knows that there have been pipeline regulations in effect for many decades that place the responsibility on the pipeline operator to monitor their pipeline right-of-way for signs of possible abnormal loading such as massive landslide potential (what is known in the industry as a breakaway landslide threat) that can easily result in pipeline rupture.[12]

F. Well Blowout prevention and Aliso Canyon similarities.

While not a specific pipeline associated matter, I have an ethical responsibility to note that the DEIR does not address the possibility of a CO_2 injection well blowout on any of the six proposed CO_2 injection wells. In late 2015, California was associated with an underground natural gas storage well blowout, the Aliso Canyon failure, that released well over 100,000 tons of natural gas which is normally lighter than air as compared to CO_2 which is heavier than air. The Aliso Canyon failure demonstrated to the public some of the risk of large high pressure underground storage reservoirs. I would advise that the Project incorporate some form of well blowout prevention design to prevent release of massive quantities of heavier than air CO_2 from the underground reservoirs should an injection well experience a blowout. The safety design should incorporate an approach with prudent independent safeties to assure that the installation will actually work and stop the release of CO_2 from the high-pressure reservoir if a well blowout occurs. Without getting into specific design issues, there are various ways to approach this possible threat, such as incorporating an automatic subservice safety valve as a blowout preventor on each injection well. The tonnage of CO_2 released from a well blowout

[10] "PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak," May 26, 2022 at PHMSA website: https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures.
[11] DEIR, Volume 1, pp. 4.9-8 & 4.9-9.
[12] PHMSA updated ADB-2022-01, "Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards," June 2, 2022.

can easily exceed, by many orders of magnitude, the tonnage of CO_2 released from a pipeline rupture. As history has often demonstrated, well blowouts can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases.

G. Background/Experience.

Accufacts was asked to review the DEIR for the Project recently released in December 2023.[13] I have over fifty years of experience in the energy industry, including almost 25 years as president of Accufacts Inc. ("Accufacts"). Accufacts provides independent expert consulting services to assist decision makers in making informed decisions concerning pipelines. Pipeline safety expertise is provided in areas including, but not limited to; pipeline failure investigation, risk management, siting, construction, design, operation, maintenance, training, control room management including Supervisory Control and Data Acquisition ("SCADA") approaches, leak/rupture detection, integrity management, emergency response, and pipeline safety regulatory development and compliance. Much of my background is grounded in pipeline incident investigations following numerous pipeline rupture tragedies spanning several decades.

For the past two decades I have been involved as a representative of the public, which carries special obligations to avoid a conflict of interest, in advancing pipeline safety regulations at the federal and various state levels as demonstrated by my CV. For example, I played a significant role representing the public in developing integrity management federal pipeline safety regulations in the early 2000s for both liquid and gas transmission pipelines. These regulatory approaches emulated a safety process approach that I instituted and developed for the City of Bellingham, WA. This process, identified as the Safety Immediate Action Plan, or SIAP, identified steps that the pipeline operator was to complete following the Bellingham rupture tragedy of June 10, 1999, before that pipeline could be permitted to be returned to service.

H. Conclusion.

The DEIR is seriously incomplete and deficient in many areas as discussed above. These deficiencies need to be properly addressed before a DEIR can be deemed complete and sufficient for the Project to move forward. It is my understanding that the County can require that such critical information related to pipeline safety and CO_2 pipelines can be ordered to be provided, or supplemented, before this Project can be allowed to move forward.

Richard B. Kuprewicz, President, Accufacts Inc. *Richard B. Kuprewicz*

[13] Draft Environmental Impact Report – SCH# 2022030180 Volume 1, Chapters 1 through 12, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol_1_Ch_1-12_upd.pdf, and Draft Environmental Impact Report – SCH# 2022030180 Volume 2, Appendices A-K, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol2.pdf, December 2023.

Attachment B
to Technical Comments of Richard Kuprewicz:
Qualifications and Experience

Curriculum Vitae.

Richard B. Kuprewicz

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Redmond, WA 98052

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Profile:

As president of Accufacts Inc., I specialize in gas and liquid pipeline investigation, auditing, risk management, siting, construction, design, operation, maintenance, training, SCADA, leak detection, management review, emergency response, and regulatory development and compliance. I have consulted for various local, state and federal agencies, NGOs, the public, and pipeline industry members on pipeline regulation, operation and design, with particular emphasis on operation in unusually sensitive areas of high population density or environmental sensitivity.

Employment:

Accufacts Inc. **1999 – Present**

Pipeline regulatory advisor, incident investigator, and expert witness on all matters related to gas and liquid pipeline siting, design, operation, maintenance, risk analysis, and management.

Position: President
Duties:
> Full business responsibility
> Technical Expert

Alaska Anvil Inc. **1993 – 1999**

Engineering, procurement, and construction (EPC) oversight for various clients on oil production facilities, refining, and transportation pipeline design/operations in Alaska.

Position: Process Team Leader
Duties:
> Led process engineers group
> Review process designs
> Perform hazard analysis
> HAZOP Team leader
> Assure regulatory compliance in pipeline and process safety management

ARCO Transportation Alaska, Inc. **1991 - 1993**

Oversight of Trans Alaska Pipeline System (TAPS) and other Alaska pipeline assets for Arco after the Exxon Valdez event.

Position: Senior Technical Advisor
Duties:
> Access to all Alaska operations with partial Arco ownership
> Review, analysis of major Alaska pipeline projects

ARCO Transportation Co. **1989 – 1991**

Responsible for strategic planning, design, government interface, and construction of new gas pipeline projects, as well as gas pipeline acquisition/conversions.

Position: Manager Gas Pipeline Projects
Duties:
> Project management
> Oil pipeline conversion to gas transmission
> New distribution pipeline installation
> Full turnkey responsibility for new gas transmission pipeline, including FERC filing

Four Corners Pipeline Co. **1985 – 1989**

Managed operations of crude oil and product pipelines/terminals/berths/tank farms operating in western U.S., including regulatory compliance, emergency and spill response, and telecommunications and SCADA organizations supporting operations.

Position: Vice President and Manager of Operations
Duties:
> Full operational responsibility
> Major ship berth operations
> New acquisitions
> Several thousand miles of common carrier and private pipelines

Arco Product CQC Kiln **1985**

Operations manager of new plant acquisition, including major cogeneration power generation, with full profit center responsibility.

Position: Plant Manager
Duties:
> Team building of new facility that had been failing
> Plant design modifications and troubleshooting
> Setting expense and capital budgets, including key gas supply negotiations
> Modification of steam plant, power generation, and environmental controls

Arco Products Co. **1981 - 1985**

Operated Refined Product Blending, Storage and Handling Tank Farms, as well as Utility and Waste Water Treatment Operations for the third largest refinery on the west coast.

Position: Operations Manager of Process Services
Duties:
> Modernize refinery utilities and storage/blending operations
> Develop hydrocarbon product blends, including RFGs
> Modification of steam plants, power generation, and environmental controls
> Coordinate new major cogeneration installation, 400 MW plus

Arco Products Co. **1977 - 1981**

Coordinated short and long-range operational and capital planning, and major expansion for two west coast refineries.

Position: Manager of Refinery Planning and Evaluation
Duties:
> Establish monthly refinery volumetric plans
> Develop 5-year refinery long range plans
> Perform economic analysis for refinery enhancements
> Issue authorization for capital/expense major expenditures

Arco Products Co. **1973 - 1977**

Operating Supervisor and Process Engineer for various major refinery complexes.

Position: Operations Supervisor/Process Engineer
Duties:
> FCC Complex Supervisor
> Hydrocracker Complex Supervisor
> Process engineer throughout major integrated refinery improving process yield and energy efficiency

Qualifications:

Served for over fifteen years as a member representing the public on the federal Technical Hazardous Liquid Pipeline Safety Standards Committee (THLPSSC), a technical committee established by Congress to advise PHMSA on pipeline safety regulations.

Committee members are appointed by the Secretary of Transportation.

Served seven years, including position as its chairman, on the Washington State Citizens Committee on Pipeline Safety (CCOPS).

Positions are appointed by the governor of the state to advise federal, state, and local governments on regulatory matters related to pipeline safety, routing, construction, operation and maintenance.

Served on Executive subcommittee advising Congress and PHMSA on a report that culminated in new federal rules concerning Distribution Integrity Management Program (DIMP) gas distribution pipeline safety regulations.

As a representative of the public, advised the Office of Pipeline Safety on proposed new liquid and gas transmission pipeline integrity management rulemaking following the pipeline tragedies in Bellingham, Washington (1999) and Carlsbad, New Mexico (2000).

Member of Control Room Management committee assisting PHMSA on development of pipeline safety Control Room Management (CRM) regulations.

Certified and experienced HAZOP Team Leader associated with process safety management and application.

Education:

MBA (1976)	Pepperdine University, Los Angeles, CA
BS Chemical Engineering (1973)	University of California, Davis, CA
BS Chemistry (1973)	University of California, Davis, CA

Publications in the Public Domain:

1. "An Assessment of First Responder Readiness for Pipeline Emergencies in the State of Washington," prepared for the Office of the State Fire Marshall, by Hanson Engineers Inc., Elway Research Inc., and Accufacts Inc., and dated June 26, 2001.

2. "Preventing Pipeline Failures," prepared for the State of Washington Joint Legislative Audit and Review Committee ("JLARC"), by Richard B. Kuprewicz, President of Accufacts Inc., dated December 30, 2002.

3. "Pipelines - National Security and the Public's Right-to-Know," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated May 14, 2003.

4. "Preventing Pipeline Releases," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated July 22, 2003.

5. "Pipeline Integrity and Direct Assessment, A Layman's Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated November 18, 2004.

6. "Public Safety and FERC's LNG Spin, What Citizens Aren't Being Told," jointly authored by Richard B. Kuprewicz, President of Accufacts Inc., Clifford A. Goudey, Outreach Coordinator MIT Sea Grant College Program, and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated May 14, 2005.

7. "A Simple Perspective on Excess Flow Valve Effectiveness in Gas Distribution System Service Lines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated July 18, 2005.

8. "Observations on the Application of Smart Pigging on Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated September 5, 2005.

9. "The Proposed Corrib Onshore System - An Independent Analysis," prepared for the Centre for Public Inquiry by Richard B. Kuprewicz, dated October 24, 2005.

10. "Observations on Sakhalin II Transmission Pipelines," prepared for The Wild Salmon Center by Richard B. Kuprewicz, dated February 24, 2006.

11. "Increasing MAOP on U.S. Gas Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2006. This paper was also published in the June 26 and July 1, 2006 issues of the Oil & Gas Journal and in the December 2006 issue of the UK Global Pipeline Monthly magazines.

12. "An Independent Analysis of the Proposed Brunswick Pipeline Routes in Saint John, New Brunswick," prepared for the Friends of Rockwood Park, by Richard B. Kuprewicz, dated September 16, 2006.

13. "Commentary on the Risk Analysis for the Proposed Emera Brunswick Pipeline Through Saint John, NB," by Richard B. Kuprewicz, dated October 18, 2006.

14. "General Observations On the Myth of a Best International Pipeline Standard," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2007.

15. "Observations on Practical Leak Detection for Transmission Pipelines – An Experienced Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated August 30, 2007.

16. "Recommended Leak Detection Methods for the Keystone Pipeline in the Vicinity of the Fordville Aquifer," prepared for TransCanada Keystone L.P. by Richard B. Kuprewicz, President of Accufacts Inc., dated September 26, 2007.

17. "Increasing MOP on the Proposed Keystone XL 36-Inch Liquid Transmission Pipeline," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated February 6, 2009.

18. "Observations on Unified Command Drift River Fact Sheet No 1: Water Usage Options for the current Mt. Redoubt Volcano threat to the Drift River Oil Terminal," prepared for Cook Inletkeeper by Richard B. Kuprewicz, dated April 3, 2009.

19. “Observations on the Keystone XL Oil Pipeline DEIS,” prepared for Plains Justice by Richard B. Kuprewicz, dated April 10, 2010.

20. “PADD III & PADD II Refinery Options for Canadian Bitumen Oil and the Keystone XL Pipeline,” prepared for the Natural Resources Defense Council (NRDC), by Richard B. Kuprewicz, dated June 29, 2010.

21. “The State of Natural Gas Pipelines in Fort Worth,” prepared for the Fort Worth League of Neighborhoods by Richard B. Kuprewicz, President of Accufacts Inc., and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated October, 2010.

22. “Accufacts’ Independent Observations on the Chevron No. 2 Crude Oil Pipeline,” prepared for the City of Salt Lake, Utah, by Richard B. Kuprewicz, dated January 30, 2011.

23. “Accufacts’ Independent Analysis of New Proposed School Sites and Risks Associated with a Nearby HVL Pipeline,” prepared for the Sylvania, Ohio School District, by Richard B. Kuprewicz, dated February 9, 2011.

24. “Accufacts’ Report Concerning Issues Related to the 36-inch Natural Gas Pipeline and the Application of Appleview, LLC Premises: 7009 and 7010 River Road, North Bergen, NJ,” prepared for the Galaxy Towers Condominium Association Inc., by Richard B. Kuprewicz, dated February 28, 2011.

25. “Prepared Testimony of Richard B. Kuprewicz Evaluating PG&E’s Pipeline Safety Enhancement Plan,” submitted on behalf of The Utility Reform Network (TURN), by Richard B. Kuprewicz, Accufacts Inc., dated January 31, 2012.

26. “Evaluation of the Valve Automation Component of PG&E’s Safety Enhancement Plan,” extracted from full testimony submitted on behalf of The Utility Reform Network (TURN), by Richard B.Kuprewicz, Accufacts Inc., dated January 31, 2012, Extracted Report issued February 20, 2012.

27. “Accufacts’ Perspective on Enbridge Filing to NEB for Modifications on Line 9 Reversal Phase I Project,” prepared for Equiterre Canada, by Richard B. Kuprewicz, Accufacts Inc., dated April 23, 2012.

28. “Accufacts’ Evaluation of Tennessee Gas Pipeline 300 Line Expansion Projects in PA & NJ,” prepared for the Delaware RiverKeeper Network, by Richard B. Kuprewicz, Accufacts Inc., dated June 27, 2012.

29. “Impact of an ONEOK NGL Pipeline Release in At-Risk Landslide and/or Sinkhole Karst Areas of Crook County, Wyoming,” prepared for landowners, by Richard B. Kuprewicz, Accufacts Inc., and submitted to Crook County Commissioners, dated July 16, 2012.

30. “Impact of Processing Dilbit on the Proposed NPDES Permit for the BP Cherry Point Washington Refinery,” prepared for the Puget Soundkeeper Alliance, by Richard B. Kuprewicz, Accufacts Inc., dated July 31, 2012.

31. “Analysis of SWG’s Proposed Accelerated EVPP and P70VSP Replacement Plans, Public Utilities Commission of Nevada Docket Nos. 12-02019 and 12-04005,” prepared for the State of Nevada Bureau of Consumer Protection, by Richard B. Kuprewicz, Accufacts Inc., dated August 17, 2012.

32. “Accufacts Inc. Most Probable Cause Findings of Three Oil Spills in Nigeria,” prepared for Bohler Advocaten, by Richard B. Kuprewicz, Accufacts Inc., dated September 3, 2012.

33. “Observations on Proposed 12-inch NGL ONEOK Pipeline Route in Crook County Sensitive or Unstable Land Areas,” prepared by Richard B. Kuprewicz, Accufacts Inc., dated September 13, 2012.

34. “Findings from Analysis of CEII Confidential Data Supplied to Accufacts Concerning the Millennium Pipeline Company L.L.C. Minisink Compressor Project Application to FERC, Docket No. CP11-515-000,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Minisink Residents for Environmental Preservation and Safety (MREPS), dated November 25, 2012.

35. “Supplemental Observations from Analysis of CEII Confidential Data Supplied to Accufacts Concerning Tennessee Gas Pipeline’s Northeast Upgrade Project,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Delaware RiverKeeper Network, dated December 19, 2012.

36. “Report on Pipeline Safety for Enbridge’s Line 9B Application to NEB,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Equiterre, dated August 5, 2013.

37. “Accufacts’ Evaluation of Oil Spill Joint Investigation Visit Field Reporting Process for the Niger Delta Region of Nigeria,” prepared by Richard B. Kuprewicz for Amnesty International, September 30, 2013.

38. “Accufacts’ Expert Report on ExxonMobil Pipeline Company Silvertip Pipeline Rupture of July 1, 2011 into the Yellowstone River at the Laurel Crossing,” prepared by Richard B. Kuprewicz, November 25, 2013.

39. “Accufacts Inc. Evaluation of Transco’s 42-inch Skillman Loop submissions to FERC concerning the Princeton Ridge, NJ segment,” prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated June 26, 2014, and submitted to FERC Docket No. CP13-551.

40. Accufacts report “DTI Myersville Compressor Station and Dominion Cove Point Project Interlinks,” prepared by Richard B. Kuprewicz for Earthjustice, dated August 13, 2014, and submitted to FERC Docket No. CP13-113-000.

41. “Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco’s Leidy Southeast Expansion Project,” prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated September 3, 2014, and submitted to FERC Docket No. CP13-551.

42. Accufacts’ “Evaluation of Actual Velocity Critical Issues Related to Transco’s Leidy Expansion Project,” prepared by Richard B. Kuprewicz for Delaware Riverkeeper Network, dated September 8, 2014, and submitted to FERC Docket No. CP13-551.

43. “Accufacts’ Report to Portland Water District on the Portland – Montreal Pipeline,” with Appendix, prepared by Richard B. Kuprewicz for the Portland, ME Water District, dated July 28, 1014.

44. “Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco’s Leidy Southeast Expansion Project,” prepared by Richard B. Kuprewicz and submitted to FERC Docket No. CP13-551.

45. Review of Algonquin Gas Transmission LLC’s Algonquin Incremental Market (“AIM Project”), Impacting the Town of Cortlandt, NY, FERC Docket No. CP14-96-0000, Increasing System Capacity from 2.6 Billion Cubic Feet (Bcf/d) to 2.93 Bcf/d,” prepared by Richard B. Kuprewicz, and dated Nov. 3, 2014.

46. Accufacts’ Key Observations dated January 6, 2015 on Spectra’s Recent Responses to FERC Staff’s Data Request on the Algonquin Gas Transmission Proposal (aka “AIM Project”), FERC Docket No. CP 14-96-000) related to Accufacts’ Nov. 3, 2014 Report and prepared by Richard B. Kuprewicz.

47. Accufacts’ Report on Mariner East Project Affecting West Goshen Township, dated March 6, 2015, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

48. Accufacts’ Report on Atmos Energy Corporation (“Atmos”) filing on the Proposed System Integrity Projects (“SIP”) to the Mississippi Public Service Commission (“MPSC”) under Docket No. 15-UN-049 (“Docket”), prepared by Richard B. Kuprewicz, dated June 12, 2015.

49. Accufacts’ Report to the Shwx’owhamel First Nations and the Peters Band (”First Nations”) on the Trans Mountain Expansion Project (“TMEP”) filing to the Canadian NEB, prepared by Richard B. Kuprewicz, dated April 24, 2015.

50. Accufacts Report Concerning Review of Siting of Transco New Compressor and Metering Station, and Possible New Jersey Intrastate Transmission Pipeline Within the Township of Chesterfield, NJ (“Township”), to the Township of Chesterfield, NJ, dated February 18, 2016.

51. Accufacts Report, “Accufacts Expert Analysis of Humberplex Developments Inc. v. TransCanada Pipelines Limited and Enbridge Gas Distribution Inc.; Application under Section 112 of the National Energy Board Act, R.S.C. 1985, c. N-7,” dated April 26, 2016, filed with the Canadian Nation Energy Board (NEB).

52. Accufacts Report, “ A Review, Analysis and Comments on Engineering Critical Assessments as proposed in

PHMSA's Proposed Rule on Safety of Gas Transmission and Gathering Pipelines," prepared for Pipeline Safety Trust by Richard B. Kuprewicz, dated May 16, 2016.

53. Accufacts' Report on Atmos Energy Corporation ("Atmos") filing to the Mississippi Public Utilities Staff, "Accufacts Review of Atmos Spending Proposal 2017 – 2021 (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 15, 2016.

54. Accufacts Report, "Accufacts Review of the U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) for the Dakota Access Pipeline ("DAPL")," prepared for Earthjustice by Richard B. Kuprewicz, dated October 28, 2016.

55. Accufacts' Report on Mariner East 2 Expansion Project Affecting West Goshen Township, dated January 6, 2017, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

56. Accufacts Review of Puget Sound Energy's Energize Eastside Transmission project along Olympic Pipe Line's two petroleum pipelines crossing the City of Newcastle, for the City of Newcastle, WA, June 20, 2017.

57. Accufacts Review of the Draft Environmental Impact Statement for the Line 3 Pipeline Project Prepared for the Minnesota Department of Commerce, July 9, 2017, filed on behalf of Friends of the Headwaters, to Minnesota State Department of Commerce for Docket Nos. CN-14-916 & PPL-15-137.

58. Testimony of Richard B. Kuprewicz, president of Accufacts Inc., in the matter West Goshen Township and Concerned Citizens of West Goshen Township v. Sunoco Pipelines, L.P. before the Pennsylvania Public Utilities Commission, Docket No. C-2017-2589346, on July 18, 2017, on Behalf of West Goshen Township and Concerned Citizens of West Goshen Township.

59. Direct Testimony of Richard B. Kuprewicz, president of Accufacts Inc., on Behalf of Friends of the Headwaters regarding Enbridge Energy, Limited Partnership proposal to replace and reroute an existing Line 3 to the Minnesota Office of Administrative Hearings for the Minnesota Public Utilities Commission (MPUC PL-9/CN-14-916 and MPUC PL-9/PPL-15-137), September 11, 2017 and October 23, 2017.

60. Direct Testimony of Richard B. Kuprewicz On Behalf of The District of Columbia Government, before the Public Service Commission of the District of Columbia, in the matter of the merger of AltaGas Ltd. and WGL Holdings, Inc., Formal Case No. 1142, September 29, 2017.

61. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2018 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated December 4, 2017.

62. Report to Hugh A. Donaghue, Esquire, Concord Township Solicitor, "Accufacts Comments on Adelphia Project Application to FERC (Docket No. CP18-46-000) as it might impact Concord Township," dated May 30, 2018.

63. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2019 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 20, 2018.

64. Report to West Goshen Township Manager, PA, "Accufacts report on the repurposing of an existing 12-inch Sunoco pipeline segment to interconnect with the Mariner East 2 and Mariner East 2X crossing West Goshen Township," dated November 8, 2018.

65. Report to West Whiteland Township Manager, PA, "Accufacts Observations on Possible Pennsylvania State Pipeline Safety Regulations," prepared by Richard B. Kuprewicz, dated March 22, 2019.

66. Accufacts Public Comments on the Proposed Joint Settlement, BI&E v. Sunoco Pipeline L.P. ("SPLP"), Docket No. C-2018-3006534 ("Proposed Settlement"), submitted on August 15, 2019 to the Pennsylvania Public Utility Commission on the behalf of West Goshen Township as an intervener.

67. Report to West Whiteland Township Manager, Ms. Mimi Gleason, "Accufacts Perspective on Two Questions from West Whiteland's Board of Supervisors on Proposed Changes to ME 2 and ME 2X Construction/Operational Activities within West Whiteland," dated September 5, 2019."

68. Report to West Goshen Township Manager, Mr. Casey LaLonde, “Accufacts Report on the episode on the evening of 8-5-19 at the Mariner East Boot Road Pump Station (“Event”), Boot Road, West Goshen Township, PA,” dated September 16, 2019.

69. Provided direct testimony before the Arizona Corporation Commission, In the Matter of the Application of Southwest Gas Corporation for the Establishment of Just and Reasonable Rates and Charges Designed to Realize a Reasonable Rate of Return on Fair Value of the Properties of Southwest Gas Corporation Devoted to its Arizona Operations (Docket No. G-01551A-19-0055), testified on behalf of Utilities Division Arizona Corporation Commission, February 19, 2020.

70. Report to West Goshen Township Manager, Mr. Casey LaLonde, “Accufacts Report on the Mariner East 2X Pipeline Affecting West Goshen Township,” dated July 23, 2020.

71. Assisted the Commonwealth of Massachusetts, Office of the Attorney General in developing pipeline safety processes to be incorporated into the settlement agreement related to Columbia Gas’ sale of Assets to Eversource following the Merrimack Valley, Massachusetts overpressure event of September 13, 2018.

72. Report to Natural Resources Defense Council, Inc., “Accufacts’ Observations on the Use of Keystone XL Pipeline Pipe Exhibiting External Coating Deterioration Issues from Long Term Storage Exposure to the Elements,” October 1, 2020.

73. Report to Pennsylvania Public Utilities Commission (“PAPUC”), “Accufacts Comments on Proposed Pennsylvania Intrastate Liquid Pipeline Safety Regulations,” dated October 29, 2021, prepared for West Whiteland Township Board of Supervisors, West Whiteland Township, PA. Filed to PAPUC public web docket November 5, 2021 by West Whiteland Township under Reference Docket Number L-2019-3010267. Addresses suggested improvements in proposed pipeline safety rules for PA intrastate liquid transmission pipelines.

74. Submitted written testimony of Richard B. Kuprewicz on Behalf of Bay Mills Indian Community to ALJ Dennis Mack, dated December 14, 2021, in the matter of the Application of Enbridge Energy, Limited Partnership for Authority to Replace and Relocate the Segment of Line 5 Crossing the Straits of Mackinac into a Tunnel Beneath the Straits of Mackinac, before the State of Michigan Public Service Commission, U-20763.

75. Public presentation to New York State Indian Point Nuclear Facility Decommissioning Oversight Board on Holtec removal activities in proximity to Enbridge three Natural Gas Transmission Pipelines, March 17, 2022.

76. Report to Pipeline Safety Trust and Bold Alliance, “Accufacts’ Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.,” March 23, 2022.

77. Accufacts Inc., Public Presentation For the National Academies of Science Engineering Medicine and The Transportation Research Board, “To Committee on Criteria for Installing Automatic and Remote-Controlled Shutoff Valves on Existing Gas and Hazardous Liquid Transmission Pipelines,” 4/27/22.

78. Accufacts Inc, “6/13/22 Webinar to Illinois Emergency Responders, Healthcare Providers, & Local Officials on Responses to CO_2 Transmission Pipeline Releases,“ 6/13/22.

79. Accufacts Report for Pipeline Safety Trust, “Safety of Hydrogen Transportation by Gas Pipelines,” 11/28/22.

80. Completed a series of testimonies related to Enbridge’s Line 5 proposal to replace 2 – 20-inch diameter existing submerged pipelines currently lying across the bottom of the Straits of Mackinac with a 30-inch diameter grade X-70 pipeline, proposed to be installed in a 21-foot diameter concrete tunnel to be installed across the approximate 4 mile span of the Straits of Mackinac. Testified on Behalf of the Bay Mill Indian Community before the State of Michigan Public Service Commission, Docket U-20763, in opposition to this very poorly designed proposal/installation allowing for movement of the pipeline on rollers within the tunnel. Final testimony to the docket submitted May 19, 2023. This is the only pipeline proposal I am aware of in the world that would place a crude oil and liquid propane pipeline, especially a 30-inch diameter pipeline, within a tunnel.

81. Issued to Ms. Niroop Srivatsa, City Manager, “Accufacts Report for the City of Lafayette on the Status of the Tree Assessment Process with PG&E,” indicating most of the trees identified for removal by PG&E risk management

approach have nothing to do with gas pipeline safety, June 15, 2023.

82. Issued Direct Testimony to Illinois Commerce Commission (“ICC”) on the Navigator Heartland Greenway LLC Application for a Carbon Dioxide Transportation and Sequestration pipeline, under Docket 23-0161, on behalf of Citizens Against Heartland Pipeline (“CAHGP”), McDonough County, Christian County and Hancock County (the “Counties”) (jointly, “Citizen and County Intervenors” of “CCI”), raising serious questions as to PHMSA’s recent assertions of pipeline safety jurisdiction, and underscoring the ICC’s authority for pipeline siting jurisdiction of said pipeline proposal in the State of Illinois, filed June15, 2023.

DEIR Comments

PLN21-01378

Carbon TerraVault I
(Kern County)

EARTHJUSTICE

December 20, 2023

VIA ELECTRONIC SUBMISSION

Lorelei Oviatt, AICP, Director
Kern County Planning and Natural Resource Dept.
2700 "M" Street, Suite 100
Bakersfield, CA 93301-2323
Loreleio@kerncounty.com
planning@kerncounty.com

Re: Request for Public Comment Extension for Draft Environmental Impact Report for Carbon TerraVault 1 (CTV 1) Carbon Capture and Sequestration Project

To Ms. Oviatt:

We are writing to request an extension of the public comment period for the Draft Environmental Impact Report ("DEIR") for the Carbon TerraVault 1 project (the "Project"). On behalf of the undersigned organizations, we ask that the Kern County Planning and Natural Resources Department ("the County") extend the deadline for comments on the DEIR by an additional forty-five (45) days—to March 28, 2024.

An extension of the deadline is warranted to give the public sufficient time to analyze and respond to the DEIR. The DEIR and its accompanying appendices are collectively more than 5,600 pages in length and highly technical, addressing a range of complex environmental and public health issues that will impact nearby community members, other Kern County residents, and the broader San Joaquin Valley for decades to come. Notably, the Project is expected to be the first facility-level deployment of carbon capture and sequestration technology in California, meaning the public and other responsible agencies have little to no experience considering this type of project and must be provided adequate time to review and fully vet the DEIR.

Although we appreciate that the current public comment period excludes the days that the Planning and Natural Resources Department will be closed for the holidays, the current 45-day timeframe for public input is still nonetheless inadequate given the scope, length, technicality, and importance of the DEIR.

In light of the foregoing "unusual circumstances,"[1] the County can and should extend the comment period by 45 days.

Granting an extension would also allow the County, in the interim, to take steps to ensure that Spanish-speaking residents in the nearby communities of Buttonwillow and Taft receive *at least* the minimum 45 days to learn about the Project and the DEIR in Spanish and provide comments on it. In Buttonwillow, two-thirds of the adults and four-fifths of the children speak Spanish at home.[2] Taft is also home to a significant number of Spanish speakers.[3]

To make the process inclusive of Spanish speakers, the County can and should do at least the following:

- Reissue and republish the Notice of Availability and any further Project notice(s), including notices of workshops and hearings in Spanish.

- Translate into Spanish and post, at a minimum, the Executive Summary of the DEIR; the translated Executive Summary and any other translated sections should be posted at least 45 days prior to the close of the extended public comment period.

- Postpone the currently scheduled public workshops until at least two weeks after the Notice of Availability and materials are made available in Spanish.

- Ensure that the workshops are easily accessible to Spanish-speaking and low-income community members by: (a) inviting residents to ask questions or offer comments in Spanish; (b) providing two-way, simultaneous Spanish and English interpretation services for any oral presentations and all verbal comments; and (c) providing a Spanish-language version of any slides or other written materials.

- Ensure that hearings before the Kern County Planning Commission and Board of Supervisors are easily accessible to Spanish-speaking and low-income community members by: (a) inviting residents to ask questions or offer comments in Spanish; (b) providing two-way, simultaneous Spanish and English interpretation services for any oral presentations and all verbal comments; (c) providing a Spanish-language

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[1] Cal. Code Regs., tit. 14, § 15105 (a).

[2] https://censusreporter.org/profiles/16000US0609332-buttonwillow-ca/.

[3] https://censusreporter.org/profiles/16000US0677574-taft-ca/.

version of any slides; and (d) allowing residents to join the hearings by phone, computer, or in person.

As our State's bedrock environmental protection and community right-to-know law, the California Environmental Quality Act was intended to allow the public to gain full information about proposed projects and to participate meaningfully in government decisions. Extending the comment deadline by 45 days and taking steps to include Spanish-speaking residents would better allow members of the public to obtain and review the DEIR and provide informed comments to the County on this important matter.

Thank you for considering this request. We welcome the opportunity to work with you moving forward.

Nirit Lotan
Earthjustice
50 California Street, Suite 500
San Francisco, CA 94118
(415) 217-2032
nlotan@earthjustice.org

Liz Jones
Senior Attorney, Climate Law Institute
Center for Biological Diversity
1212 Broadway, Suite 800
Oakland, CA 94612
(310) 365-9281
ljones@biologicaldiversity.org

Genevieve Amsalem
Director, Air and Climate Justice Team
Central California Environmental Justice Network
1400 Chester Ave, Suite L,
Bakersfield, CA 93301, USA
(248) 860-0852
genevieve.amsalem@ccejn.org

Gordon Nipp
Vice Chair, Kern-Kaweah Chapter

Sierra Club
P.O. Box 3357
Bakersfield, CA 93385
(661) 477-1140
gordon.nipp@kernkaweah.sierraclub.org

Keith Alvidrez

From: Lau, Scott@DOT <Scott.Lau@dot.ca.gov>
Sent: Wednesday, December 27, 2023 9:50 AM
To: Keith Alvidrez
Cc: Deel, David@DOT; Mendibles, Lorena@DOT
Subject: ZCC 4, 5 / CUP 2, 3, 5, 6, 13, 14 / ZCC 4, 5 / MAP 119, 120, 138 Carbon TerraVault I

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Hi,

I have reviewed the Carbon TerraVault development and have no comments.

Respectfully,

Scott Lau
Associate Transportation Planner
California Department of Transportation
1352 West Olive Avenue
Fresno, CA 93778
Cell: (559) 981-7341

Office Memorandum

To: Lorelei Oviatt, Director
Planning and Natural Resources Department
Attn: Keith Alvidrez, Planner II

January 8, 2024

From: Cesar Ayon, Engineering Manager CA
Public Works Department/Development

Subject: 7-8.3.b Draft Supplemental Environmental Impact Report for Carbon Terravault I Project by California Resources Corporation (PP22405)

Development Review Division

This Division has reviewed the subject project and has no comment.

Thank you for the opportunity to comment on this project. If you have any questions or comments, please contact Rodd Parke of this Division at (661) 862-8848.

Floodplain Management Division

This Division has reviewed the subject project and has the recommend the following:

The runoff of storm water from the site will be increased due to the increase in impervious surface generated by the proposed development.

Therefore, this Division recommends the following be included as Conditions of Approval for this project:

The applicant shall provide a plan for the disposal of drainage waters originating on site and from adjacent road right-of-ways (if required), subject to approval of the Public Works Department, per the Kern County Development Standards.

Thank you for the opportunity to comment on this project. If you have any questions or comments, please contact Brian Blaise of this Division at (661) 862-5098.

Sewer and Water Division

This Division has reviewed the subject project and has no comment.

Thank you for the opportunity to comment on this project. If you have any questions or comments, please contact Kyle Perez of this Division at (661) 862-8852.

CSA Division

This Division has reviewed the subject project and has no comment.

Thank you for the opportunity to comment on this project. If you have any questions or comments, please contact Stephan Chavira of this Division at (661) 862-5115.

SoCalGas
A Sempra Energy utility

Transmission Technical
Services Department

9400 Oakdale Ave
Chatsworth, CA 91311
SC9314

January 18, 2024

Keith Alvidrez
Kern County
AlvidrezK@kerncounty.com

Subject: **Carbon TerraVault I (Kern County) by California Resources Corporation (CRC) (PP22405); ZCC 5, Map 119; ZCC 4, Map 120; CUP 13, Map 118; CUP 14, Map 118; CUP 5, Map 119;
CUP 6, Map 119; CUP 3, Map 120; CUP 2, Map 138**

DCF: **0008-24NC**

The Transmission Department of SoCalGas does not operate any facilities within your proposed improvement. However, the Distribution Department of SoCalGas may maintain and operate facilities within your project scope.

To assure no conflict with the Distribution's pipeline system, please e-mail them at:

NorthwestDistributionUtilityRequest@semprautilities.com

Best Regards,
Nerses Papazyan
SoCalGas Transmission Technical Services
SoCalGasTransmissionUtilityRequest@semprautilities.com

Keith Alvidrez

From: Raylene Borrego <Raylene.Borrego@sanmanuel-nsn.gov>
Sent: Friday, January 19, 2024 10:49 AM
To: CTV1EIRComments
Subject: Response to Review EIR Draft for the Carbon TerraVault I Project, Kern County, [COU-KERN-2023-15]

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Dear Keith,

Thank you for contacting the Yuhaaviatam of San Manuel Nation (formerly the San Manuel Band of Mission Indians) regarding the above-referenced project. YSMN appreciates the opportunity to review the project documentation, which was received by the Cultural Resources Management Department on December 22nd, 2023. The proposed project is located outside of Serrano ancestral territory and, as such, YSMN will not be requesting to receive consulting party status with the lead agency or to participate in the scoping, development, or review of documents created pursuant to legal and regulatory mandates.

Kindly,

Raylene Borrego
Cultural Resources Technician
Raylene.Borrego@sanmanuel-nsn.gov
O:(909) 864-8933 x 50-2035
M:(909) 737-3349
26569 Community Center Dr Highland, California 92346

Keith Alvidrez

From: Alvaro Ramos <ramosalvaro131313@gmail.com>
Sent: Monday, January 22, 2024 12:11 PM
To: CTV1EIRComments
Subject: Stop the Kern County Carbon Capture Project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Dear Kern County Planning and Natural Resources Department,

The Union of Concerned Scientists has pointed out several reasons not to allow the Carbon Capture Project project:

Continued oil drilling worsens air quality and harms public health. Adding CCS capture technology could extend the life of the oil drilling that the Elk Hills plant powers. Oil and gas production generates toxic air pollutants such as fine particulate matter (PM2.5) which causes an estimated 1200 premature deaths in the Valley every year. PM2.5 is also linked to heart disease and stroke, and they worsen asthma.

The CCS project is unsafe for nearby communities. It will store 40-50 million metric tons of carbon dioxide (CO2) near Buttonwillow. If this CO2 leaks, it could cause suffocation and death. A CO2 pipeline leak in Mississippi lead to the hospitalization of hundreds of people living in a town about half a mile away. And Buttonwillow is in a remote area. If there is a pipeline leak, residents would have to make a long journey to get to a hospital.

If a CO2 leak comes into contact with groundwater, the water can be contaminated because CO2 reacts chemically with water to become more acidic, so contaminants dissolve into it. Injecting CO2 underground can also trigger earthquakes.

CCS is not a climate solution. It regularly fails to live up to its promises. For example in Australia, Chevron promised its CCS project would capture 80% of CO2 emissions but captured less than half—only 30%. A Canadian CCS plant actually emitted more greenhouse gases than it captured. The uncaptured CO2 is emitted into the air, making the climate crisis worse. The project also won't capture emissions from sourcing, transporting and storing the CO2, and those emissions add up.

The project is a major financial risk. The project promises that it will store the captured carbon permanently. But the project owner, California Resources Corporation, has already filed for bankruptcy once, in 2020. There is a risk that the company could file for bankruptcy again, leaving environmental cleanup bills to taxpayers.

Sincerely,

Alvaro Ramos

Keith Alvidrez

From: Lau, Scott@DOT <Scott.Lau@dot.ca.gov>
Sent: Tuesday, January 23, 2024 1:21 PM
To: Keith Alvidrez
Cc: Duran, Braden@DOT
Subject: Caltrans response to Extension of Comment Period for Carbon Terravault

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Hi,

As previously mentioned, Caltrans have reviewed this DEIR and have no significant comments.

Respectfully,

Scott Lau
Associate Transportation Planner
California Department of Transportation
1352 West Olive Avenue
Fresno, CA 93778
Cell: (559) 981-7341

Keith Alvidrez

From: Michelle Ghafar <mghafar@earthjustice.org>
Sent: Wednesday, January 24, 2024 7:02 PM
To: Colin O'Brien; Lorelei Oviatt; Keith Alvidrez
Cc: CTV1EIRComments; Nirit Lotan; Craig Murphy
Subject: RE: Question re DEIR air quality section for CTV1

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Hello Lorelei and Keith,

Thanks again for your helpful response regarding the updated DEIR and next steps on notice. We're continuing to review and digest the document and are hoping to clarify an additional issue in Vol. 2, Appendix E related to "Geology and Soils."

In a few places throughout Appendix E, the DEIR references a separate "Appendix 1" related to all the wellbores in the Elk Hills oil field and that "lists the wells individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements." (See Vol. 2, PDF pp. 2019, 2021, 2240, 2242, 2271, 2273, 2894.)

We tried to locate Appendix 1, but as best we can tell it does not appear to be included in the document. We noticed, however, that Vol. 2, PDF p. 2250 mentions that Appendix 1 may be considered confidential to CTV.

Can you please clarify whether Appendix 1 was intentionally excluded from the DEIR? Or perhaps this was an inadvertent omission?

Thank you in advance for any additional information you can provide. We continue to appreciate your help as we navigate the document!

Michelle Ghafar
She/Her/Hers
Attorney
Earthjustice
50 California Street, Suite 500
San Francisco, CA 94111
T: 415-217-2186
F: 415-217-2040
earthjustice.org

Office of the Fire Marshal
Kern County Fire Department
Fire Prevention Unit

2820 M St. • Bakersfield, CA 93301 • www.kerncountyfire.org
Telephone 661-391-3310 • FAX 661-636-0466/67 • TTY Relay 800-735-2929

February 13, 2024

Kern County Planning and Natural Resources Department
2800 M St., Bakersfield, CA 93301
Attn: **Keith Alvidrez, Planner II**

Re: Kern County Fire Department Comments Regarding Planning Department Project

To Whom It May Concern,

The Kern County Fire Department, as the local fire authority, has received a request for comments regarding Draft Environmental Impact Report-Carbon Terra Vault I. Upon initial review it has been determined that there are no Fire Code concerns regarding this project.

Please feel free to call our Fire Prevention Office at (661) 391-3310 with any questions.

Respectfully,
Regina Arriaga
Assistant Fire Marshal
Kern County Fire Department

February 22, 2024

To: Lorelei Oviatt, Director
Planning and Natural Resources Department
Keith Alvidrez, Planner II

From: Jeremy M. Brock, County Surveyor JMB
By: Andres Arias, Engineering Support Supervisor Phone: 28959

Subject: Extension of comment period of Draft of an Environmental Impact Report – Carbon Terra Vault I (Kern County) by California Resources Corporation (SCH#2022030180).

I have reviewed the above noted project Notice of Preparation of Draft of EIR and recommend the following conditions be placed on the Conditional Use Permits:

1. Prior to issuance of a building or grading permit: All survey monuments shall be tied out by a Licensed Land Surveyor. A corner record for each monument or record of survey shall be submitted to the County Surveyor for review and processing, per Section 8771 of the Professional Land Surveyor's (PLS) Act.

2. Prior to Final Inspection: All survey monuments that were destroyed during construction shall be re-set or have a suitable witness corner set. A post construction corner record for each monument re-set or a record of survey shall be submitted to the County Surveyor for processing, per Section 8771 of the Professional Land Surveyor's Act.

3. Upon completion of project: All survey monuments shall be accessible by a Licensed Land Surveyor or their representatives, with prior notice, per Section 8774 of the PLS Act and Civil Code 846.5 (a).

Thank you for the opportunity to review and comment on this project. Should you have any questions please contact me.

Lorelei H. Oviatt, AICP, Director
2700 "M" Street, Suite 100
Bakersfield, CA 93301-2323
Phone: (661) 862-8600
Fax: (661) 862-8601 TTY Relay 1-800-735-2929
Email: planning@kerncounty.com
Web Address: http://kernplanning.com/

PLANNING AND NATURAL RESOURCES DEPARTMENT

Planning
Community Development
Administrative Operations

January 17, 2024

FILE: DEIR CTV 1

TO: Interested Parties and Agencies

RE: Extension of Comment Period to March 1, 2024 – Draft Environmental Impact Report (DEIR) Carbon TerraVault I (Kern County) by California Resources Corporations (CRC) (SCH# 2022030180).

This is to advise that the Kern County Planning and Natural Resources Department has prepared a DEIR for the project identified below that was released on December 19, 2023. As mandated by State law, the minimum public review period for this document is 45 days and has now been extended for a review period of 72 days.

A textual error in Chapter 4.3 Air Quality resulted in the printing deletion of Mitigation Measure 4.3-9. The online document has been corrected to include this mitigation measure.

PROJECT TITLE: Carbon TerraVault I (Kern County) by California Resources Corporation (CRC) (PP22405); ZCC 5, Map 119; ZCC 4, Map 120; CUP 13, Map 118; CUP 14, Map 118; CUP 5, Map 119; CUP 6, Map 119; CUP 3, Map 120; CUP 2, Map 138.

DOCUMENT AVAILABILITY: The Draft EIR and the documents referenced in it are available for public review at the Planning and Natural Resources Department, which is located at 2700 "M" Street, Suite 100, in Bakersfield, CA 93301 or on the Department website at: https://kernplanning.com/environmental-doc/carbon-terravault-1-kerncounty

PUBLIC COMMENT: The CEQA review period is now

December 19, 2023 – March 1, 2024

Written comments may be submitted to the project planner identified below prior to the close of the DEIR public review period on **March 1, 2024, at 5:00 p.m.** to:

Kern County Planning and Natural Resources Department
ATTN: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100, Bakersfield, CA 93301
Phone: (661) 862-5015
E-mail: CTV1EIRComments@kerncounty.com

Sincerely,

Lorelei H. Oviatt

LORELEI H. OVIATT, AICP, Director
Kern County Planning and Natural Resources Department

From: Colin O"Brien
To: Keith Alvidrez; CTV1EIRComments
Cc: Michelle Ghafar; Nirit Lotan
Subject: Question about the administrative record for Carbon TerraVault I Project
Date: Thursday, February 29, 2024 1:38:09 PM

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Hi Keith –

I have a hopefully quick question about the administrative record that the County is compiling for the Carbon TerraVault I (CTV I) Project.

As best I can tell, every (or almost every) impact section of the CTV I Draft EIR states something along the lines of the following:

"The analysis in this section is based on the Kern County (County) *Final Environmental Impact Report - Revisions to the Kern County Zoning Ordinance - 2015(C) Focused on Oil and Gas Local Permitting*, certified on November 9, 2015), supplemented by a Supplemental EIR certified on December 11, 2018, a Supplemental Recirculated EIR (SREIR) certified on March 8, 2021, and an Addendum adopted on August 23, 2020 (collectively referred to as the 'Oil and Gas EIR')." (See, e.g., CTV I Draft EIR at p. 4.1-1.)

Given these repeated references, does the County intend to include all the collective components of the "Oil and Gas EIR," including appendices, in the administrative record for the CTV I Project? I presume so, and hopefully you can confirm that is the case. Otherwise, we and others commenting on the CTV 1 Draft EIR might feel compelled to submit the Oil and Gas EIR ourselves, which could lead to a large volume of unnecessary duplication.

Sincere thanks,
Colin

Colin C. O'Brien
Pronouns: he/him/his
Deputy Managing Attorney
California Regional Office
Earthjustice
50 California Street, Suite 500
San Francisco, CA 94111
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EARTHJUSTICE

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STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **GAVIN NEWSOM**, *Governor*

DEPARTMENT OF WATER RESOURCES
P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

March 1, 2024

Mr. Keith Alvidrez
Kern County Planning and Natural Resources Department
2700 M Street, Suite 100
Bakersfield CA 93301
alvidrezk@kerncounty.com

SCH# 2022030180 Carbon TerraVault1 by California Resources Corporation (Carbon TerraVault1) Draft Environmental Impact Report

Dear Mr. Alvidrez:

The California Department of Water Resources California Aqueduct Subsidence Program (CASP) has reviewed the Carbon TerraVault1 by California Resources Corporation (Carbon TerraVault1) draft Environmental Impact Report (DEIR) and has the following comments. These comments are the result of CASP's review, and do not reflect the current views or concerns of any other DWR programs.

Project Description

The proposed project is the approval of conditional use permits for the construction and operation of a 9,130-acre carbon capture and storage project facility with related capture facilities and pipelines for the Carbon Terra Vault I project.

Comments

Chapter 3 Project Description

3.1 Project Overview

The proposed project will inject carbon dioxide (CO2) into an underground injection control well. The project includes approximately 13 miles of underground facilities and injection pipeline and related infrastructure to capture, transfer and store CO2 from pre-combustion Elk Hills field gas.

The proposed project site consists of two specific sets of parcels within the Elk Hills oilfield along and north of Skyline Road. The boundaries for the project CCS surface land area and underground approved storage area (pore space) are approximately 26 miles southwest of Bakersfield, approximately 8.5 miles from the city of Taft, and approximately 4 miles from the unincorporated community of Buttonwillow. The project roughly parallels sections of the CA Aqueduct for approximately 10 miles (Mile Posts 225 to 235). At the projects closest point, the boundary is approximately 1.5 miles from the

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Aqueduct (NE corner of project Parcel # 158-040-06).

Section 4.7 Geology and Soils

4.7.2 Environmental Setting

This environmental setting section discusses Off-site Landslide, Lateral Spreading, Subsidence, Liquefaction, or Collapse, but does not include a discussion of subsidence beyond the project infrastructure within project boundaries (e.g., injection-well design). The current physical conditions related to subsidence that need to be included in the environmental setting extends beyond the project boundaries. The environmental setting specifically for subsidence needs to be expanded to include regional subsidence and effects on nearby, non-project infrastructure (i.e., CA Aqueduct).

4.7.4 Impacts and Mitigation Measures

This section states the geology and soils baseline conditions are presented in Section 4.7.2, Environmental Setting, and there is no discussion of baseline for potential regional subsidence impacts in that section. We request the baseline for regional subsidence in relation to nearby, non-project infrastructure (i.e., CA Aqueduct) be included in 4.7.2 environmental settings.

Impact 4.7-6: Be Located on a Geologic Unit or Soil That Is Unstable, or That Would Become Unstable as a Result of the Project, and Potentially Result in On or Off-Site Landslide, Lateral Spreading, Subsidence, Liquefaction, or Collapse

This section needs to include a subsidence impact analysis. While there may be limited geotechnical information on the relationship between subsidence and underground storage of CO2, this does not mean there are no potential subsidence impacts. An impact analysis and mitigation measures 4.7-3 must be applied to potential subsidence impacts. DWR-CASP is willing to provide guidance for these tasks in relation to subsidence monitoring of DWR infrastructure.

Mitigation Measure MM 4.7-3.

The geology and soils mitigation measure requires future site-specific geotechnical reports, and that the owner/operator shall implement all requirements of any site-specific geotechnical report. We request that, 1) any site-specific geotechnical report include reporting on any regional impacts of subsidence associated to carbon sequestration; and 2) ground surface elevation monitoring of the area between the project AoR and the CA Aqueduct, and relevant survey points along the Aqueduct be performed periodically

DWR-CASP provides the following comments as guidance in the event the MM 4.7-3 project geotechnical report or other evidence identifies subsurface activities at or near the project location, or within one mile of the Aqueduct, are impacted by project activities. As the magnitudes of subsidence at both the project and along the Aqueduct nearby are comparable, further study into the systematic relationship between these areas and the potential-impacts to-infrastructure at the location of the Aqueduct as part of

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the geotechnical report would be required as part of the geology and soils mitigation measures.

If you have any questions, need additional information or would like to discuss our comments further, please contact David Moldoff, David.Moldoff@water.ca.gov.

Sincerely,

nancy finch

Nancy Finch
Attorney III

From:	Lancaster, Jeremy@DOC
To:	Keith Alvidrez
Cc:	"State.Clearinghouse@opr.ca.gov"; OLRA@DOC; Gooch, Brad@DOC
Subject:	CEQA Review Comments - Carbon TerraVault 1 by California Resources Corporation (SCH#2022030180)
Date:	Friday, March 1, 2024 5:41:57 PM

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Dear Mr. Alvidrez:

The Department of Conservation's California Geological Survey (CGS), has reviewed the CEQA Draft Environmental Impact Report (DEIR) for the Carbon TerraVault 1 Project by California Resources Corporation (CEQA SHN: 2022030180). This message conveys the following comments from CGS concerning geology, soils, seismology, and geologic carbon sequestration related to the project area.

Liquefaction and Landslide Hazards

The CGS has not begun mapping Seismic Hazard Zones for liquefaction or landslides within the project area, or in this region of the state. The lack of a zone information does not preclude the potential for rainfall induced landslides, and seismically induced landslide and liquefaction.

Additional information is available at the links below:

- Deep-seated landslide susceptibility: https://maps-cadoc.opendata.arcgis.com/maps/b6cf689f727340d6b3f8cd869e69c729/explore?location=35.255322%2C-119.356426%2C10.40

Earthquake Zones of Required Investigation (liquefaction, landslides and faults):

- https://maps.conservation.ca.gov/cgs/EQZApp/app
- https://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps

Surface Fault Rupture and Ground Shaking Hazard

The project area is not located in an Earthquake Fault Zone presently mapped by CGS. The DEIR has addressed this hazard with reference to several publications and reports, including the USGS Quaternary Fault and Fold Database that contains CGS fault activity data. CGS notes that, while the project area is not located in an Earthquake Fault Zone presently mapped by CGS the site may contain unmapped faults not included in the USGS database.

Additional information is available at the links below:
https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf

Geological Carbon Sequestration

There are a few mentions of enhanced oil recovery using carbon dioxide (i.e., US EPA Class II) in Volumes I and II of the DEIR. CGS notes that SB 905 prohibits an operator from injecting a concentrated carbon dioxide fluid produced by a carbon dioxide capture, removal, or sequestration project into an injection well for purposes of enhanced oil recovery, including the facilitation of enhanced oil recovery from another well.

Throughout the volumes, it is stated that the planned reservoirs have been tested by significant trapping of both natural and injected gas. However, there is no documentation provided to support the conclusion that there has been no gas seepage at the surface, either prior to discovery or subsequently.

In Volume I (p. 4.10-28), the statement "The Elk Hills oilfield area has been identified as a location suitable for such storage due to the faults and folds that serve as restrictive structures combined with the thick confining layers of the Tulare Formation and Amnicola Clay that form geologic barriers to usable groundwater sources." is unreferenced. We suggest appropriate references be provided to support the stated geologic characterization.

In Volume I (p. 4.7-25), the statement "...due to the uncertainty of the implementation of multiple projects and the ability to simultaneously cease injection during an event, the impacts from cumulative induced seismic activity from this project plus any future permitted carbon capture and storage (CCS) project is significant and unavoidable even with mitigation." is a significant acknowledgment that basin-scale management of subsurface pressure will be critical to the success of this Class VI injection project and subsequent ones sited locally.

In the beginning of Volume II, the contact for CGS is incorrect and should be noted that the correct CGS contact is:
California Geological Survey | Department of Conservation
Attn: Jeremy Lancaster, State Geologist
715 P Street, Sacramento, CA 95814

In Volume II, there are numerous dated references using the former name of the California Geological Survey. The California Division of Mines and Geology (CDMG) changed its name to CGS in 2006. The State Geologist of California is the director of the California Geological Survey.

In Figure 6 (Volume II), the surface geologic map appears to be CGS State Geologic Map. This map was developed at a very coarse scale and details were simplified to be able to display information statewide. This includes the simplification of fault features. Suggest using a detailed map of the region to depict the geology. Additional mapping can be found in the following locations:

USGS NGMDB: https://ngmdb.usgs.gov/mapview/?center=-119.227,35.285&zoom=9
CGS Geologic Map Resources:

- https://www.conservation.ca.gov/cgs/rgm/maps
- https://www.conservation.ca.gov/cgs/publications/sr217

In Volume II, there are figure references to a publication named DOE, 1993; however, this reference is not explicitly listed in the reference section.

In Volume II, the document describes drilling data on the Elk Hills oilfield including the existence of 7,500+ wells drilled. CGS notes that unforeseen issues stemming from the quality and integrity of each of the 7,500+ wells are not described in this document.

In Volume II, there are many statements explaining the level of geologic certainty of the storage structure based on 3D seismic reflection data. It is important to note that, while unlikely, penetrations through the confining layers are possible as well as the possibility of undetected, sub-seismic faults and fracture networks.

In Volume II, Geomechanical Modeling, there is mention of a 2-D model to simulate the 3-D/4-D reality of the injection, given greater injection rates planned. CGS notes that two-dimensional modeling may not adequately represent an approximation of 3-D/4-D reality.

In Volume II, a statement is made that "...seismometers will be able to detect events with a magnitude 0 to 1.0 and will be installed pre-injection to provide baseline seismicity" which is a good practice. CGS notes that the writer may be implying that these magnitudes are the minimum threshold of detection. CGS suggests this information be revised for clarity.

In Volume II, a statement is made that " The seismometers will be able to detect events with a magnitude 0 to 1.0 and will be installed pre-injection to provide baseline seismicity. In addition, CTV will monitor the Southern California Earthquake Data Center (SCEDC) network for seismic events." Does this mean that any earthquakes above M1.0 are only detected by the instruments of the SCEDC (or other) networks? CGS suggests these statements be revised for clarity.

In Table 2 (Vol. II), a statement is made (among many response actions) that the response actions for seismic events >M2.0 within two miles of the injection well include venting CO2 from surface facilities. Will the flux of vented CO2 be calculated or measured? If so, how and for what period? Also noted in the table is that response actions will only take place for events above M1.0 (first operating state goes to M1.5) and within two miles from the injector. However, according to previous earthquake detection statements the seismometers

operated by CRC will have bandwidth of only M0-M1. Please revise and clarify.

In Volume II it is stated that there are no (*known*) faults that extend into the confining Reef Ridge Shale. There is not a present analysis of leakage from the 7,500+ existing wells penetrating various depths across the site. While "Analysis of the three-dimensional seismic and well data provides no evidence that the faults either transect the Monterey Formation or penetrate the confining Reef Ridge Shale.", CGS notes that there could be fracture/fault networks undetected by the seismic data.

In Volume II, a statement indicates that "personnel have access to the continuous data being acquired during operations." CGS suggests that additional information/clarification be provided whether the CTV personnel also have a simultaneous connection to the networked seismometer data as well. This would enable real-time data analysis with all the seismometer data together.

Volume II states "There is no geochemistry analysis for the Reef Ridge Shale. The shale will only provide fluid for analysis if stimulated. However, given the low permeability of the rock, high capillary entry pressure, and the low carbonate content, the Reef Ridge Shale is not expected to be impacted by the CO2 injectate." CGS notes that this section does not include a discussion of uncertainty in the data and characterization of the shale unit.

In Vol. II, under Seismic Risk, it states "Regionally there were no reservoir containment issues associated with oil and gas operations and the Reef Ridge Shale. Moreover, there was no impact to Elk Hills infrastructure (Jenkins, 1955)." This is a key fact that demonstrates the resilience of the site structure to earthquake shaking. However, CGS notes that a rupture on the San Andreas fault or Pleito thrust fault might generate stronger ground shaking and amplification effects at the site.

CGS suggests that additional information be provided on the depth of borehole seismometers planned for the project. As this information is key for designing a seismic monitoring network, the communication of these data will support the coordination of future seismometer installations in the Central Valley near this proposed Class VI injection project. CGS also notes that SB 905 (71463) requires that "the State Geologist shall report seismic activity or leakage of carbon dioxide from a carbon dioxide capture, removal, or sequestration project to the state board and may recommend changes in the operations of the project to the state board. The state board may require changes in operations of a carbon dioxide capture, removal, or sequestration project to ensure public and environmental health and safety, including, but not limited to, a mandatory pause in operation, if the monitoring and reporting detects increased seismicity or carbon dioxide leakage outside of the geologic storage reservoir." CGS notes that it may be good practice to include the State Geologist in notifications to the EPA Director regarding

seismicity.

There are several Figures included in Vol. II referencing the state of ground level subsidence, many of which contain the word Subsistence in the title. CGS notes this as a typo that should read as Subsidence, not Subsistence.

CGS notes the following language from the CO2 Retention Analysis documented in Vol. II:

> "Risks from other potential leak paths identified, such as leakage up the interior of the casing, leakage across the caprock through faults or features, and leakage from earthquake damage, were considered low and were not included in the Blade study (these pathways are discussed in Section 3 below). It was assumed that all the existing wells will be abandoned in compliance with existing regulation, and in accordance with best practices (there are no legacy abandoned wells in the EHOF Storage Complex)."
>
> "Two single-well Open-IAM models were built, one for A1-A2 and one for 26R. Monte Carlo simulations were performed using the effective permeability of the leak path as the stochastic parameter to generate 2,000 realizations of the amount of CO2 leaked into the atmosphere from a single type well."
>
> Comment: CGS notes that in other sections of the report 7,500+ wells are identified, but that in the analyses described in the quoted information above only 150 and 204 existing wellbores in A1-A2 and 26R are considered. CGS suggests that additional clarification be provided on the difference between the number used in the analysis and 7,500+ wells in the area cited previously.

Lastly, CGS notes that for the purpose of CEQA review, projects involving three- and four-dimensional considerations of geologic and seismic hazards are challenging to review without provision of subsurface 3D geometry of the geologic reservoir where sequestration will occur. Making these data available for review would provide additional context and support to the conclusions made in the reports provided.

If you have any questions based on these comments, please contact Brad Gooch.

Sincerely,

Brad T. Gooch, Ph.D., P.G.
Senior Engineering Geologist
3D Geological Modeling Unit Supervisor | Geologic Carbon Sequestration Group Lead
Regional Geologic & Landslides Mapping Program | Watershed Hazards and Climate Adaptation

California Geological Survey | Department of Conservation | Natural Resources Agency
M: (916) 879-0361 | E: Brad.Gooch@Conservation.Ca.Gov
CGS Geologic Carbon Sequestration Group:
https://www.conservation.ca.gov/cgs/gcs

and,

Jeremy Lancaster P.G. C.E.G.
State Geologist, Director
California Geological Survey
715 P Street, MS 19-01, Sacramento, CA 95814
E: Jeremy.Lancaster@Conservation.Ca.Gov
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Comments regarding Draft EIR: Carbon TerraVault I, SCH# 2022030180

To: Kern County Planning and Natural Resources Department

We urge the Kern County Planning and Natural Resources Department to advise a "No Project" alternative due to the significant and unavoidable negative impacts to air quality, the increase in health risks and the lack of benefit to the community proposed by this carbon capture and sequestration project. The report states that the proposed project would produce more carbon dioxide than is sequestered and, according to communications from fossil fuel industry engineers, the improvements to the technology to attain a net reduction in carbon dioxide are eight or more years in the future. Meanwhile, the frontline communities and the valley portion of Kern County will suffer the significant health impacts of increased particulate matter (PM 10 and PM 2.5) and nitrogen oxides (NOx) air pollution as well as additional health risks.

Air pollution contributes to adult and childhood lung disease, heart disease, cancers, immune system disruption, premature death of adults, preterm births and low birth weight, congenital heart defects, learning and behavior disorders, Alzheimer's disease and dementia, and obesity risk (Kelly, 2021; Valley Air, 2022; Qian Di, 2017; ANHE, 2020; McKenzie, 2019; NIEHS, 2024). Kern County has the highest rates of chronic diseases and obesity in California and the financial, social, and quality of life impacts of these diseases are significant (KC Public Health, 2023). This project will exacerbate the burden of disease in Kern County. Although conditional land use permitting fees will contribute funds for county safety net services, we fear that this will be offset in a large measure by increases to health care costs due to the burden of screening, diagnosing, and treating lifelong chronic diseases. In addition, the ripple effect of higher health insurance and health care costs, lost work days, lost school days and absenteeism will impact the business and educational sectors of the county.

Particulate matter damages the linings of airways and blood vessels, and the smallest particles (PM2.5) enter the individual cells to cause cellular and organ damage, including cancer. NOx contributes directly to the formation of ozone, which inflames the lining of the lungs, especially in

children who have more rapid respiratory rates and are more likely to be outdoors when ozone levels are high. This can result in permanent scarring and lifelong disability (Valley Air, 2022). This project is expected to increase the levels of multiple criteria pollutants and will utilize agreements with Valley Air to offset the significant and unavoidable impacts. This leaves our communities to deal with improving air quality on their own, exposing the most vulnerable populations living nearby to damaging pollution. Providing grant writing assistance provides very little protection against the on-going threats of worsening air quality.

The San Joaquin Air Pollution Control District in their Arvin/Lamont Community Emissions Reduction Program, Health Impacts of Air Pollution report, states "daily exposure to high PM2.5 concentrations was significantly correlated with increased daily hospital and emergency room admission rates for asthma and other respiratory and cardiovascular diseases" (Valley Air, 2022, p. F-2). These communities are located far from acute care hospitals, making the risks of respiratory and cardiovascular events even more likely to be life-threatening.

Other health risks detailed in the EIR include vector borne diseases such as West Nile Virus and rodent borne disease in an area not covered by Kern County Vector Control. Precautionary measures should be taken to protect our communities, especially in the absence of any real benefit of this CCS project to efforts to arrest climate change.

The national report on options for carbon dioxide removal in the United States, Roads to Removal, designated direct air capture and storage powered by renewable energy as the only net reduction strategy for removing carbon dioxide from our atmosphere (2023). The county itself has proposed this strategy in a Westside energy park project. Carbon TerraVault I does not provide a net reduction of carbon dioxide in the initial phase and only proposes a possible direct air capture addition in the future.

Without the clear benefits of lessening climate change, this project's health risks and potential for rising healthcare costs far outweigh its benefits to the people and government of Kern County. While the healthcare community is clamoring for stricter air pollution standards to protect patients (ALA, 2023),

Kern is introducing significant and unavoidable sources of air pollution in an already heavily impacted section of the state. On most days our community members will be left with no safe place to breathe in the valley. A "No Project" recommendation is the best alternative.

Submitted March 1, 2024 by

Karin Urso, RN, MSN, PHN,
California Nurses for Environmental Health and Justice
karinurso@att.net

References: (small sample of scientific evidence and community opinion)

Alliance of Nurses for Healthy Environments (ANHE). (2023). "Air Quality and Air Pollution" in Environmental Health in Nursing. 3rd Ed., p.70-78. https://envirn.org/e-textbook/

American Lung Association (ALA). Health Professionals for Clean Air and Climate Action. https://www.lung.org/policy-advocacy/healthy-air-campaign/health-pros-clean-air-climate

Kelly, F. J., Mudway, I., & Fussel, J. C. (2021). Air pollution and asthma: critical targets for effective action. *Pulmonary Therapy, (7)*, 9-21. https://doi.org/10.1007/s41030-020-00138-1

Kern County Public Health. (2023). 2023 Community Health Assessment. https://kernpublichealth.com/wp-content/uploads/2024/01/Community-Health-Assessment-CHA.pdf

McKenzie, L.M., Allshouse, W. & Daniels, S. (2019). Congenital heart defects and intensity of oil and gas well site activities in early pregnancy. *Environment International, 132.* https://doi.org/10.1016/j.envint.2019.104949

National Institute of Environmental Health Sciences (NIEHS).(2024). Air Pollution and Your Health. *National Institutes of Health.* https://www.niehs.nih.gov/health/topics/agents/air-pollution

Roads to Removal. (2023). Roads to removal: Options for carbon dioxide removal in the United States. Lawrence Livermore National Laboratory. https://roads2removal.org/resources/

San Joaquin Air Pollution Control District (Valley Air). (2022). Health Impacts of Air Pollution, Arvin/Lamont Community Emissions Reduction Program (CERP), Appendix F. https://community.valleyair.org/media/qoglbbbc/appendix-f_health-information.pdf

Qian Di, M. S. et al. (2017). Air pollution and mortality in the Medicare population. *The New England Journal of Medicine,* 376, 2513 - 2522. Air Pollution and Mortality in the Medicare Population | NEJM

Via Email

March 1, 2024

Kern County Planning and Natural Resources Department
Attn: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100
Bakersfield, CA 93301
CTV1EIRComments@kerncounty.com
Alvidrezk@kerncounty.com

Re: Comments on the Draft Environmental Impact Report for Carbon TerraVault I

Dear Mr. Alvidrez:

On behalf of Center for Biological Diversity, Center on Race, Poverty & the Environment, Central California Environmental Justice Network, Central Valley Air Quality Coalition, and Sierra Club, we are writing to submit the following comments regarding the Draft Environmental Impact Report (the Draft EIR) for the Carbon TerraVault I Project (the CTV I Project) for carbon capture and storage (CCS) in the Elk Hills oil field. These comments are offered to ensure that Kern County (the County) complies with the California Environmental Quality Act (CEQA)[1] and CEQA Guidelines[2] in its consideration of the CTV I Project.

In addition, we submit technical expert analyses prepared by Ron Sahu, PhD, QEP, CEM (Attachment A); Dominic DiGiulio, PhD (Attachment B); and Richard Kuprewicz (Attachment C). We refer the County to these reports, both here and throughout these comments, for further discussion of the Draft EIR's inadequacies.

As an initial matter, we urge the County to redress key deficiencies in the Draft EIR that inhibit public comment and participation. In particular, the Draft EIR fails to provide an "Appendix 1" that is repeatedly referenced throughout the document and relied upon for key information about existing oil and gas wellbores and planned monitoring wells at the Project site.[3] The County must recirculate the Draft EIR, include the missing Appendix 1, and provide a

[1] Pub. Resources Code, § 21000 *et seq.*
[2] Cal. Code Regs., tit. 14, § 15000 *et seq.* (CEQA Guidelines).
[3] See, e.g., Draft EIR, Vol. 1 at 4.7-1 (noting "Geology and Soils" analysis in section 4.7 is based on U.S. Environmental Protection Agency's (EPA's) Class VI Underground Injection Control (UIC) Permit Application for CTV I); Draft EIR, Vol. 2, App'x E.2: EPA Class VI UIC Permit Application Narratives for the Elk Hills 26R Storage Project and the A1A2 Storage Project at 2240 ("Appendix 1 provides a complete list of all API-12 wellbores within the [area of review]. As required by 40 CFR 146.84(c)(2), the well table in Appendix 1 describes each well's type, construction, date drilled, location, measured depth, true vertical depth, completion record relative to the A1-A2 injection zone, record of plugging, requirement for corrective action, if necessary. CTV also identifies well work to be completed during the pre-operational testing phase.").

minimum 45-day comment period to give the public sufficient time to review and comment on the CTV I Project as required by CEQA.[4]

Beyond the obvious error of failing to include Appendix 1, the Draft EIR is generally missing critical details about the CTV I Project and vague throughout, making it impossible to sufficiently analyze the range of impacts due to the Project and to adopt adequate mitigation measures. The Draft EIR therefore fails in its basic purpose of being an informational document "to provide public agencies and the public in general with detailed information about the effect that a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project."[5]

These errors are particularly inappropriate because this Project will be the first in California to deploy CCS in order to facilitate continued fossil fuel extraction and combustion, which is an application of this technology that threatens to seriously derail progress toward state and federal climate commitments.[6] Indeed, not only will the CTV I Project extend the life of the decades-old Elk Hills oil field and the existing gas plant and power plant supporting the field, the Project will also justify the build-out of multiple new polluting facilities as future CO_2 sources, including a blue hydrogen plant, a renewable dimethyl ether production facility, a gasoline plant, and a waste-to-energy production facility.[7] Rather than doubling down on counterproductive and risky projects that will allow the Elk Hills field to continue operating for years longer than necessary, and further lock in the County's dependence on the fossil fuel industry, the County should be investing in the transition to renewable clean energy solutions.

In the past, initial projections of specific CCS proposals have frequently overestimated the level of capture that those projects ended up achieving in practice.[8] The Draft EIR neither grapples with this possibility in the context of CTV I nor demonstrates how it plans to avoid the pitfalls that hindered earlier projects. And by allowing fossil fuel facilities to keep operating, CTV I will ultimately serve to exacerbate pollution and ongoing harms to the County's frontline communities.[9] The process of capturing, transporting, injecting, and storing CO_2 also poses serious public health and safety threats, including from toxic releases and catastrophic accidents

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[4] CEQA Guidelines, § 15105(a).
[5] See Pub. Resources Code, § 21061.
[6] See Inst. for Energy Economics & Fin. Analysis (IEEFA), *The Carbon Capture Crux* (Sept. 2022) at 73–74, https://ieefa.org/sites/default/files/2022-09/The%20Carbon%20Capture%20Crux.pdf.
[7] Cal. Resources Corp. (CRC), *Carbon TerraVault Vaults*, https://www.crc.com/carbon-terravault/vaults/default.aspx (last accessed Feb. 23, 2024).
[8] See, e.g., IEEFA, *The Carbon Capture Crux*; IEEFA, *Carbon Capture and Storage*, https://ieefa.org/ccs#:~:text=Yet%20an%20IEEFA%20review%20of,low%20carbon%2C%20not%20a%20solution (last updated Dec. 5, 2023).
[9] See Jacobson, M.Z., *The Health and Climate Impacts of Carbon Capture and Direct Air Capture*, Energy Environ. Sci. 12 (2019), 3567–74, https://doi.org/10.1039/C9EE02709B; Concerned Health Professionals of N.Y. & Physicians for Social Responsibility, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure* (Apr. 2022) at 80–81, https://www.psr.org/wp-content/uploads/2022/04/compendium-8.pdf.

that endanger the homes, schools, and other sensitive locations near Elk Hills.[10] The Draft EIR fails to demonstrate how the CTV I Project will minimize these harms, nor does it indicate that the Project's alleged benefits are justified in light of them.

These harms will disproportionately fall on people of color and lower income residents who have long been overburdened by the same oil and gas operations and polluting industries that CTV I now threatens to prolong.[11] The Elk Hills oil field neighbors environmental justice communities in Buttonwillow, Taft, and Tupman that cannot afford the air, climate, energy, water, health and safety, geologic, biological, and other impacts from the CTV I Project.[12]

After carefully reviewing the Draft EIR, we have concluded that it fails in numerous respects to comply with CEQA. As explained below, the Draft EIR violates CEQA because it fails to: (1) properly define the project description and the scope of the CTV I Project's foreseeable impacts; (2) properly consider reasonably foreseeable projects; (3) adequately analyze and mitigate growth-inducing impacts; (4) employ appropriate Project objectives; (5) properly consider alternatives to the Project; and (6) adequately analyze and mitigate numerous foreseeable environmental impacts and cumulative impacts. As the first environmental impact report prepared for a CCS project in California, the Draft EIR falls far short of establishing appropriate standards and safeguards should these projects move forward in the future.

For these and the additional reasons expressed below, we strongly urge the County to reject the Draft EIR as an informational document, and to prepare and circulate a revised Draft EIR that complies with CEQA.

We include a table of contents on the next page to facilitate review.

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[10] See DiGiulio Report at 3–5; Zegart, *The Gassing of Satartia*, Huffington Post (Aug. 26, 2021), https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f.

[11] See Lam, Y. et al., *Briefing: Analysis of Proposed Carbon Capture Projects in the US Power Sector and Co-Location with Environmental Justice Communities* (Sept. 2023) at 4, https://static1.squarespace.com/static/5d14dab43967cc000179f3d2/t/64f9df23792cce775bf32100/1694097188142/Map_Proposed+CCS+Projects+-+Two+Pager_CURRENT.pdf (showing 94.3% of planned CCS projects in the U.S. power sector are located within 3 miles of an environmental justice community, including CTV I).

[12] Numerous studies have found a significant association between proximity to oil and gas production and adverse health outcomes in the San Joaquin Valley. See, e.g., Gonzalez, D.J.X. et al., *Oil and Gas Production and Spontaneous Preterm Birth in the San Joaquin Valley, CA* (2020), Environmental Epidemiology, 4(4), https://journals.lww.com/environepidem/Fulltext/2020/08000/Oil_and_gas_production_and_spontaneous_preterm.1.aspx?context=LatestArticles.

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I. THE DRAFT EIR'S ANALYSIS AND MITIGATION ARE BASED ON AN IMPROPER PROJECT DESCRIPTION

CEQA aims to foster greater transparency to ensure that decisionmakers and stakeholders are informed of potentially harmful environmental consequences of proposed projects, receive a clear and robust analysis of those consequences, and are assured that feasible mitigation is implemented. This level of transparency requires a complete understanding of the project and an analysis that encompasses the project's full scope. "Only through an accurate view of the project may outsiders and public decision-makers balance the proposal's benefits against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal . . . and weigh other alternatives in the balance."[13] Here, the County does not achieve the level of transparency required by CEQA because of an inappropriately narrow project description.

Under CEQA, a "project" is defined as the whole of an action that has the potential to cause direct or indirect physical changes to the environment.[14] A project description that omits integral components of the full project may result in an EIR that fails to disclose all the impacts of the project.[15] EIR project descriptions have been rejected as inadequate when, as is the case here, the EIR limited the scope of environmental review by artificially narrowing the project description, thus minimizing the project's impacts and undermining public review.[16]

A proper description and analysis must include "future action" that is "a reasonably foreseeable consequence of the initial project" and would "be significant in that it will likely change the scope or nature of the initial project or its environmental effects."[17] As explained below, the Draft EIR fails to include the whole of the action in its analysis, and to analyze reasonably foreseeable and significant consequences of the CTV I Project.

The Draft EIR's scope is too narrow because it fails to address critical components of the CTV I Project, including the interrelationship between the Project and the development of industries in Kern County that will send CO_2 for sequestration to the Elk Hills oil field, and between the Project and development of CO_2 transportation infrastructure. And the inadequate

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[13] *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 192.
[14] CEQA Guidelines, § 15378(a); see *Habitat Watershed Caretakers v. City of Santa Cruz* (2013) Cal.App.4th 1277, 1297.
[15] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829 (project description for sand and gravel mine omitted water pipelines serving project); *City of Santee v. County of San Diego* (1989) 214 Cal.App.3d 1438, 1454 (concluding that complete project description is necessary to ensure that environmental impacts of entire project are considered).
[16] See, e.g., *Rural Landowners Assn. v. City Council* (1983) 143 Cal.App.3d 1013, 1024 (EIR for city general plan amendment and rezoning that failed to describe or analyze the impacts of development that would follow annexation to the city); *County of Inyo, supra*, 71 Cal.App.3d at 193 (EIR for groundwater pumping and water export project that failed to describe or analyze groundwater exports and instead improperly sought to characterize expanding groundwater exports as a separate, ongoing project).
[17] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal* (1988) 47 Cal.3d 376, 396, as modified on denial of reh'g (Jan. 26, 1989).

specification of the project description and scope also renders the Draft EIR informationally inadequate.

The project description states that the Project includes "the construction and operation of an approximately 9,130-acre CCS facility with related capture facilities and pipelines for the initial source."[18] That "initial source," according to the Draft EIR, would be the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility and used at the Elk Hills power plant. The Draft EIR goes on to say that "[n]o additional sources of CO_2 (from outside Elk Hills) or other new development are proposed for the CCS Surface Land Area or injection into the project."[19]

However, the "initial source" that the Draft EIR analyzes is only the first among several sources that are proposed to send CO_2 for storage in the Project. The storage reservoirs have the capacity to store almost 50 million metric tons (MMT) of CO_2 and the Project proponent is seeking to approve *the whole project's storage capacity* in the Draft EIR.[20] The Draft EIR's analysis discloses that at a maximum, the initial source's CO_2 will add up to about 31 MMT of captured CO_2.[21] And even this number is hypothetical and might in fact be much lower, as it assumes continuous operations of the power plant into the year 2045, while the Draft EIR admits that the plant "may be forced to close sooner" due to California's fossil fuels policies.[22]

While the Draft EIR notes that other sources could be sending CO_2 to the Project, it fails to disclose *any* meaningful information regarding these sources. The Draft EIR makes only a few passing references throughout to future sources, claiming that "[a]ll future sources are required to be permitted with a separate CUP process and environmental review for compliance with CEQA."[23] It further argues that because these sources "have not been permitted or completed CEQA, information cannot be provided" regarding the CO_2 they will be storing or potential emissions.[24]

The project description section of the Draft EIR lists under "Cumulative Projects" several projects in the County. The Draft EIR provides nothing more than the name, location, type, acreage, and status of these projects. Some of the projects are listed as "Carbon Capture and Storage" projects, while others, such as the NLC Energy "Waste to Energy" or the Lone Cypress "Blue Hydrogen" projects, may be potential CO_2 sources for the CTV I Project. The Draft EIR does not provide any other useful information regarding these potential sources anywhere in its analysis.[25]

An accurate and stable project description is necessary so that the lead agency and the public have enough information to "ascertain the project's environmentally significant effects,

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[18] Draft EIR, Vol. 1 at 3-1.
[19] Draft EIR, Vol. 1 at 3-1.
[20] Draft EIR, Vol. 1 at 4.8-19.
[21] Draft EIR, Vol. 1 at 4.8-24 (Table 4.8-4).
[22] Draft EIR, Vol. 1 at 4.8-24.
[23] Draft EIR, Vol. 1 at 4.8-19
[24] Draft EIR, Vol. 1 at 4.8-25.
[25] Draft EIR, Vol. 1 at 3-43 to 3-44.

assess ways of mitigating them, and consider project alternatives."[26] Information about the sources for the CO_2 that will be injected into the Project's storage facility is crucial for this very reason. The specific industrial processes that will emit the CO_2, the capture technology, the CO_2 properties, and the mode of transportation to the Project all have major implications for the CTV I Project's impacts on air pollution, greenhouse gas emissions, hazardous materials, and the public's health, to name just a few categories.

As just one example, whether CO_2 will be transported to the Project by trucks or pipelines, and the routes of such trucks or the locations of the pipelines, are all critical pieces of information necessary to assess the Project's potential impacts. Courts have held that an EIR for a mining operation failed as an informational document because it failed to include a "description of the facilities that will have to be constructed to deliver water to the mining operation."[27] In the same way, the Draft EIR fails to describe the methods and facilities that will be used to send CO_2 into the Project. As discussed below, an expert report attached to these comments also found that important information regarding pipelines is missing from the Draft EIR.

While the Draft EIR provides no information on the methods of CO_2 transportation from its potential sources, its project description section states that "[i]t is anticipated that diesel heavy heavy [sic] duty trucks would make 40 trips per day following the access routes designated for travel"[28] as part of the Project's operational traffic. The Draft EIR fails to include *any* explanation as to the reason for these heavy-duty truck trips. Moreover, these trips are not mentioned or analyzed in the transportation analysis section or in the air quality section.

Another example of the failure to properly include all related actions and reasonably foreseeable consequences is the Golden State Hydrogen project. On January 30, 2024, the Tulare County Board of Supervisors approved a Notice of Exemption for Golden State Hydrogen, a new hydrogen plant in Pixley, California, some 60 miles north of the CTV I Project. That project was approved without any CEQA review under the ministerial decision exemption.[29] The Golden State Hydrogen operating statement contemplates the building of a potential facility in Tulare County to capture and store CO_2 from this facility, but there is no guarantee it will ever be built. The statement states that until such project is built "the Applicant plans to sequester CO_2 by liquefying it on site and delivering it to the proposed Carbon Terravault I (CTV) at Elk Hills, California."[30] Despite the fact that there is a known facility that explicitly plans on sending its CO_2 for storage at the CTV I Project, this component of transporting CO_2 to the Project is missing from the Draft EIR completely.

Even beyond specific known facilities, the Draft EIR must include within its scope a discussion of potential industries that will be sending CO_2 to be stored, not only because these industries and the CO_2's modes of transportation are integral components of the "whole" CTV I

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[26] *Sierra Club v. City of Orange* (2008) 163 Cal.App.4th 523, 533.
[27] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829.
[28] Draft EIR, Vol. 1 at 3-36.
[29] Tulare County Resource Management Agency, *Notice of Exemption No.., CEQ 23-013 - Golden State Hydrogen Plant Pixley* (Jan. 30, 2024), https://ceqanet.opr.ca.gov/2024010948.
[30] Padre Associates, Inc., prepared for Proteum Energy, LLC, *Operating Statement – Golden State Hydrogen Plant Project* (Oct. 2023) at 9.

Project, but also to address the CTV I Project's potential impacts on the development of CO_2-sending industries in the County and beyond. These impacts include both incentivizing new CO_2-emitting industries, and extending the life of fossil fuel sources that would continue to operate under the guise of "zero emission" when they would have been phased out but for the Project.

The Draft EIR further argues in the greenhouse gas (GHG) section that information about future sources of CO_2 is unknown, and at the same time, that future sources will come from "essential but hard to decarbonize" industries.[31] Nothing in the Draft EIR indicates how this "essential but hard to decarbonize" category is defined or suggests the County will condition future sources on falling within it. The only disclosed source in the Draft EIR is a fossil fuel plant that sends power to oil production activities.[32]

Notably, the Project has no practical or financial justification without its CO_2-sending industries. As the Draft EIR itself admits, "[t]he life of the project is dependent on the sources permitted for injection into the storage, the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[33] The lack of information or standards regarding CO_2-sending industrial facilities creates a serious concern that instead of reducing and sequestering current CO_2 emissions, the Project will attract and incentivize the construction of new CO_2 generating facilities. This concern is illustrated by the fact that the cumulative projects table includes the "CTV energy park", described only as including "Multiple Projects" in an "[u]nknown (Elk Hills)" location.

Moreover, according to California Resource Corporation's (CRC's) website, a number of Carbon Dioxide Management Agreements (CDMAs) have been finalized to assure sequestration at the Project site by specific industrial facilities. All the projects that have entered into a CDMA should be included in the project description. These projects include: the Lone Cypress Blue Hydrogen project (CDMA entered into in May 2023), a new renewable dimethyl ether (rDME) production facility by InEnTec, Inc. (CDMA entered into in May 2023), a renewable gasoline plant by Verde Clean Fuels (CDMA entered into in July 2023), and a waste-to-energy production facility by NLC Energy (CDMA entered into in November 2023). All these projects are planned to be co-located at Elk Hills.[34] Moreover, and importantly, several of these projects contemplate CRC, CTV, or affiliated companies possessing an "equity stake" in the CO_2-sending facilities.[35]

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[31] Draft EIR, Vol. 1 at 4.8-26

[32] "The Elk Hills Power plant provides about one third of its power for oilfield operations and the remainder is distributed to the California power grid." Draft EIR, Vol. 1 at 3-3.

[33] Draft EIR, Vol. 1 at 4.8-24.

[34] CRC, *Carbon TerraVault Vaults*.

[35] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* (July 31, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Provides-Second-Quarter-2023-Update/default.aspx ("CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake") (accessed Mar. 1, 2024); CRC, *Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA* (May 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Announces-Two-New-Storage-Only-Carbon-Dioxide-Management-Agreements-and-Submission-of-Another-Class-VI-Permit-to-the-EPA/default.aspx ("CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake").

As CRC has noted publicly, these projects "play an important role within Carbon TerraVault's strategy" in developing the Project.[36]

Another project which must be included in the project description is the Avnos Direct Air Capture (DAC) project. This project is included in CRC's application to the U.S. Environmental Protection Agency (EPA) for a Class VI injection well permit and, should that permit be approved, will be an approved source of CO_2 for sequestration. In its 2023 operations updates, CTV describes the California DAC Hub as being "led by CTV's subsidiary CTV Direct, LLC" and states it was selected to receive approximately $12 million in DOE funding.[37]

The Draft EIR appendix includes a 350-page report prepared in June 2023 for the County's Planning and Natural Resources Department and titled "Envisioning a Carbon Management Park."[38] This "Carbon Management Park", whose location is undisclosed, includes various industries, some of which have potential serious environmental impacts, such as hydrogen and steel mills. The report prepared for the carbon management park is clear about the financial dependency of a carbon sequestration project on its sources, stating that "[f]or those wells to be cost effective, there will need to be a significant source of CO_2 – on the scale of millions of metric tons annually – available for injection."[39]

The Draft EIR must be revised to include a meaningful discussion of all the potential industries that will be sending CO_2 for sequestration in the CTV I Project, the CO_2 transportation modes for the Project, and their environmental impacts. It must also discuss the Project's potential to incentivize the creation of more GHG emissions sources and new industries, including fossil fuel facilities. Only by doing so would it potentially properly reflect the whole of the action that is being proposed for approval.

II. THE DRAFT EIR IMPROPERLY PIECEMEALS THE PROJECT

The Draft EIR is engaging in impermissible piecemealing under CEQA by failing to analyze at least two projects that should be analyzed as part of the Project: The Avnos DAC Project and Lone Cypress Blue Hydrogen Project.

Courts have used a two-prong test to determine whether an EIR must include an analysis of the environmental effects of future expansion or other action: whether (1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its

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[36] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* ("This project highlights the value proposition of our CTV Clean Energy Park and its important role within Carbon TerraVault's strategy . . . . We welcome NLCE as a trusted partner in developing and furthering California's decarbonization efforts and supporting Kern county's ambitions to become the leading carbon sequestration area in the state.").

[37] Business Wire, *Carbon TerraVault Provides 2023 Update* (Feb. 27, 2024), https://www.businesswire.com/news/home/20240227366330/en/Carbon-TerraVault-Provides-2023-Update.

[38] Draft EIR, Vol. 2, App'x K.2: Carbon Management Business Park 2023 Report, Envisioning A Carbon Management Business Park (June 2023).

[39] Draft EIR, Vol. 2, Envisioning A Carbon Management Business Park at 3.

environmental effects.[40]

Both the Avnos DAC Project and Lone Cypress Blue Hydrogen Project are included in CRC's application to the U.S. EPA for a Class VI injection well permit: "CTV plans to source carbon dioxide initially from Lone Cypress, a proposed hydrogen plant, Elk Hills pre-combustion gas treatment, and the proposed Avnos direct air capture facility."[41] Should EPA approve the Class VI permit for the CTV I Project (for which it already issued a draft permit for comments), it will include the DAC and the Lone Cypress Hydrogen facilities as approved source of CO_2.[42]

CTV I describes itself as responsible for assembling "a consortium of organizations across industry, technology, academia, national labs, community, government, and labor, to pursue U.S. Department of Energy (DOE) funding under its Regional Direct Air Capture (DAC) Hubs Initiative to create the California DAC Hub, the state's first full-scale DAC plus storage (DAC+S) network of regional DAC+S hubs."[43]

For the Lone Cypress Project, CRC's website states the company entered into a CDMA with Lone Cypress Energy Services, LLC in December 2022.[44]

Both projects, while in different stages, are in advanced enough stages to be a reasonably foreseeable consequence of the CTV I Project and are not speculative or uncertain.[45]

In a quarterly report to the California Public Utilities Commission from January 31, 2024, SoCalGas discloses that it is a member of the California Direct Air Capture Hub Consortium working toward the DAC project in Kern County and that the consortium was awarded an $11.8 million grant from DOE. It further states that the DAC facility's project manager "is currently in contract negotiations and expects to finalize the negotiation in early 2024, allowing for an expected project kickoff thereafter."[46]

As for the status of Lone Cypress, documents obtained through a California Public Records Act (PRA) request show that the project's application was deemed complete by Kern County in September 2023,[47] and a draft Notice of Preparation was already prepared for the

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[40] *Laurel Heights, supra*, 47 Cal. 3d 376 at 396.
[41] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* (Dec. 2023) at 1.
[42] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits.*
[43] CRC, *California DAC Hub*, https://www.crc.com/carbon-terravault/projects/california-dac-hub/default.aspx (last accessed Mar. 1, 2024).
[44] CRC, *Lone Cypress CDMA*, https://www.crc.com/carbon-terravault/projects/lone-cypress-cdma/default.aspx (last accessed Mar. 1, 2024).
[45] *Save Round Valley Alliance v. County of Inyo* (2007) 157 Cal.App.4th 1437, 1450.
[46] SoCalGas, *Quarterly Report on Status of Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), or Creating Helpful Incentives to Produce Semiconductors and Science Act (CHIPS) Projects Pursuant to Resolution E-5254* (Jan. 31, 2024) at 2.
[47] Email from Jamal Ferguson, Kern County, to Greg Brooks, *PLN23-00800 Project Meeting* (Sept. 13, 2023).

project EIR in December 2023.[48]

Both projects are not only a reasonably foreseeable consequence of the initial CTV I Project, but they are also dependent on the Project.[49] A DAC project, by definition, must be tied to a carbon sequestration reservoir to operate. In the same way, Lone Cypress relies on the CTV I Project's sequestration for its operations.

The June 2023 "Environmental Information Form" for Lone Cypress includes the following description of the project from the project proponent:

> The Lone Cypress Hydrogen Project will produce 65 Metric Tonnes (MT) per Day of liquid hydrogen using proven technology. The hydrogen will be manufactured by feeding approximately 13MM sdd of natural gas and 0.32 acre-feet per day (2,440 bpd) of water into a Steam Methane Reformer (SMR) (...) *The CO2 produced as a byproduct from the hydrogen generation will be captured, compressed to supercritical state, and transported via pipeline to a sequestration EPA Class VI well at CRC's CTV Project.* The Lone Cypress Hydrogen Project will sequester over 200,000 MT of carbon dioxide annually.[50]

In the same document, under "[a]sociated project", the applicant lists CTV I, and goes on to say that "CTV 1 will sequester CO_2 from the proposed project; therefore, *CTV must be completed before this project can commence operations.*"[51]

Both the DAC and the Lone Cypress Hydrogen projects come with their own set of environmental impacts related to both construction and operations, which will likely affect the CTV I Project's environmental effects. Both projects must therefore be included in the Draft EIR, and their potential impacts must be disclosed and analyzed.

III. THE DRAFT EIR FAILS TO ANALYZE GROWTH-INDUCING IMPACTS

CEQA requires the Draft EIR to describe growth-inducing impacts of the CTV I Project,[52] including ways in which the Project could directly or indirectly foster economic growth that could lead to an adverse physical change to the environment.[53]

In a one-paragraph discussion, the Draft EIR explains that because Project operation would include five regular full-time employees, with five potential additional maintenance

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[48] Kern County Planning & Natural Res. Dept., *Draft Notice of Preparation/Initial Study Checklist, Elk Hills Blue Hydrogen by Lone Cypress Energy Services, LLC* (Dec. 2023).
[49] *Paulek v. Dept. of Water Res.* (2014) 231 Cal.App.4th 35.
[50] Environmental Information Form, *Elk Hills Blue Hydrogen Plant by Lone Cypress Holding* (filed June 1, 2023) at 2–3 (emphasis added).
[51] *Id.* at 3 (emphasis added).
[52] Pub. Resources Code, § 21100(b)(5); CEQA Guidelines, § 15126(d).
[53] CEQA Guidelines, §§ 15126.2(d), 15064(e); *Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) 124 Cal.App.4th 1184, 1205.

employees, the Project "would not result in a substantial influx of people" and "is not likely to induce any growth within Kern County."[54]

By focusing on the projected number of employees in the CTV I Project alone, the Draft EIR ignores the requirement to discuss the ways in which a proposed project could foster *economic growth*, not only population growth, directly or indirectly.[55] Clearly, as described above, the CTV I Project is just the first step in a much larger development, for which CTV already signed multiple CDMAs. In addition, the storage capacity proposed for approval can accommodate many more metric tons of CO_2 than the Draft EIR analyzes. Further economic growth from the Project is clearly what the Project proponents and the County envision, and it should be analyzed.

Moreover, a report prepared for the County to analyze the potential fiscal and economic benefits of a carbon management park found significant economic growth from such a park development: The potential volume ("output") associated with the carbon management park and related offsite activities is projected in the report to range from $4.5 billion to $6.9 billion per year. Regarding employment, the report finds that, at full buildout, the park and related offsite activities would directly and indirectly support 13,500 to 22,000 permanent jobs.[56] While this report does not directly analyze the specific projects envisioned for the Elk Hills oil field, it shows the potential economic growth that needs to be discussed under a proper growth-inducing analysis.

IV. THE DRAFT EIR FAILS TO PROVIDE ADEQUATE PROJECT OBJECTIVES

The Draft EIR does not provide an adequate set of project objectives. The document articulates no purpose, need, or objectives for the CTV I Project independent of a list of "the applicant's objectives" for the Project.[57] Because, as discussed below, the integrity and validity of an alternatives analysis depends in significant part on the articulation and assessment of the lead agency's project objectives, an EIR that lacks an adequate statement of those objectives will not be in compliance with CEQA. This deficiency is compounded by the likelihood that the Project will both attract and incentivize the construction of new CO_2-generating facilities instead of focusing on reducing and sequestering CO_2 emissions from existing facilities, and also be used as a rationale to extend the life of existing fossil-fuel infrastructure whose utility otherwise may cease sooner.

Here, the Draft EIR states:

The following are the applicant's project objectives:

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[54] Draft EIR, Vol. 1 at 5-7.
[55] CEQA Guidelines, § 15126.2(e).
[56] The Natelson Dale Group Inc., *Analysis of Potential Fiscal and Economic Benefits of Kern County Carbon Management Industry* (Apr. 4, 2023) at 6, https://psbweb.kerncounty.com/planning/pdfs/cmbp/CMBP_Potential_Fiscal_Economic_Benefit_Analysis.pdf.
[57] Draft EIR, Vol. 1 at 3-7, 6-7.

- Construct and operate a permanent underground storage facility for CO_2, in an economically feasible manner.
- Contribute to CRC's adopted goals of Full-Scope Net Zero emissions for Scope 1 (direct greenhouse gas emissions), Scope 2 (indirect greenhouse gas emissions associated with the purchase of electricity/steam/heat/cooling) and Scope 3 (all other indirect greenhouse gas emissions resulting from the company's business operations) emissions by 2045.
- Support California's Executive Order B-55-18, for California to achieve carbon neutrality by 2045 and net negative emissions thereafter.
- Site and design the project in an environmentally responsible manner consistent with current Kern County and California guidelines.
- Promote economic development and bring living-wage jobs to Kern County.[58]

The Draft EIR articulates no purpose, need, or objectives for the CTV I Project independent of this list of "the applicant's objectives" for the Project. But without a purpose, need, and objectives adopted by the lead agency, the Draft EIR cannot meaningfully assess impacts and develop or compare a reasonable range of alternatives to the proposed Project.[59] Because the applicant operates the oil field that will be a major source of CO_2 for the storage facility, and this facility appears to be designed at least in part to enable the oil field operations to continue to emit Scope 1, 2, and 3 emissions and to facilitate the development and operation of new GHG-emitting facilities, working against state carbon neutrality goals, it is particularly important to scrutinize the project objectives and ensure they reflect public agency goals.

V. THE DRAFT EIR FAILS TO ANALYZE ADEQUATE ALTERNATIVES

The Draft EIR is also unlawful for failing to properly put forward, describe, and analyze a reasonable range of alternatives. Under CEQA, a proper analysis of alternatives is essential to comply with the Act's mandate that significant environmental impacts be avoided or substantially lessened where feasible.[60] The analysis of alternatives lies at the "core of an EIR,"[61] and an EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[62]

The purpose of the requirement to contemplate alternatives is to identify ways to mitigate or avoid the significant effects of a project.[63] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental

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[58] Draft EIR, Vol. 1 at 3-7, 6-7.

[59] *North Coast Rivers Alliance v. Kawamura* (2015) 243 Cal.App.4th 647, 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)) ("[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency"); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).

[60] Pub. Resources Code, § 21002; CEQA Guidelines, §§ 15002(a)(3), 15021(a)(2), 15126(d); *Citizens for Quality Growth v. City of Mount Shasta* (1988) 198 Cal.App.3d 433, 443–45.

[61] *Citizens of Goleta Valley v. Bd. of Supervisors* (1990) 52 Cal.3d 553, 564.

[62] *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 735; see also Pub. Resources Code, § 21002.1(a).

[63] Pub. Resources Code, § 21002.1.

effects."[64] The alternatives discussion must be "meaningful" and must "contain analysis sufficient to allow informed decision making."[65] The alternatives analysis is critical to the integrity of an EIR.[66] An EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[67] An alternatives analysis under CEQA must focus on potentially feasible alternatives to the project, even if these alternatives would impede to some degree the attainment of project objectives, or would be more costly.[68]

As explained below, the Draft EIR's alternatives discussion fails to comply with CEQA. The alternatives discussion is flawed for at least seven reasons: (1) it relies on an inadequate project description; (2) it relies on an inadequate set of project objectives; (3) it relies on an inadequate understanding of the Project's own impacts; (4) it fails to consider a reasonable range of alternatives; (5) it fails to properly or coherently discuss the "no project" alternative and compare it to the Project; (6) it fails to meaningfully describe or analyze the action alternatives it considers; and (7) it fails to provide substantial evidence to support its comparisons of alternatives to the proposed Project. The Draft EIR must be revised to properly analyze project alternatives, as required by CEQA.

A. The Draft EIR Cannot Properly Consider Alternatives Without an Adequate Project Description, Adequate Description of the Lead Agency's Project Objectives, and Adequate Analysis of Project Impacts.

The Draft EIR's alternatives analysis fails in three threshold ways: it is not based on an adequate project description, it does not articulate a public purpose and need for the Project, and it does not describe, assess, or analyze impacts properly. These deficiencies render the alternatives analysis inadequate.

First, the Draft EIR's alternatives analysis is flawed because it is not based on a stable, accurate project description. As demonstrated above, the Draft EIR's analysis and mitigation are based on an improper project description that understates and misstates the CTV I Project's scope, and omits integral components of the full Project. Without a proper project description, it is not possible to effectively develop alternatives or compare Project impacts with alternatives in a way that is coherent and supported by substantial evidence.

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[64] *Save Panoche Valley v. San Benito County* (2013) 217 Cal.App.4th 503, 52 (citations omitted); see also Pub. Resources Code, §21081(a); CEQA Guidelines, §15091(a)(3); *Cal. Native Plant Society v. City of Santa Cruz* (2009) 177 Cal.App.4th 957, 1002.

[65] *Laurel Heights, supra*, 47 Cal.3d at 403–04.

[66] *In re Bay-Delta Programmatic Envtl. Impact Report Coordinated Proceedings*, 43 Cal.4th 1143, 1162 (2008) ("The EIR is the heart of CEQA, and the mitigation and alternatives discussion forms the core of the EIR.").

[67] *San Joaquin Raptor/Wildlife Rescue Center, supra*, 27 Cal.App.4th at 735; see also Pub. Resources Code, § 21002.1(a).

[68] CEQA Guidelines, § 15126.6(b), (f); see also Pub. Resources Code, § 21102.1(a) ("The purpose of an environmental impact report is to identify the significant effects on the environment of a project, to identify alternatives to the project, and to indicate the manner in which those significant effects can be mitigated or avoided.").

Second, without a proper description of the Project's purpose and need and a set of project objectives adopted by the lead agency, it is impossible to adequately assess alternatives to the Project in a way that complies with CEQA.

A proper statement of the lead agency's project objectives is essential to the development of an adequate alternatives analysis. This principle is apparent throughout the Guidelines and caselaw. For example, "[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency."[69] The Draft EIR must include "[a] clearly written statement of objectives," as this will guide the County in developing a reasonable range of alternatives.[70] CEQA Guidelines section 15124(b) notes that a "clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[71] That statement of the *lead agency's* objectives, in informing the *lead agency's* reasonable range of alternatives to a proposed project, cannot simply be delegated to a project proponent.

Moreover, "[a] lead agency may not give a project's purpose an artificially narrow definition. An agency 'may structure its EIR alternative analysis around a reasonable definition of underlying purpose and need not study alternatives that cannot achieve that basic goal. For example, if the purpose of the project is to build an oceanfront resort hotel or a waterfront aquarium [citation], a lead agency need not consider inland locations.'"[72] This principle requires, again, that the lead agency take responsibility for articulating the project purpose and need as well as the project objectives.

Here, as noted above, the Draft EIR articulates no purpose, need, or objectives for the Project independent of a list of "the applicant's objectives" for the Project.[73] The Draft EIR contains no further discussion of purpose, need, or objectives beyond this list. But, as reflected in the case law and Guidelines,[74] it is not possible for a lead agency to meaningfully undertake an independent evaluation of alternatives if the agency uncritically uses an applicant's objectives as the benchmark for evaluation, and fails to include its own statement of purpose and objectives. A range of alternatives that is based exclusively on "the applicant's project objectives," and not incorporating any public purpose, need, or objectives that have been adopted by the lead agency, thus cannot comply with CEQA. Moreover, reliance exclusively on applicant project objectives is particularly inappropriate where there are unmitigable significant impacts that will require the

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[69] *North Coast Rivers Alliance, supra*, 243 Cal. App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).

[70] CEQA Guidelines, §15124(b).

[71] CEQA Guidelines, § 15124(b).

[72] *North Coast Rivers Alliance, supra*, 243 Cal.App.4th at 668 (citing *Bay–Delta, supra*, 43 Cal.4th at 1166 [internal citations omitted]).

[73] Draft EIR, Vol. 1 at 3-7, 6-7.

[74] *North Coast Rivers Alliance, supra,* 243 Cal.App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b).

County to find overriding considerations, given the need for the objectives to "aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[75]

Third, without a proper analysis of the Project's impacts, any alternatives analysis is necessarily flawed because the comparison of Project impacts to the anticipated impacts of alternatives will be unsupported by substantial evidence. Here, the significant deficiencies in the Draft EIR's analysis of Project impacts make any comparison of those impacts with the impacts of proposed alternatives meaningless.

This deficiency in the Draft EIR—flawed impact analysis leading to flawed alternatives analysis—is apparent across multiple impact areas, discussed throughout these comments. Any comparison of the impacts of the Project with the impacts of alternatives will fail if the Project impacts are misstated or improperly analyzed. But the deficiency is most glaring in the context of GHG impacts, where the Draft EIR's alternatives analysis asks its readers to accept a paradox: first, the Project will have significant unmitigable impacts on GHG emissions.[76] Second, the no-project alternative will have less-than-significant impacts on GHG emissions.[77] And third, at the same time, according to the Draft EIR, the no-project alternative's impacts are "greater than project" impacts.[78] On its face, this analysis cannot stand scrutiny, since it is internally inconsistent. This internal inconsistency, in turn, is a consequence of a fundamental failure in the underlying Project GHG analysis and conclusions, as discussed in section VI.B of these comments.

These analytical failures render the Draft EIR deficient. And beyond that, the failures also constitute fundamental informational deficiencies in the Draft EIR. It is not possible for the public or a decisionmaker to compare the alternatives meaningfully if the conclusions being compared are incoherent or internally inconsistent, as is the case here.

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[75] CEQA Guidelines, § 15124(b); see *Preservation Action v. San Jose* (2006) 141 Cal.App.4th 1336, 1351–52 ("Since CEQA charges the agency, not the applicant, with the task of determining whether alternatives are feasible, the circumstances that led the applicant in the planning stage to select the project for which approval is sought and to reject alternatives cannot be determinative of their feasibility. The lead agency must *independently* participate, review, analyze and discuss the alternatives in good faith." [citing *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 736]).

[76] Draft EIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"), 6-21 (Project GHG impacts "significant and unavoidable").

[77] Draft EIR, Vol. 1 at 6-13 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]").

[78] Draft EIR, Vol. 1 at 6-21 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-23 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

B. The Draft EIR Fails to Adequately Consider a Reasonable Range of Alternatives.

An EIR must consider a reasonable range of alternatives which "offer substantial environmental advantages over the project proposal."[79] The Public Resources Code makes it clear that proper alternatives need to "substantially lessen" the significant environmental effects of a project.[80] Here, the Draft EIR rejects without analysis several alternatives that meet that criterion and satisfy at least some project objectives. This improper failure to consider alternatives appears to have occurred, at least in part, because the applicant's project objectives are drawn too narrowly[81], and the applicant's conception of "feasibility" is improperly constrained.[82]

The lead agency, not the applicant, bears the responsibility to evaluate alternatives based on project objectives, as demonstrated above.[83] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental effects."[84] The lead agency also must evaluate feasibility based on objective criteria. "Feasible" means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors."[85]

Here, the Draft EIR should have considered a wider range of alternatives that minimize or avoid impacts from the proposed Project. Alternatives that involve eliminating or reducing oil extraction from CRC's oil fields, for example, satisfy most of even the applicant's project objectives, including contributing to CRC's adopted goals of Full-Scope Net Zero emissions by 2045, supporting California's Executive Order B-55-18, and siting and designing the Project in an environmentally responsible manner. If the goal is to keep oil field-generated CO_2 out of the atmosphere, there are alternative ways to accomplish this that the Draft EIR fails to consider.

The Draft EIR should be revised to consider these and other reasonable alternatives, as required under CEQA.

C. The Draft EIR's Discussion of Alternative 1, the "No Project" Alternative, is Inadequate Under CEQA.

The Draft EIR's "no project" alternative discussion provides a brief examination, unsupported by evidence or analysis, of the environmental consequences of not permitting the Project or any alternative. This summary discussion of Alternative 1 is inadequate under CEQA because it fails to include basic information about the no-project alternative.

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[79] *Citizens of Goleta Valley, supra*, 52 Cal.3d at 566.
[80] Pub. Resources Code, § 21002; see also CEQA Guidelines, § 15126.6(a).
[81] *North Coast Rivers Alliance, supra*, 243 Cal.App.4th at 668.
[82] *Preservation Action, supra*, 141 Cal.App.4th at 1351–52.
[83] *Kings County Farm Bureau, supra*, 221 Cal.App.3d at 736; *Preservation Action, supra*, 141 Cal.App.4th at 1351–52.
[84] CEQA Guidelines, § 21081; *Mountain Lion Foundation v. Fish Game Com.* (1997) 16 Cal.4th 105, 134.
[85] Pub. Resources Code, § 21061.1; *Cal. Native Plant Society, supra*, 177 Cal.App.4th at 960.

The CEQA Guidelines require that the no project analysis discuss "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services."[86] Here, however, the discussion lacks "adequate information regarding the no-project alternative" that would allow the decisionmakers to make "an informed, reasoned decision on whether this Project should go forward."[87] In *Save the Hill Group v. City of Livermore*, the court found that a "no-project" alternative that failed to provide adequate information as to what would be reasonably expected to occur if a project would not go forward was in violation of CEQA, and set the EIR approval aside.[88]

The same reasoning applies here. The Draft EIR should contrast the impacts of the proposed Project with the impacts of the no-project alternative, with specificity and, where possible, quantification, across all impact categories. It should provide a "factually based forecast of the environmental impacts of preserving the status quo."[89] Instead, the Draft EIR includes a cursory narrative discussion, with no supporting evidence or analysis, articulating only what the applicant asserts the consequences of the no-project alternative would be. The Draft EIR then bases its comparison with the proposed Project on this thin discussion.

This missing information is, in the words of the *Save the Hill Group* court, "just the sort of information CEQA intended to provide those charged with making important, often irreversible, environmental choices on the public's behalf."[90] The alternatives analysis must be revised to provide a robust discussion of the "no-project" reasonable consequences.

Additionally, as discussed above, the analysis of the no-project alternative is inadequate because the comparison between the no-project alternative and the proposed Project is misleading, inconsistent, and incoherent. The Draft EIR's characterization of Alternative 1 as having greater GHG impacts than the Project, in particular, reflects a failure to adequately and coherently describe and analyze this alternative as well as a failure to coherently analyze the Project's impacts.[91]

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[86] CEQA Guidelines, § 15126.6(e)(2).
[87] *Save the Hill Grp. v. City of Livermore* (2022) 76 Cal.App.5th 1092, 1113, review denied (July 13, 2022).
[88] *Id.* at 1113.
[89] *Ctr. for Biological Diversity v. Dept. of Fish & Wildlife* (2015) 234 Cal.App.4th 214, 253.
[90] *Save the Hill Grp., supra*, 76 Cal.App.5th at 1113.
[91] Compare Draft EIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"); 6-21 (Project GHG impacts "significant and unavoidable"), 6-13 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]") with Draft EIR, Vol. 1 at 6-21 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-23 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

Finally, Alternative 1 would also address the failures, highlighted elsewhere in these comments, in framing project objectives and in neglecting to analyze the fact that the Project is designed to facilitate and justify the continued extraction of oil and burning of fossil fuels for energy. An adequate comparative analysis between the impacts of Alternative 1 and the Project would require analysis of the Project's sources of CO_2 and of the Project's facilitation of fossil fuel extraction and combustion.

D. The Draft EIR Fails to Adequately Describe or Analyze Alternatives 2 and 3.

The Draft EIR's discussion of the two "action" alternatives, DAC (Alternative 2) and nature-based carbon storage (Alternative 3), is cursory and lacking in specificity and support.[92] The Draft EIR not only fails to describe either alternative with specificity, but also fails to disclose or even meaningfully attempt to discuss the projected impacts of either alternative. As a consequence, the Draft EIR fails to support its conclusions—where it compares alternatives' impacts with the Project's impacts—with substantial evidence.

First, Alternative 2, the DAC Alternative, fails to specify any of the major features of the hypothetical DAC facility that forms the basis of the alternative. The Draft EIR does not specify, for example, what technology will be used, the size and throughput of the facility, what infrastructure would be built and where, or what resources it would take to build and maintain that infrastructure and operate the facility. Instead, the document presents only a discussion of the generalized features of DAC technology and facilities, with not one word about how those features might or might not appear in the application of DAC as an alternative to the proposed Project, as discussed in sections I and II of these comments.[93] The Draft EIR then fails even to make a serious attempt to assess the impacts of the DAC alternative in each impact category[94]—a task that would have been fruitless, given the lack of specificity about the alternative's basic features. Correspondingly, the Draft EIR and appendices do not contain evidence, methodology, modeling, or calculations regarding any such impacts. And following from this, there is no substantial evidence—indeed, no evidence at all—supporting the Draft EIR's comparison of Project impacts with the purely speculative conclusions about the DAC alternative's impacts. Nor is the brief discussion of whether Alternative 2 meets project objectives[95] supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed.

Second, Alternative 3, the "Nature Based Carbon Storage" alternative, also fails to meaningfully specify any of the features of the alternative. While the Draft EIR sets forth some general ideas about what types of features this potential alternative might include, the alternative remains completely unformed.[96]

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[92] Draft EIR, Vol. 1 at 6-17 to 6-20 (containing the Draft EIR's entire discussion of these two alternatives).
[93] Draft EIR, Vol. 1 at 6-17 to 6-19 (containing the Draft EIR's discussion of Alternative 2, in full).
[94] Draft EIR, Vol. 1 at 6-17 to 6-19.
[95] Draft EIR, Vol. 1 at 6-17 to 6-19.
[96] Draft EIR, Vol. 1 at 6-19 to 6-20 (containing the Draft EIR's discussion of Alternative 3, in full).

This text, with the "example" of "planting of trees," comes closest to articulating the features of Alternative 3:

> The most applicable nature-based carbon storage alternative for the area of the project site would be regenerative agriculture, as it coincides with the current zoning. Planting of trees would be one example of regenerative nature-based carbon storage for the highest ability to store atmospheric carbon.[97]

It is clear on its face that this statement does not present a specific alternative to the proposed Project. As with Alternative 2, the Draft EIR lacks any discussion, beyond the speculation above, of what technology will be used, much less how the alternative would be configured or what, specifically, it would entail.[98] And the closest the Draft EIR comes to articulating the scope or size of this alternative is in a purely conditional, hypothetical statement: "If 9,000 acres of the project site were remediated of all oil and gas facilities and prepared for planting, an estimated 400 to 1,000 trees per acre could be planted, resulting in a new forest area of 3.6 million to 9 million trees."[99] Notably, even all these hypothetical statements in the Draft EIR lack any evidence or foundation in the Draft EIR or appendices, but instead just appear as assertions, without any references or citations to articulate or support any methodology, analysis, or conclusions.

Accordingly, there is no meaningful analysis of either the features or impacts of the alternative, making it impossible to compare the Project's impacts with the alternative's impacts, and making the conclusions in that attempted comparison lacking in substantial evidence for support. Nor is the brief discussion of whether Alternative 3 meets project objectives[100] supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed.

VI. THE DRAFT EIR FAILS TO ANALYZE AND MITIGATE SIGNIFICANT IMPACTS

The discussion of a proposed project's environmental impacts is an essential component of an EIR.[101] The fundamental purpose of CEQA is to "inform the public and its responsible officials of the environmental consequences of their decisions *before* they are made."[102] To do so, an EIR must contain facts *and* analysis, not just an agency's bare conclusions.[103]

As explained in detail below, the Draft EIR's environmental impacts analysis is deficient under CEQA because it fails to provide the necessary facts and analysis to allow the County and the public to make informed decisions about the CTV I Project.

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[97] Draft EIR, Vol. 1 at 6-19.
[98] Draft EIR, Vol. 1 at 6-19 to 6-20.
[99] Draft EIR, Vol. 1 at 6-19 to 6-20.
[100] Draft EIR, Vol. 1 at 6-19 to 6-20.
[101] See CEQA Guidelines, § 15126.2(a) ("An EIR *shall* identify and focus on the significant effects of the proposed project on the environment.") (emphasis added).
[102] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal.*, 6 Cal.4th 1112, 1123.
[103] *Citizens of Goleta Valley, supra*, 52 Cal.3d at 568.

CEQA also requires an EIR to describe and adopt all feasible mitigation measures to address a project's significant environmental impacts.[104] Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[105]

Generally, the "[f]ormulation of mitigation measures should not be deferred until some future time."[106] As an exception, "measures may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way."[107] Crucially, there is a "distinction between stating a generalized goal and adopting specific performance criteria," and "[s]imply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[108] Further, even where the deferred formulation of mitigation might be allowable, there is a point beyond which delayed implementation is not allowed: "[o]nce the project reaches the point where activity will have a significant adverse effect on the environment, the mitigation measures must be in place."[109]

"Where several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified."[110]

As discussed below, throughout the Draft EIR, the County's proffered mitigation measures are insufficient, riddled with inconsistencies, and ultimately not adequate to satisfy CEQA's legal requirements.

A. The Draft EIR's Analysis and Mitigation of Air Quality Impacts is Inadequate.

1. The Draft EIR states heavy-duty truck traffic is expected for Project operations but does not describe or analyze the impacts of such traffic.

Within the chapter on project description, in the section for "Operational and Maintenance Activities," the Draft EIR describes five full-time employees who will be onsite at all times and another five employes who may need to be onsite when repairs or other maintenance is required.[111] The Draft EIR calculates "Operational Traffic" for these employees, who are expected to collectively make 20 daily trips in "Passenger Vehicles."[112]

Separately, the discussion of "Operational Traffic" includes a heading for "Truck Traffic," which is followed by one sentence that states: "It is anticipated that diesel heavy heavy [sic] duty trucks would make 40 trips per day following the access routes designated for

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[104] Pub. Resources Code, § 21002; CEQA Guidelines, § 15126.4(a)(1).
[105] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).
[106] CEQA Guidelines, § 15126.4(a)(1)(B).
[107] *King & Gardiner Farms, LLC v. County of Kern* (2020) 45 Cal.App.5th 814, 856.
[108] *Id.* at 856.
[109] *Id.* at 860, quoting *POET, LLC v. Cal. Air Resources Bd.* (2013) 218 Cal.App.4th 681, 738.
[110] CEQA Guidelines, § 15126.4(a)(1)(B).
[111] Draft EIR, Vol. 1 at 3-35.
[112] Draft EIR, Vol. 1 at 3-35 to 3-36.

travel."[113] No further information on the nature, purpose, or impacts of this operational heavy-duty truck traffic is provided in the project description chapter. Nor is there any further discussion anywhere else in the Draft EIR.

As noted above, the Draft EIR must be revised to thoroughly explain this aspect of the CTV I Project. Based on the Notice of Preparation/Initial Study as well as other available information, it seems likely these trucks will be carrying CO_2 from offsite industrial sources, perhaps including but not limited to the Golden State Hydrogen Project that has been proposed in Pixley, California.[114]

In addition to fully explaining the nature and purpose of the operational heavy-duty truck trips in the project description, the impacts of such heavy-duty truck traffic during Project operation must be analyzed and mitigated consistent with CEQA's requirements. As acknowledged in the Notice of Preparation/Initial Study, truck and other vehicle traffic threatens significant direct and cumulative impacts in at least the following categories: air quality, energy demand and consumption, greenhouse gas emissions, hazards and hazardous materials, noise, and transportation and traffic.[115] Depending on the nature and purpose of the operational heavy-duty truck traffic, additional significant impacts are possible.

2. The Draft EIR must be updated to address the revised national ambient air quality standard for $PM_{2.5}$.

The Air Quality section of the Draft EIR must be updated to reflect the U.S. EPA's issuance of a new national ambient air quality standard (NAAQS) for fine particulate matter, also known as $PM_{2.5}$. On February 7, 2024, U.S. EPA strengthened the annual health-based NAAQS for $PM_{2.5}$ from a level of 12 micrograms per cubic meter to 9 micrograms per cubic meter.[116]

Beyond just acknowledging the new standard, the Draft EIR should also address the implications of the new annual $PM_{2.5}$ NAAQS: air quality in Kern County currently does not

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[113] Draft EIR, Vol. 1 at 3-36.

[114] *Notice of Preparation/Initial Study* at 4 ("The proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project."); *Operating Statement – Golden State Hydrogen Plant Project, supra*, at 9 (noting that CO_2 emissions from new hydrogen plant in Pixley, CA will be liquefied and delivered to the CTV I Project until a CCS facility is developed in Tulare County).

[115] *Notice of Preparation/Initial Study* at 24–25, 29, 32, 34–35, 40, 44–45.

[116] See generally EPA, *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter* (prepublication version, signed Feb. 5, 2024), https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-final-frn-pre-publication.pdf; accord, EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* (Feb. 7, 2024), https://www.epa.gov/newsreleases/epa-finalizes-stronger-standards-harmful-soot-pollution-significantly-increasing.

meet the new standard[117] and is not expected to meet it in 2032,[118] meaning the San Joaquin Valley Air Pollution Control District (Air District) will have to institute further restrictions on polluting projects and activities through the San Joaquin Valley airshed, including in Kern County.[119]

3. The Draft EIR must be updated to make clear the full danger posed by increased $PM_{2.5}$ emissions.

a. The Draft EIR should disclose that there is no safe level of exposure to $PM_{2.5}$.

Along with U.S. EPA's issuance of its revised $PM_{2.5}$ NAAQS, the agency also summarized the latest scientific studies on the health effects of $PM_{2.5}$.

The Draft EIR should update its discussion of the health effects of $PM_{2.5}$ to reflect the latest science summarized by U.S. EPA in its standard-setting decision. Such an update is necessary because CEQA requires that an EIR conduct "an analysis that connect[s] the air quality effects to human health consequences."[120]

Of key importance to disclose to Kern County residents and decisionmakers: currently available evidence indicates there is no safe level of exposure to $PM_{2.5}$.[121] Consequently, it is essential that the County adopt all feasible mitigation for increased $PM_{2.5}$ emissions.

b. The Draft EIR should better address the relationship between $PM_{2.5}$ and DPM.

The Draft EIR's description of air pollutants and health effects discusses "Particulate Matter (PM_{10} and $PM_{2.5}$)" separately from "Diesel Particulate Matter."[122]

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[117] See EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* at Figure 1; accord EPA, *Fine Particle Concentrations for Counties with Monitors Based on Air Quality Data from 2020 – 2022* at 1, https://www.epa.gov/system/files/documents/2024-02/table_annual-pm25-county-design-values-2020-2022-for-web.pdf (last accessed Mar. 1, 2024).

[118] EPA, *EPA Projects More than 99% of Counties Would Meet the Revised Fine Particle Pollution Standard* (Feb. 7, 2024), https://www.epa.gov/system/files/documents/2024-02/2024-pm-naaqs-final-2032-projections-map.pdf.

[119] Lazo, *California's Pursuit of Clean Air Just Got Much Harder: New Soot Standards Set*, Cal Matters (Feb. 7, 2024) ("Achieving the new target will take wide-ranging new state and local regulations aimed at cutting emissions"), https://calmatters.org/environment/2024/02/california-new-soot-standards.

[120] *Sierra Club v. County of Fresno* (2018) 6 Cal.5th 502, 522.

[121] According to EPA: "[t]he currently available evidence does not identify particular PM2.5 concentrations that do not elicit health effects. Rather, health effects can occur over the entire distribution of ambient PM2.5 concentrations evaluated, and epidemiologic studies conducted to date do not identify a population-level threshold below which it can be concluded with confidence that PM2.5-related effects do not occur." EPA, *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter* (prepublication version) at 168.

[122] Compare Draft EIR, Vol. 1 at 4.3-13 to 4.3-15 with *id.* at 4.3-25 to 4.3-26.

The discussion of $PM_{2.5}$ notes that "$PM_{2.5}$ constitutes a large portion of combustion particulates, including diesel particulate matter (DPM)," (p. 4.3-14) but does not direct the reader to the separate, further discussion of the dangers of DPM.

To prevent confusion and to convey the full extent of the health risks posed by $PM_{2.5}$, the Draft EIR's discussion of $PM_{2.5}$ should include a cross reference to the more detailed discussion of DPM in the section that addresses "Health Effects and Risks of Toxic Air Contaminants."

Confusingly, the Draft EIR's discussion of $PM_{2.5}$ currently includes an erroneous cross reference. At Volume 1, page 4.3-15, the text states: "The section below entitled 'Oil and Gas Operations and Health Effects' further discusses potential health effects of $PM_{2.5}$ emissions, among other things." But no such section with that title exists.

c. The Draft EIR should address how $PM_{2.5}$ exacerbates illness and death from COVID-19.

The Draft EIR's discussion of the health effects of $PM_{2.5}$ fails to adequately address "the nature and magnitude"[123] of the CTV I Project's increased emissions because it does not acknowledge the studies that demonstrate that exposure to $PM_{2.5}$ has been found to lead to an increase in the death rate for COVID-19, especially for people of color.[124] Indeed, one recent study determined that thousands of COVID-19 deaths could have been prevented during the first year of the COVID-19 pandemic in California, especially in the San Joaquin Valley, if ambient levels of $PM_{2.5}$ pollution were lower.[125]

The Draft EIR therefore should be updated with a discussion of the health risks posed by COVID-19 generally, along with a further discussion of the COVID-19 morbidity and mortality increased by exposure to $PM_{2.5}$.

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[123] *Sierra Club*, *supra*, 6 Cal.5th at 522.

[124] See Cal. Dept. of Public Health, *State Officials Announce Latest COVID-19 Facts* (News Release No. NR20-111) (June 3, 2020), https://www.cdph.ca.gov/Programs/OPA/Pages/NR20-111.aspx; Chow, D.S. et al., *The Disproportionate Rise in COVID-19 Cases Among Hispanic/Latinx in Disadvantaged Communities of Orange County, California: A Socioeconomic Case-Series*, Johns Hopkins Bloomberg School of Public Health (2020), https://www.medrxiv.org/content/10.1101/2020.05.04.20090878v1.full.pdf; Goyal, M.K. et al., *Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children*, Pediatrics (2020), https://pediatrics.aappublications.org/content/pediatrics/early/2020/08/03/peds.2020-009951.full.pdf; Petroni, M., et al., *Hazardous Air Pollutant Exposure As a Contributing Factor to COVID-19 Mortality in the United States*, Environ. Res. Lett., Vol. 15, no. 9 (Sept. 11, 2020), https://iopscience.iop.org/article/10.1088/1748-9326/abaf86; Tian, H. et al., *Risk of COVID-19 is Associated with Long-term Exposure to Air Pollution*, medRxiv (Apr. 24, 2020), https://doi.org/10.1101/2020.04.21.20073700; Wu, X. et al., *Exposure to Air Pollution and COVID-19 Mortality in the United States: A Nationwide Cross-Sectional Study* (updated Nov. 4, 2020), https://projects.iq.harvard.edu/covid-pm/home; Zhu, Y., *Association Between Short-Term Exposure to Air Pollution and COVID-19 Infection: Evidence from China*, 727 Science of the Total Environment (Apr. 2020), https://doi.org/10.1016/j.scitotenv.2020.138704.

[125] English, P.B. et al., *Association Between Long-Term Exposure to Particulate Air Pollution with SARS-CoV-2 Infections and COVID-19 Deaths in California, U.S.A.*, Environmental Advances 9 (2022) 100270, https://doi.org/10.1016/j.envadv.2022.100270.

Notably, the Draft EIR includes a proposed mitigation measure (MM 4.3-6) that addresses COVID-19, stating that: "Owner/operators shall implement all orders related to the COVID-19 pandemic or any other pandemic mandated by Kern County Public Health on well sites and related to worker safety." To provide context for this mitigation measure, the Draft EIR should be revised as recommended above to make clear why COVID-19 is a health concern, particularly for a project that is expected to significantly increase $PM_{2.5}$ emissions.

4. The Draft EIR contradicts earlier statements about the nearest sensitive receptor.

The Draft EIR states: "The closest sensitive receptor to the project site is McKittrick Elementary School, which is 2.5 miles southwest of the facility pipeline and 4.46 miles from injection well 357-7R. The nearest residence is approximately 4.5 miles southeast of the injection line and 4.4 miles from injection well 345-36R."[126] In contrast, the Initial Study/Notice of Preparation states: "The sensitive receptor closest to the project site is the rural residence approximately 1 mile to the south of the project site."[127]

It is important for purposes of both impact analysis and mitigation that the Draft EIR correctly identifies the nearest sensitive receptor. The County must explain the discrepancy between the Draft EIR and the Initial Study/Notice of Preparation and, if the nearest sensitive receptor is actually only one mile away, revise its impacts analysis and mitigation measures accordingly.

5. The Draft EIR's air quality impact analysis is premised on unexplained and/or faulty assumptions.

As set forth in the attached report prepared by Dr. Ranajit Sahu (attached as Attachment A, hereafter "Sahu Report"), the Draft EIR's assessment of impacts and formulation of mitigation measures is inadequate because it is premised on assumptions that are unexplained if not faulty. For example:

- The data provided on "Existing Air Quality" is dated—covering 2019 to 2021—and therefore may not be representative of current air quality in Kern County.

- Nowhere does the Draft EIR or accompanying report prepared by Trinity Consultants explain the assumptions upon which the emissions estimates are made. It is unclear how the various emissions factors were selected and whether they are representative of expected activities and equipment for the CTV I Project.

- Further, assumptions about the expected project activities are unexplained despite their uncanny precision (e.g., well pad construction is expected to take 11 days; every well to be drilled is identified with a specific and unique depth; five hydrocranes are expected to operate exactly 1968.75 hours).

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[126] Draft EIR, Vol. 1 at 1-5.

[127] *Notice of Preparation/Initial Study* at 3.

- The Draft EIR suggests false precision by failing to disclose quantitative error ranges and/or to qualitatively explain the uncertainty inherent in the emission estimates.

- Additionally, page 4-6 of the Trinity Consultants' report is completely blank. It is unclear whether this was intentional, or perhaps a formatting issue? To the extent information is missing—it should be provided to the public with appropriate time for review.

6. The Draft EIR fails to adequately address cumulative air quality impacts.

The Draft EIR acknowledges that the CTV I Project will contribute to cumulatively significant air quality impacts. It states: "Because the project's specific emissions would contribute to Kern County's 2020 emissions inventory and to the 2025 projected emissions of Kern County, *the project's incremental effects on air quality would be cumulatively considerable* and, even with mitigation, this potentially significant cumulative impact would be cumulatively significant and unavoidable."[128]

Although the Draft EIR acknowledges a significant cumulative impact on air quality, it does not evaluate or explain the severity of the impact or its consequences for local residents. The Draft EIR's bare conclusion—without further analysis—violates CEQA because "a sufficient discussion of significant impacts requires not merely a determination of whether an impact is significant, but some effort to explain the nature and magnitude of the impact."[129] Further, the Draft EIR is inadequate because, for an analysis of air quality impacts, an EIR must explain the "connection . . . between the two segments of information presented in the EIR—potential project emissions and human health impacts."[130]

To adequately address the CTV I Project's cumulative air quality impacts, the Draft EIR should address "how the environmental and public health burdens of a project might specially affect certain communities."[131] As part of this analysis, the Draft EIR should account for increased emissions from the Project "together with any pollution burdens [nearby] communities already are bearing, or may bear from probable future projects."[132]

A thorough analysis of cumulative air quality impacts is crucial because Kern County already experiences some of the worst and unhealthiest air quality in the country.[133] Such poor air quality is particularly burdensome because "Kern County has a higher percentage of Hispanic, linguistically isolated, and pollution burdened populations than do other areas of

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[128] Draft EIR, Vol. 1 at 1-11 to 1-12, 5-3 (italics added).
[129] *Sierra Club*, *supra*, 6 Cal.5th at 519.
[130] *Id.* at 520.
[131] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* (2012) at 3, https://oag.ca.gov/sites/all/files/agweb/pdfs/environment/ej_fact_sheet.pdf.
[132] *Id.* at 4.
[133] American Lung Assn., *State of the Air* (2023) at 14–18 (listing Bakersfield, CA as the most polluted city in U.S. for daily and annual particulate matter and the third-most polluted city for ozone), https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf.

California."[134] Indeed the majority-Hispanic residents (63.9 percent) nearest to the proposed CTV I Project are particularly overburdened already: the Project has been proposed for a census tract that already faces one of the highest pollution burdens in the state (96th percentile) as well as challenges posed by unemployment (89th percentile), poverty (86th percentile), and linguistic isolation (83rd percentile).[135]

Notably, in addition to thoroughly addressing the existing air pollution burden in the Project area, the Draft EIR must also address "probable future projects."[136] As discussed elsewhere in these comments, the CTV I Project represents merely one component of extensive further industrial development that is expected in the area.

In addition to adequately analyzing cumulative effects of the CTV I Project in the context of the existing pollution burden on frontline communities and expected future projects, the County must then reassess the Draft EIR's evaluation of alternatives and identification of all feasible mitigation measures. As explained by the Office of the Attorney General, "[w]here a local agency has determined that a project may cause significant impacts to a particular community or sensitive subgroup, the alternative and mitigation analyses should address ways to reduce or eliminate the project's impacts to that community or subgroup."[137] Pursuant to CEQA's requirements and consistent with the Office of the Attorney General's guidance, the County should work with the public and affected communities to develop mitigation measures that will adequately address the CTV I Project's cumulative impacts.

7. The Draft EIR fails to adopt all feasible mitigation to control fugitive dust.

The Draft EIR acknowledges that PM_{10} is largely emitted as fugitive dust, often generated by construction, demolition, excavation, extraction, and/or other earthmoving activities.[138] Such activities—as well as vehicle traffic, another source of PM_{10}—will occur at the CTV I Project site, and the Draft EIR concludes that the Project's construction and operational activities will cause a significant increase in PM_{10} emissions.[139] Consequently, all feasible mitigation for PM_{10} must be adopted.

Mitigation Measure (MM) 4.3-2 specifies that "The Owner/operator shall develop and implement a Fugitive Dust Control Plan in compliance with San Joaquin Valley Air Pollution

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[134] Kern County Planning & Natural Resources Dept., *Final Supplemental Recirculated Environmental Impact Report (October 2020) for Revisions to Title 19-Kern County Zoning Ordinance–(2020 A), Focused on Oil and Gas Local Permitting* (Jan. 2021), section 7.2.6 (Response to Comments of Interested Parties), response to comment 0010-3.
[135] Office of Environmental Health Hazard Assessment (OEHHA), *CalEnviroScreen 4.0*, results for 6029003700, https://oehha.ca.gov/calenviroscreen/maps-data (last visited Feb. 26, 2024).
[136] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* at 4.
[137] *Id.* at 4.
[138] Draft EIR, Vol. 1 at 4.3-14, 4.3-38 to 4.3-39.
[139] Draft EIR, Vol. 1 at 4.3-63 to 4.3-68.

Control District fugitive dust suppression regulations."[140] The Measure further specifies 14 specific "dust control measures [that] shall be implemented."[141]

The prescribed specific measures set forth in MM 4.3-2 are inadequate and do not represent all feasible mitigation for fugitive dust at the Project site. Inexplicably, MM 4.3-2 does not include all feasible measures identified by the San Joaquin Valley Air Pollution Control District in its most recent Guidance for Assessing and Mitigating Air Quality Impacts.[142] Nor does MM 4.3-2 institute all measures contemplated by the Air District's Regulation VIII.[143] Indeed, some of the measures set forth in MM 4.3-2 contradict stricter requirements set forth in Regulation VIII.

Consistent with CEQA's requirement to adopt all feasible mitigation, MM 4.3-2 should be revised to reflect stronger and/or additional mitigation to control fugitive dust. MM 4.3-2 must be strengthened not only to comply with CEQA, but to abide by the legislative directive that projects like CTV I "include . . . [s]trategies to minimize, to the maximum extent technologically feasible, copollutant emissions from facilities where CCUS or CDR technology is deployed to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."[144] Consequently, MM 4.3-2 should be revised to include the following:

- Work should be phased to reduce the amount of disturbed surface area at any one time.[145] The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.

- At all times, for all activities (i.e., *not* just excavated soil piles, construction activities on unpaved surfaces, and grading), visible dust emissions should be limited to 20% opacity.[146]

- Wind barriers should be constructed and maintained to limit visible dust emissions to 20% opacity.[147] The Owner/operator should be required to describe where and how it will construct and maintain wind barriers in the required Fugitive Dust Control Plan.

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[140] Draft EIR, Vol. 1 at 4.3-58.
[141] Draft EIR, Vol. 1 at 4.3-58.
[142] See San Joaquin Valley Air Pollution Control District (SJVAPCD), *Guidance for Assessing and Mitigating Air Quality Impacts* (Mar. 19, 2015) at 77–78, https://www.valleyair.org/transportation/GAMAQI.pdf.
[143] The Air District's Regulation VIII and its constituent rules are described in the Draft EIR in Volume 1 at 4.3-38 to 4.3-39. Further, it is available on the Air District's website at https://ww2.valleyair.org/rules-and-planning/current-district-rules-and-regulations/regulation-viii-fugitive-pm10-prohibitions/.
[144] Health & Safety Code, § 39741.1(a)(3)(A).
[145] Rule 8021, section 5.2 and table 8021-1.
[146] Rule 8021, sections 5.0, 5.2, 5.4.1, and table 8021-1; Rule 8051, section 5.0.
[147] Rule 8021, section 5.2 and Table 8021-1.

- Traffic speeds on unpaved roads should be limited to 15 miles per hour (*not* 25), with speed limit signs posted.[148]

- Construction activities should be discontinued whenever visible dust emissions exceed 20% opacity, even if ambient wind speeds do not exceed 25 miles per hour.[149]

- Track out should be prevented by one of the following: a grizzly with rails, pipes or grates to dislodge debris off exiting vehicles; a layer of washed gravel at one inch or larger in diameter, three inches deep; extension of paved road at least 100 feet from publicly maintained road; or installation of a wheel washer.[150]

- All visible carryout and trackout on paved public roads or the paved shoulders of a paved public road should be removed at the end of each workday;[151] it is not sufficient to isolate carryout or trackout behind a locked gate.

- For empty haul trucks, the interior of the cargo compartment must be cleaned or covered before the empty truck leaves the site.[152]

Additionally, MM 4.3-2 must specify that no construction or grading permits shall be issued, and no activities expected to cause fugitive dust emissions may otherwise commence, unless and until the Air District approves a Fugitive Dust Control Plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[153]

8. The Draft EIR does not provide adequate mitigation to protect sensitive receptors.

a. MM 4.3-5 is inadequate and does not constitute all feasible mitigation.

To protect sensitive receptors, MM 4.3-5 states: "No Class VI or Class II well shall be located within 4000 feet of any sensitive receptor."[154] According to the Draft EIR, this measure

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[148] Rule 8021, section 5.3.
[149] Rule 8021, section 5.4.1.
[150] See Rule 8041, sections 5.8 and 5.9; see also Kern County Planning & Natural Resources Dept., *Recirculated Draft Environmental Impact Report for 99 Houghton Industrial Park Project* (Oct. 2019) (hereinafter "99 Houghton Recirculated Draft EIR") at 4.3-43, https://psbweb.kerncounty.com/UtilityPages/Planning/EIRS/99_Houghton/DEIR/_99_Houghton_RDEIR_Vol%201.pdf.
[151] Rule 8041, section 5.1.
[152] Rule 8031, table 8031-1.
[153] *King & Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET, supra,* 218 Cal.App.4th at 738.
[154] Draft EIR, Vol. 1 at 1-30, 4.3-74.

is intended to mitigate an "escape" of CO_2 "into the atmosphere," which "could result in health impacts to humans and wildlife."[155]

While MM 4.3-5 appropriately establishes a sizeable setback from the CTV I Project's injection wells, it is unclear if the setback distance provides adequate mitigation because the Draft EIR does not explain how the distance of 4,000 feet was selected. The Draft EIR must be updated to substantiate that MM 4.3-5's setback distance is adequate to protect sensitive receptors, reflecting an assessment of site-specific factors.

Notably, as described in the "Failure Investigation Report" for the CO_2 pipeline rupture that occurred not far from Satartia, Mississippi, emissions from the rupture affected community members located "approximately one mile" away.[156] As a consequence of the rupture and the significant leak of CO_2, 45 people were taken to the hospital and all 200 residents of Satartia had to be evacuated.[157] The threat posed by CO_2 emissions from an injection well—particularly in the event of a blowout—would seem to be equal if not greater than the threat posed by a pipeline rupture.

Beyond the need to substantiate MM 4.3-5's setback distance for injection wells, the stated rationale for the measure makes plain the measure's inadequacy. As the Draft EIR aptly notes, the escape of CO_2 "via either well failure *or pipeline rupture* . . . could result in health impacts to humans and wildlife."[158] Indeed, the incident near Satartia demonstrates that it is not only injection wells that pose a threat to public health, but also pipelines and presumably any other equipment or structure that could leak significant quantities of CO_2. Consequently, MM 4.3-5 should be revised to require a protective setback from not only the injection wells, but also the Project's pipelines and any other structures or equipment containing or conveying CO_2.

b. MM 4.3-7 constitutes inadequate and unlawfully deferred mitigation.

As a further measure to address air quality impacts on sensitive receptors, MM 4.3-7 sets forth the following monitoring requirements:

> Prior to issuance of any construction or grading permits, the Owner/operator shall consult with the San Joaquin Valley Air Pollution Control District and develop a draft Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project including but not limited to: criteria pollutants, CO_2, and H_2S. The plan shall be reviewed and approved by both the San Joaquin Valley Air District and the California Air Resources Board, with a draft copy to the EPA UIC Program and Kern County Planning and Natural Resources, and implemented before any construction on the CCS facilities can occur. The final

[155] Draft EIR, Vol. 1 at 4.3-73.
[156] Draft EIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC (May 26, 2022) at 3.
[157] Draft EIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC at 2.
[158] Draft EIR, Vol. 1 at 4.3-73 (italics added).

approved plan shall be provided to the EPA UIC Program and Kern County Planning and Natural Resources.[159]

Given the CTV I Project's potential to expose nearby community members to substantial concentrations of air pollution, both criteria air pollutants and toxic air contaminants, the County can and should insist on a robust monitoring plan to detect elevated pollution levels.

Unfortunately, MM 4.3-7 does nothing more than generically require development and approval of a future plan. The Measure fails to identify any performance standards to be used to develop the monitoring plan and, equally important, neglects to identify performance standards for the mitigation to be instituted when the monitoring identifies significant impacts. This open-ended and therefore potentially meaningless promise of a mitigation measure to be developed sometime in the future violates CEQA's requirements for deferred mitigation.

In *Gray v. County of Madera* (2008) 167 Cal.App.4th 1099, the court rejected—for lack of any performance standards—a mitigation measure that required monitoring private wells near a quarry and, if an impact was found, specified that the project must replace the lost water from existing wells on the proponent's property. Even though the respondent county in *Gray* had "committed itself to a specific mitigation goal—the replacement of water lost by neighboring landowners because of mine operations," the court concluded the goal was not a specific performance standard that complied with CEQA.[160]

MM 4.3-7 is even more deficient than the mitigation measure rejected in *Gray*, as the Draft EIR does not identify any performance standards for the monitoring plan to be established beyond the pollutants to be addressed, let alone any performance standards for the mitigation to be implemented upon the identification of impacts. To meet CEQA's requirements, MM 4.3-7 should identify:

- Specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters;

- Requirements for reporting monitoring results to the County and responsible agencies and/or performance standards to be used to develop such reporting requirements;

- Requirements for reporting monitoring results to affected communities, regional community-based organizations, and to the public online and/or performance standards to be used to develop such meaningful public disclosure;

- Threshold level(s) and requirements for notification of nearby residents, other affected communities, and schools when a threshold is exceeded and/or performance standards to be used to develop such public notification requirements;

[159] Draft EIR, Vol. 1 at 1-31, 4.3-74.
[160] *Gray, supra,* 167 Cal.App.4th at 1119.

- Threshold levels of air pollution that, if detected at the fenceline, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation;

- Mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

To adequately protect community members, monitoring parameters for the plan to be developed pursuant to MM 4.3-7 should be developed with input from nearby residents and affected communities. Community input is particularly valuable and important for determining the locations of monitors (including, but not limited to, near sensitive receptors and along the project fenceline), the number of monitors, and the thresholds that will trigger community notification and response requirements.

9. The Draft EIR fails to adopt all feasible mitigation to address Valley Fever.

The Draft EIR institutes one mitigation measure, MM 4.3-6, to address Valley Fever.[161] MM 4.3-6 is inadequate and does not incorporate all feasible mitigation to address Valley Fever.

MM 4.3-6 should be revised to include the fuller protections that the County previously devised for the 99 Houghton Industrial Park Project, as set forth in MM 4.3-1 of the Recirculated Draft EIR for the project:[162]

- The Owner/operator should be directed to thoroughly clean equipment, vehicles, and other items of dust before they are moved offsite to other work locations.

- Grading and trenching work should be phased so that earthmoving equipment is working ahead or down-wind of workers on the ground. The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.

- The area immediately behind grading or trenching equipment should be sprayed with water before ground workers move into the area.

- In the event that a water truck runs out of water before dust is sufficiently dampened, any ground workers that otherwise would be exposed to dust should be directed to leave the area until a full truck resumes water spraying.

- All heavy-duty earth-moving vehicles should be closed-cab and equipped with a HEPA-filtered air system.

- Evidence of required training on how to spot and report the symptoms of Valley Fever and how to properly use personal protective equipment should be provided by the Owner/operator to the Kern County Planning and Natural Resources Department within 24 hours of the training session.

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[161] Draft EIR, Vol. 1 at 1-30 to 1-31, 4.3-74.
[162] See 99 Houghton Recirculated Draft EIR at 1-27, 4.3-48 to 4.3-49.

10. The Draft EIR fails to adopt all feasible mitigation for cumulatively significant net increases in nonattainment air pollutants, including $PM_{2.5}$.

The Draft EIR acknowledges that the CTV I Project will result in a cumulatively considerable net increase of criteria air pollutants for which the San Joaquin Valley has been designated a "nonattainment" area pursuant to applicable state and federal ambient air quality standards. In particular, the Draft EIR states that "[t]he project's total emissions would exceed the San Joaquin Valley Air Pollution Control District thresholds for nitrogen oxides (NOx), particulate matter with a diameter of 10 micrometers or less (PM_{10}), and particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), for which the project region is nonattainment under an applicable federal or State ambient air quality standard."[163]

To address the CTV I Project's significant criteria air pollutant emissions, the Draft EIR includes MM 4.3-9, which "requires the execution of a Developer Mitigation Agreement (DMA)" with the Air District.[164] According to the Draft EIR: "[t]he implementation of a DMA (MM 4.3-9) to reduce criteria pollutants of NO_X, ROGs, and PM net incremental emissions generated by a project has been incorporated into development projects in the county since 2008."[165]

In several respects, MM 4.3-9 does not meet CEQA's requirement that the County adopt all feasible mitigation, nor does it comply with the requirement of Health and Safety Code section 39741.1(a)(3)(A) that CCS projects "minimize, to the maximum extent technologically feasible, copollutant emissions . . . to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."

a. The County must approve the DMA and institute other requirements to ensure MM 4.3-9 is enforceable and enforced.

While MM 4.3-9 appropriately requires the Owner/Operator enter into the DMA and pay associated fees due to the Air District prior to the approval of any grading or construction activity, the Measure fails to specify that the agreement must be approved by the County as well, subject to public review and comment. In litigation over Kern County's Oil and Gas Ordinance, courts have found that the specific terms of such an implementing agreement are consequential and must provide for "particular" and "enforceable" mitigation.[166] Further, in correspondence between the County and Air District concerning such agreements, the County has confirmed that it—as lead agency—is ultimately "responsible for the implementation of all mitigation

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[163] Draft EIR, Vol. 1 at 1-11.
[164] Draft EIR, Vol. 1 at 4.3-68.
[165] Draft EIR, Vol. 1 at 4.3-68.
[166] *King & Gardiner Farms, LLC v. County of Kern* (Fifth District Court of Appeal Case No. F077656, Feb. 25, 2020), Slip Opinion at 67-74; *Vaquero Energy Inc., et al. v. County of Kern, et al.* (Kern County Superior Case No. BCV-15-101645-GP, June 7, 2022), Ruling on Petitions for (Third) Writ of Mandate at 21–23.

measures."[167] For these reasons, the County must itself review and approve the DMA, subject to the additional steps for community input and public review discussed below.

The County should withhold its approval of the DMA unless and until the California Air Resources Board confirms in writing that the DMA meets the requirements of section 39471.1 of the California Health and Safety Code. MM 4.3-9 currently specifies that the DMA "shall be reviewed by the California Air Resources Board for compliance with" section 39741.1 "before execution and adoption,"[168] but does not specify if or how compliance will be confirmed. MM 4.3-9 should be revised to specify that written confirmation of compliance is required.

To ensure that MM 4.3-9 and all the other mitigation measures set forth in the Draft EIR are implemented and fully enforceable, the County should specify in the CUPs required by the CTV I Project that compliance is required, with construction as well as subsequent operational activities conditioned upon initial and ongoing compliance.

Further, MM 4.3-9 should be revised to require: (a) reporting by the Owner/operator to verify that actual CTV I Project emissions are consistent with the Draft EIR's emissions estimates and the fee paid; (b) reporting by the Air District to confirm that funding by the Owner/operator is sufficient to fund local pollution-reducing projects that, in fact, offset the Project's actual emissions; and (c) a mechanism that requires the Owner/operator to pay a supplemental fee or fees if actual Project emissions exceed the Draft EIR's estimates and/or the initial fee proves to be insufficient.

b. MM 4.3-9 is ambiguous about exactly what mitigation is required.

The Draft EIR and MM 4.3-9 are not clear about precisely what mitigation will be required under the mitigation measure. MM 4.3-9 states:

> The Owner/operator shall pay fees to fully offset Project emissions of NOx (oxides of nitrogen), ROG (reactive organic gases), PM10 (particulate matter of 10 microns or less in diameter), and PM2.5 (particulate matter of 2.5 microns or less in diameter) (including as applicable mitigating for reactive organic gases by additive reductions of particulate matter of 10 microns or less in diameter) (collectively, "designated criteria emissions") to avoid any net increase in these pollutants.[169]

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[167] Letter from Kern County Planning & Natural Resources Dept. to SJVAPCD (Sept. 15, 2020) at 2; accord Letter from SJVAPCD to County of Kern Planning and Natural Resources Department (Oct. 30, 2020) at 2 (stating the Air District "is not responsible for making whole any shortfalls for emission reductions that the District is not able to achieve with the mitigation funds it receives from the County" pursuant to an emissions reduction agreement because "as the lead agency under CEQA," it is the County's "obligation to ensure implementation of all mitigation measures included in the Environmental Impact Report").

[168] Draft EIR, Vol. 1 at 1-32. 4.3-71.

[169] Draft EIR, Vol. 1 at 1-31, 4.3-70.

MM 4.3-9's requirement to "fully offset Project emissions . . . to avoid any net increase in these pollutants" is ambiguous. It is unclear if the County is mandating that, for each air pollutant emitted by the CTV I Project, the DMA will require an equivalent, offsetting reduction in the same air pollutant. Conversely, the County may intend to treat all the criteria air pollutants collectively and interchangeably, with the DMA only required to ensure that the combined sum of all increased criteria air pollutant emissions will be offset by an equivalent reduction in criteria air pollutants—no matter the particular air pollutant reductions achieved. Either way, the Draft EIR should be revised to clarify what the terms in the mitigation measure mean. For example, if it is the County's intention to allow reductions in PM_{10} to be credited as mitigation for $PM_{2.5}$ under MM 4.3-9, the Draft EIR should say as much so that the public and decisionmakers fully understand how MM 4.3-9 will operate.

c. The County must require that increases in $PM_{2.5}$ emissions be offset with commensurate reduction in $PM_{2.5}$.

To the extent the County intends to treat all the criteria air pollutants interchangeably for purposes of mitigation, such an approach fails to ensure that significant increases in particular air pollutants will be reduced, as CEQA requires. In this regard, the conflation of $PM_{2.5}$ and PM_{10} is especially problematic.

In reviewing mitigation for the Kern County Oil and Gas Ordinance, the courts have twice found that treating $PM_{2.5}$ and PM_{10} interchangeably for purposes of mitigation is unlawful. In 2020, the Fifth District Court of Appeal agreed with petitioners that the County's 2015 EIR failed to adequately mitigate $PM_{2.5}$ pollution. Reviewing the issue as a matter of law, the court observed that $PM_{2.5}$ and PM_{10} "are not the same" and faulted the County's mitigation measure and a related emissions reduction agreement for "[l]umping them together."[170] According to the appellate court, absent a finding that it would be infeasible, the County was required to adopt "fully enforceable" mitigation in the form of a "particular requirement" for $PM_{2.5}$.[171]

More recently, in 2022, the Kern County Superior Court again agreed with petitioners that the County unlawfully failed to adopt all feasible mitigation for $PM_{2.5}$ and to make such mitigation enforceable. In its ruling, the court faulted the County for continuing to "conflat[e] … PM2.5 and PM10."[172]

Although MM 4.3-9 mentions both $PM_{2.5}$ and PM_{10} separately, that is insufficient. Instead, MM 4.3-9 should specify that the Project's $PM_{2.5}$ emissions will be mitigated by funding projects that result in an equivalent quantity of $PM_{2.5}$ reductions. Absent such an explicit requirement in MM 4.3-9, significant increases in $PM_{2.5}$ may, in fact, evade mitigation. In its 2020 opinion, the Fifth District explained how this could happen in a detailed hypothetical:

> Suppose that during a proposed project's first year of operation it was estimated to emit 16 tons of PM2.5 and to emit 17 tons of PM10 that was larger than PM2.5. If the project proponent were to enter into offset agreements that reduced PM10

[170] *King & Gardiner Farms* Slip Opinion at 70–72.
[171] *King & Gardiner Farms* Slip Opinion at 70–73; accord *King & Gardiner Farms*, 45 Cal.App.5th at 830.
[172] *Vaquero Energy*, Ruling on Petitions for (Third) Writ of Mandate at 22.

that was larger than PM2.5 by 30 tons in the first year, then the net particulate matter emissions for the first year would be three tons, which is below the standard of significance for both PM10 and PM2.5. However, the 16 tons of PM2.5 emissions would not have been offset and, under Air District's 15-ton per year threshold of significance for that air pollutant, one would conclude that the project would have a significant adverse effect on air quality despite the offsets of PM10.[173]

d. Additional changes are required to ensure that MM 4.3-9 will effectively reduce air quality impacts to the extent feasible.

MM 4.3-9 recognizes the importance of addressing air quality impacts where the CTV I Project's increased air pollution emissions will be experienced most acutely—i.e., in the communities nearest to the proposed Project. MM 4.3-9 therefore appropriately requires that monies collected pursuant to the DMA will be used to fund pollution-reducing mitigation projects within a 20-mile radius.[174]

MM 4.3-9 also responds to the need for outreach to local community members to ensure effective operation of the DMA, requiring the Owner/operator to pay an annual fee "for the creation of a county managed community liaison position to provide technical support to the Eligible CCS Air Funding Communities and coordination with the San Joaquin Valley Air Pollution Control District to expedite use of the funding for air mitigation projects."[175] This likewise is a welcome and appropriate requirement.

Nonetheless, further steps can and should be taken to ensure the DMA effectively reduces air quality impacts. Specifically:

- MM 4.3-9 should require the Owner/operator and the Air District to establish a community-led steering committee made up of affected residents that live within Eligible CCS Air Funding Communities. The purpose of this steering committee would be to provide input to the Owner/operator and the Air District as the terms of the DMA are developed, and to advise the Air District on its funding decisions once the DMA is executed.

- MM 4.3-9 should also specify that, with the support of the DMA-funded community liaison, the steering committee will hold periodic public meetings and/or workshops to hear residents' concerns and to provide information about the availability of DMA funds.

- In addition to requiring funding for the community liaison position, MM 4.3-9 should also require additional funding to ensure that the public liaison and steering committee can conduct outreach in English as well as Spanish—with an ability to provide written materials in both languages as well as interpretation at meetings and/or workshops.

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[173] *King & Gardiner Farms* Slip Opinion at 71.
[174] Draft EIR, Vol. 1 at 4.3-71.
[175] Draft EIR, Vol. 1 at 4.3-71.

B. The Draft EIR's Analysis and Mitigation of Climate Impacts is Inadequate.

1. The Draft EIR's GHG analysis is inadequate under CEQA.

The Draft EIR's GHG emissions analysis is unsupported, self-contradicting, and violates CEQA's requirements for proper analysis.

The GHG analysis reveals a contradiction at the heart of the premise of this Project: the Draft EIR's analysis of GHG impacts concludes that even though permanent CO_2 sequestration and reductions in CO_2 emissions are CTV I Project's main objectives, the Project has a potentially significant impact from GHG emissions. Even worse, the Draft EIR reaches this conclusion in part based on the assertion that it cannot guarantee that the CO_2 it proposes to inject underground will actually be put underground and remain there permanently without release or leakage. And no meaningful analysis or evidence supports the Draft EIR's conclusions relating to any of these points. The GHG analysis fails, too, for the same reason the project description is inadequate: the analysis does not incorporate the full scope of Project facilities and activities or their GHG emissions—and relatedly, the Draft EIR does not grapple with whether and to what extent the Project may extend the life of existing fossil fuel facilities and associated GHG emissions. The analysis does not adequately assess consistency with plans and policies relating to GHGs. The Project improperly fails to have a plan for monitoring the CO_2 to guarantee it will remain sequestered. And finally, the mitigation is inadequate, including an improper reliance on offset credits as mitigation for its potentially significant GHG impacts.

a. The GHG analysis fails to disclose important information regarding the Project's emissions.

The Draft EIR's analysis of GHG emissions is informationally inadequate. It fails to disclose the full range of projected emissions from the overall scope of activities relating to the Project, or even from the full operations of capture and storage activities.

The GHG impact analysis discloses that the County plans to issue entitlements for the whole storage capacity of 49.25 MMT of CO_2, as well as CCS facilities capturing CO_2 from the existing plants (the gas plant and power plant) at the Elk Hills oil field. Future sources, according to the Draft EIR, "are required to be permitted with a separate CUP process and environmental review for compliance with CEQA."[176]

The analysis then provides an estimate of the construction and operational emissions. The analysis is provided only for the existing plants and the new capture facilities built for them. Under Table 4.8-4, "Estimated Operational Greenhouse Gas Emissions", the Draft EIR presents the expected emissions from the existing plant, the projected emissions from mobile sources of the capture facility, and the projected amounts of CO_2 captured and sequestered until the year

[176] Draft EIR, Vol. 1 at 4.8-19.

2045.[177] The Draft EIR concludes that over 20 years, the Project will result in net emissions reduction of 31,217,430 MT CO_2e.[178]

But the Draft EIR fails to disclose the operational emissions from the capture facility *stationary sources* and includes only its mobile emissions in Table 4.8-4. This is misleading and inadequate. The Sahu Report notes that the analysis is missing, and should include, GHG emissions associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance.[179] The analysis must include the projected GHG emissions from *all* Project operations.

b. The GHG analysis fails to properly analyze future sources of CO_2 injection.

As discussed above, the project description and scope are too narrow. This flaw also renders the GHG emissions analysis inadequate.

The Draft EIR reviews the total potential CO_2 storage of the Project, which is almost at 50 MMT, and the projected injection up until 2045.[180] Regarding the sources of this CO_2, the Draft EIR acknowledges that "[a]dditional sources will need to be identified and permitted by the applicant"[181] and claims that "[e]ach of those sources will have capture facilities with the same amine technology or better and a reasonable assumption can be made that it would produce the same GHG emissions per ton of capture as evaluated for this initial source."[182] The Draft EIR goes on to argue that:

> All known sources are shown in Section 3.9 of Chapter 3, Project Description, but as they have not been permitted or completed CEQA, information cannot be provided on the total amount of GHG emissions they produce, how much will be captured, how much stored, how much additional created or how much will still be released to the atmosphere.[183]

The Draft EIR fails to analyze GHG impacts from the full range of facilities and activities that constitute and relate to the Project, as explained more fully in this letter's discussion of project description and cumulative impacts. Moreover, the document presents an internally contradictory picture of reasonably foreseeable CO_2 sources for the storage facility. The Draft EIR argues that information about future sources of CO_2 is unknown, and at the same time argues that future sources will come from "essential but hard to decarbonize" industries.[184] If the information regarding future sources is still unknown, it is unclear how the Draft EIR can assume they will come from such industries. Nothing in the Draft EIR indicates that the County will

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[177] Draft EIR, Vol. 1 at 4.8-24 ("Table 4.8-4 shows only the initial source permitted with this EIR (collection of pre-combustion oilfield gas from in-field CRC facilities) at the same rate").
[178] Draft EIR, Vol. 1 at 4.8-24.
[179] Sahu Report at 4.
[180] Draft EIR, Vol. 1 at 4.8-25.
[181] Draft EIR, Vol. 1 at 4.8-25.
[182] Draft EIR, Vol. 1 at 4.8-25.
[183] Draft EIR, Vol. 1 at 4.8-25.
[184] Draft EIR, Vol. 1 at 4.8-26.

condition future sources on falling within the "essential but hard to decarbonize" category, or defines which industries qualify for that category. This is especially concerning given the fact that the only fully-disclosed source in the Draft EIR is a fossil fuel plant that sends power to oil production activities.[185]

The Draft EIR also provides no support for the claim that future sources will use the same amine technology and create the same levels of operational emissions. Again, nothing in the Draft EIR mitigation measures conditions future sources on using that same technology or better. In fact, the Draft EIR admits the possibility of "additional, unmitigated GHG emissions be[ing] created from the capture facility operations"[186] but fails to disclose what the circumstances, likelihood, or magnitude of those "additional, unmitigated GHG emissions" are.

Not only is the Draft EIR analysis not supported by evidence, but it is also contradicted by the evidence. As discussed above, available information about future sources is available well beyond what the Draft EIR discloses and analyzes. The Draft EIR fails to account in any way for the emissions generated by the facilities that will send their CO_2 for sequestration, including through transportation, and fails to analyze the Project's GHG emissions throughout its projected life span. It must include that information and account for its impacts on GHG emissions.

c. The GHG analysis fails to analyze the whole Project's lifespan.

The Draft EIR also fails to explain why the analysis goes only to the year 2045 and up to 31 MMT of CO_2,[187] when the Draft EIR seeks to approve the whole storage capacity of almost 50 MMT, and the Project's lifespan is currently estimated to be 30 years (or roughly to 2054),[188] and potentially longer. EPA's docket for the CTV I Project Class VI permit indicates that CTV would be required to implement an EPA-approved Post-Injection Site Care and Site Closure Plan, and that it will include post-injection monitoring for at least 50 years and until it demonstrates non-endangerment of underground sources of drinking water (USDW) based on monitoring and other site data.[189]

The analysis should account for the whole storage capacity the Draft EIR is seeking to approve, and for the whole projected life of the related CCS facilities and sources.

d. The GHG analysis fails to account for potential life extension of fossil fuel facilities.

The first proposed source for CO_2 sequestration in the CTV I Project is the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility

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[185] Draft EIR, Vol. 1 at 3-3.
[186] Draft EIR, Vol. 1 at 4.8-26
[187] Draft EIR, Vol. 1 at 4.8-26
[188] Draft EIR, Vol. 1 at 4.2-14.
[189] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* at 4–5.

and used at the Elk Hills power plant.[190] The GHG analysis assumes continuous operations of the power plant, which is already over 20 years old, at least into the year 2045.[191]

The GHG analysis fails to provide any information about the expected life of the power plant independently of its role as a CO_2 source for the Project, despite acknowledging that California aims to reduce its dependency on fossil fuels.[192] In some places, the Draft EIR even assumes continued operations for the 30-year duration of the proposed Project. [193]

As the Sahu Report notes, the proposed Project would require the power plant to operate for over 50 years, while "[w]ithout significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project."[194]

The Draft EIR fails to address the critical question of whether the CTV I Project may facilitate extending the life of the Elk Hills power plant or of any other fossil fuel source, and the resulting GHG emissions implications.

e. The GHG analysis does not disclose potential offset credit generation.

The DEIR does not discuss or disclose whether Project proponents believe its operations will—or should—receive credit as offsets in the cap-and-trade market. A recent report by the Independent Emissions Market Advisory Committee noted that "there are conflicting views on whether carbon dioxide removals should be given credit as offsets in the cap-and-trade market and resolving this will be an important issue for CARB and the legislature."[195] CRC's presentation regarding the CTV I Project from November 2023 states that "[t]he capture project is targeting 45Q credit generation as well as the potential for LCFS qualification and Cap & Trade (C&T) avoidance."[196]

The question of whether the CTV I Project can generate offset credits is crucial for a full analysis of the Project's impacts. If the Project is allowed to generate credits, it means its overall GHG impacts will be materially different than those claimed under the GHG analysis, as its operation may allow for continued emissions elsewhere. The analysis must disclose and analyze the issue of offset credits generation by the Project.

f. The GHG analysis is not supported by the evidence.

The Draft EIR's analysis for Impact 4.8-1, "Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment," is unsupported

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[190] Draft EIR, Vol. 1 at 3-1.
[191] California Energy Commission (CEC), *Elk Hills Power Project* (last accessed Feb. 28, 2024), https://www.energy.ca.gov/powerplant/combined-cycle/elk-hills-power-project.
[192] Draft EIR, Vol. 1 at 4.8-24.
[193] Sahu Report at 3
[194] Sahu Report, at 3–4.
[195] Independent Emissions Market Advisory Committee, *2023 Annual Report* (Feb. 2024) at p. 27.
[196] CRC and CTV, *Third Quarter 2023 Results* (Nov. 01, 2023).

by substantial evidence and internally contradictory. This analysis assumes that unless "any of the injected CO2 leak at injection," or "additional, unmitigated GHG emissions be created from the capture facility operations," the injected CO_2 will remain in the reservoirs, resulting in reduction of CO_2 emitted by the CO_2 source industries.[197] The Draft EIR also, however, acknowledges briefly that leaks might happen "at injection." And even more confusingly, the Draft EIR makes a significance finding based on the acknowledged (and vaguely-stated) risk of a GHG "release due to unforeseen circumstances or equipment failure."[198] Moreover, as the expert report of Dr. Dominic DiGiulio (attached as Attachment B, hereafter "DiGiulio Report") shows, to the extent the Draft EIR relies on the assumption that stored CO_2 will actually both reach and remain in the reservoirs as required for the Project to meet its objectives, that assumption is not supported by the evidence.

In his report, Dr. DiGiulio concludes that "[i]nformation presented in the DEIR and Class VI permit applications does not support a finding that the project will retain 99% of stored CO_2 in excess of 100 years at cessation of injection, as required by the California Air Resources Board."[199] Dr. DiGiulio explains that the retention is not credible due to the large number of wellbore penetrations in the area, the high pressure of storage, the fact the storage will primarily consist of supercritical fluid, and the elevated risk of seismic activity in the vicinity of the Project area.[200]

Dr. DiGiulio explains that leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2.[201] Given the large number of well penetrations in the area, a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection is required to assess the CO_2 retention.[202] However, as the DiGiulio Report shows, the Draft EIR fails to support its conclusions regarding CO_2 retention with evidence.

The full extent of the failure to support the Draft EIR's analysis and conclusions is detailed in the DiGiulio Report. A few examples of that failure are provided below.

The Draft EIR identified 204 wellbores in the 26R reservoir that penetrate the Reef Ridge Shale - the primary confining layer in both storage areas. For the 26R reservoir area, the Draft EIR states that "*Appendix 1*" lists the wells individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements. However, Appendix 1 is missing from the Draft EIR.[203] A document that might be a part of that missing appendix was submitted to the EPA. However, that does not absolve the Draft EIR from the duty to "adequately inform the public and decision makers, who may not be previously familiar with the details of the project."[204] Moreover, there is no mention of

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[197] Draft EIR, Vol. 1 at 4.8-26
[198] Draft EIR, Vol. 1 at 4.8-26.
[199] DiGiulio Report at 8.
[200] DiGiulio Report at 8.
[201] DiGiulio Report at 3.
[202] DiGiulio Report at 8.
[203] DiGiulio Report at 11.
[204] *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal. 4th 412, 443, as modified (Apr. 18, 2007).

preparation of the same type of Appendix for the A1 – A2 Reservoir area. Appendix 1 must be included in a recirculated version. The Draft EIR must be revised to include a detailed wellbore-by-wellbore evaluation in order to assess leakage potential and minimize it.[205]

Class VI permit applications require "A tabulation of all wells within the area of review which penetrate the injection or confining zone(s)." That information was provided late, to the EPA only, and is not included in the Draft EIR.[206] Moreover, the document that was provided to the EPA is still missing critical information and riddled with vague and indefinite terms. The DiGiulio Report explains that records of plugging and/or completion should at least include wellbore schematics including actual details of plugging and completion. The Draft EIR must be recirculated with the necessary information. This should include all information associated with wellbores relevant to wellbore integrity, including, for example, internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, and cement squeeze operations.[207]

The DiGiulio Report notes that the Draft EIR assumes a 0.0% wellbore barrier failure rate for 354 wellbores, which is not only at odds with the published rates of wellbore failure, ranging from 2-75% in the literature, but also unsupported by any data that can be independently reviewed.[208] Dr. DiGiulio notes that it does not appear the EPA conducted an independent evaluation of wellbore integrity of well penetration, and that there is no supporting evidence to accept the statement of no wellbore barrier failure.[209] The Draft EIR must be revised to include all relevant information, including but not limited to wellbore diagrams, cement evaluation logs, and internal and external mechanical integrity tests, to support its conclusions with evidence.

Finally, Dr DiGiulio highlights the fact that there are inconsistencies between the Draft EIR and the documents filed with the EPA for the Project's Class VI permit applications: most notably, there are discrepancies in the number of wellbores requiring plugging.[210] These discrepancies must be addressed and the Draft EIR must be revised accordingly.

In sum, the analysis takes credit for the potential CO_2 storage of the Project, but fails to support the conclusion that CO_2 will be retained in the ground with evidence.

2. The Draft EIR's halfhearted and contradictory finding of potentially significant GHG impacts violates CEQA.

The Draft EIR finds that "[a]ccounting for the GHG emissions reductions from CCS, the Project's impacts related to GHG emissions would be less than significant."[211] But then it goes on to make a significance finding, saying:

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[205] DiGiulio Report at 11.
[206] DiGiulio Report at 11.
[207] DiGiulio Report at 10–11.
[208] DiGiulio Report at 12.
[209] DiGiulio Report at 12.
[210] DiGiulio Report at 10–11.
[211] Draft EIR, Vol. 1 at 4.8-26.

> However, the estimated reductions are contingent upon injected CO_2 remaining in the identified geographically confined reservoirs for storage in perpetuity without leakage from injection and capture activities. Should any of the injected CO_2 leak at injection or additional, unmitigated GHG emissions be created from the capture facility operations, then GHG emissions from the project would be potentially significant.[212]

With this brief statement, the Draft EIR concludes that despite implementation of several mitigation measures, "the possibility of a release due to unforeseen circumstances or equipment failure remains" and the CTV I Project's impacts from GHG emissions "remain significant and unavoidable."[213] This specific acknowledgment of significant impact from the risk of unintended releases of GHGs is articulated in the Draft EIR's GHG impacts section as one of the rationales for the GHG significance finding, but is not included in the summary of impacts in Table 1.1.[214] Moreover, as discussed more fully above and in the DiGiulio Report, the Draft EIR's impact analysis ignores this risk completely.

First, if this conclusion is correct—if the Project may have a significant (negative) impact on GHG emissions because of the risk of release from failure at any stage in Project operations—then the County should not approve the CTV I Project, as it does not fulfill its fundamental objective: to capture and permanently store CO_2 emissions underground.

Second, the Draft EIR's handling of this issue violates CEQA. The Draft EIR attempts to avoid accounting for the Project's impacts by acknowledging the possibility of leakage and finding that risk to be a significant and unavoidable impact, and at the same time failing to include any analysis of the nature, extent, or magnitude of this risk—and elsewhere the Draft EIR appears to deny the risk even exists. The Draft EIR thus does not comply with CEQA's requirement that an EIR will "be prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences."[215] And the conclusions are thus not supported by substantial evidence.

The courts are clear that "[A]n EIR's designation of a particular adverse environmental effect as 'significant' does not excuse the EIR's failure to reasonably describe the nature and magnitude of the adverse effect."[216] Yet the Draft EIR does exactly that. The GHG discussion makes no reasonable effort "to explain the nature and magnitude of the impact" from GHG leakage, as CEQA requires.[217] It includes no information regarding the probability of CO_2 leakage, the circumstances under which it might happen, the potential magnitude of such leakage, or its impacts on GHG emissions. It simply classifies the impact as significant and unavoidable without any meaningful discussion. By doing so, it also violates the rule set by the courts that an EIR must set forth the bases for its findings; a bare conclusion regarding an

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[212] Draft EIR, Vol. 1 at 4.8-26.
[213] Draft EIR, Vol. 1 at 4.8-26.
[214] Draft EIR, Vol. 1 at 1-13.
[215] *Sierra Club, supra*, 6 Cal.5th 502 at 514.
[216] *Cleveland Nat'l Forest Found. v. San Diego Assn. of Governments* (2017) 3 Cal.5th 497, 514.
[217] *Sierra Club, supra*, 6 Cal.5th 502 at 519.

environmental impact without an explanation of its factual and analytical basis is not sufficient.[218]

As stated in the DiGiulio Report, CO_2 leakage from geologic storage is bound to occur, and "the important question is not whether there will be leakage, but whether the extent of leakage is acceptable [...] and how leakage will be monitored and quantitated."[219] The Draft EIR fails to do just that.

There are several leakage risks that a proper analysis must account for and analyze. First, the risk of leakage from well penetration: the DiGulio Report notes the presence of 354 well penetrations in the storage area, leading to a well penetration density of 16.4 wells/km^2. As explained in the report, research shows that more than 8 wells/km^2 concentrations are of concern regarding CO_2 retention in the ground.[220] The Draft EIR must be revised to include a robust evaluation of wellbore integrity of both plugged and unplugged wells, to properly reflect the risk of leakage from these wells.

Leakage from wellbores can also be manifested in the form of a CO_2 well blowout.[221] Despite the fact that release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions, the Draft EIR fails to discuss the probability of such an event when discussing GHG emissions impacts.[222]

The Draft EIR also fails to analyze the issue of lateral confinement to storage areas. As the DiGiulio Report shows, there is no evidence to support the assumption that CO_2 stored in reservoirs will in fact be confined and will not migrate beyond them.[223] The Draft EIR must be revised to support these assumptions and assess the risk of leakage from lateral migration.

The DiGiulio Report also shows that the Draft EIR's analysis of seismic risk is highly deficient and not supported by the evidence, as it fails to properly account for all factors of seismic risk.[224] The flaws in the Draft EIR's seismic analysis are discussed in detail below. However, as explained in the DiGiulio Report, the effects of natural or induced seismicity are of particular concern at the CTV I Project, due to its effect on wellbores, which can occur even after a well is permanently plugged and abandoned. The Draft EIR must be revised to properly account for the seismicity risks, and once this is done, to properly account for the risk of CO_2 leakage resulting from seismic activity.

The Draft EIR's GHG analysis must be revised to include an accurate, meaningful discussion of GHG impacts that is supported by the evidence, and this evidence-supported

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[218] *Laurel Heights, supra*, 47 Cal. 3d at 404.
[219] DiGiulio Report at 7.
[220] DiGiulio Report at 7.
[221] DiGiulio Report at 4.
[222] DiGiulio Report at 5.
[223] DiGiulio Report at 6–7.
[224] DiGiulio Report at 20.

analysis must reflect a consistent conclusion as to the nature, magnitude, and significance of the impact.

3. The Draft EIR's GHG consistency analysis is inadequate under CEQA.

Under Impact 4.8-2, the Draft EIR purports to analyze whether the Project will conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gas.[225] Under this impact area, the Draft EIR first analyzes the CTV I Project's consistency with CARB's 2022 Scoping Plan.[226] The Scoping Plan analysis is inadequate under CEQA. Not only it is short, generic, and superficial, but it also fails to address important ways in which the Project is not consistent with the Scoping Plan.

The Draft EIR's consistency analysis is made up of a few paragraphs generally describing the Scoping Plan discussion of carbon capture, removal and sequestration, followed by a bullet point list of the Scoping Plan's "Strategies for Success" in the sector, and ending with a single paragraph stating flatly that the Project "would support the Strategies for Success identified in the CARB 2022 Scoping Plan," "would comply with any new regulations developed as a result of implementation of the identified Strategies" and "is reasonably expected to reduce region wide and Statewide GHG emissions." The paragraph concludes with no further discussion to show the Project would be consistent with the CARB 2022 Scoping Plan.[227]

First, the analysis is generic. It fails to provide the reader with "sufficient information to foster informed public participation and to enable the decision makers to consider the environmental factors necessary to make a reasoned decision,"[228] as required under CEQA. The analysis also fails to provide substantial evidence to support its conclusions. Except for flatly declaring consistency, the analysis does not address any of the Scoping Plan Strategies beyond simply listing them. It fails to make a connection between the Strategies and the Project, and explain how the Project is consistent with them, or how they are even relevant to the Project. Just as an example, the identified Strategies that call for the state to "Evaluate and streamline permitting barriers to project implementation while protecting public health and the environment" and to "update the CARB Carbon Capture and Sequestration Protocol with the best available science and implementation experience" have nothing to do with the Project.

Second, the analysis fails to address the crucial issue of the Project's CO_2 sources' consistency with the Scoping Plan. The Scoping Plan states that CCS is included in the Scoping Plan "to address emissions from limited sectors, including electricity generation, cement production facilities, and refineries."[229] The Scoping Plan also discusses implementation in the electricity sector in or before 2045 as well as the potential to support hydrogen production.[230] As

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[225] Draft EIR, Vol. 1 at 4.8-28.
[226] Draft EIR, Vol. 1 at 4.8-28.
[227] Draft EIR, Vol. 1 at 4.8-30.
[228] *Berkeley Keep Jets Over the Bay Comm. v. Bd. of Port Comm'rs*, 91 Cal.App.4th 1344, 1356, 111 Cal. Rptr. 2d 598, 606 (2001), as modified on denial of reh'g (Sept. 26, 2001).
[229] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 86.
[230] *Id.*

discussed above, the Draft EIR fails to provide information regarding its future CO_2 sources and therefore cannot conclude the Project is consistent with the Scoping Plan. Moreover, the only disclosed CO_2 source in the Draft EIR is the pre-combustion Elk Hills oil field gas which provides about one third of its power for oil field operations—not even a sector the Scoping Plan lists for CCS implementation. The Draft EIR's conclusion that the CTV 1 Project is consistent with the Scoping Plan is therefore not only unsupported by the evidence, but is also contradicted by it.

Finally, the Draft EIR fails to address the fact that the CTV 1 Project's proposed mitigation measures are inconsistent with the Scoping Plan. As discussed below, a primary mitigation measure proposed in the Draft EIR, in addition to monitoring plans and compliance with regulations, is buying credits to offset GHG emissions.[231] However, the Scoping Plan makes clear that GHG mitigation measures come in a hierarchical order: first, the lead agency must "exhaust[] all the on-site GHG" mitigation. Then, "CARB recommends prioritizing local, off-site GHG mitigation measures" and only then use "non-local off-site mitigation, and voluntary offsets issued by a recognized and reputable voluntary carbon registry."[232] As discussed below, the Draft EIR fails to comply with the requirement that offsets will be issued by a recognized and reputable registry, and it also fails to exhaust, or even discuss, all onsite GHG mitigation and other local measures. Finally, it fails to acknowledge and discuss the fact that by improperly relying on offsets, it is inconsistent with the Scoping Plan.

4. The Draft EIR fails to analyze and mitigate cumulatively considerable GHG emissions impacts.

The Draft EIR's analysis of the CTV I Project's cumulative GHG emissions impacts suffers from many of the same flaws pointed out above regarding its project-level analysis, and from several other serious flaws. The Draft EIR must be revised to correct these flaws before any decision can be made regarding the Project.

First, there are basic misstatements and inconsistencies that call the analysis into question. As one example, the analysis claims that "Table 4.8-3 shows total GHG reductions of 3,967,977 MT CO_2e over 20 years from implementation of the project".[233] In fact, Table 4.8-3 shows the estimated construction GHG Emissions, not total reductions,[234] and those projected reductions of the Project, according to the other tables in the GHG analysis, are 31,217,430 MT CO_2e over 20 years, not 3,967,977 as stated in the cumulative analysis.[235]

Moreover, the Draft EIR frames its cumulative GHG analysis in fundamentally misleading ways. For example, the document includes the following statement: "Since the project individually results in a net reduction in GHG emissions, the project would also contribute to reductions in cumulative GHG emissions."[236] First, this statement directly

[231] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[232] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 270–71.
[233] Draft EIR, Vol. 1 at 4.8-32.
[234] Draft EIR, Vol. 1 at 4.8-22.
[235] Draft EIR, Vol. 1 at 4.8-24.
[236] Draft EIR, Vol. 1 at 4.8-32.

contradicts the Draft EIR's cumulative GHG significance finding, which concludes that the Project will contribute to cumulatively considerable significant GHG emissions.[237] And second, this statement completely misses the point of cumulative impact analysis: that "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[238] In other words, if a CEQA analysis could infer a project's cumulative impacts directly from its individual impact, there would be no need for a cumulative impact analysis at all.

Another major flaw is that the cumulative impact analysis fails to analyze the CTV I Project's cumulative *projects*. Under CEQA, cumulative impact analysis requires consideration of "other projects causing related impacts,"[239] including "probable future projects."[240] The Draft EIR provides a list of cumulative projects under its project description section. But it fails to analyze their impacts in the GHG analysis, claiming that "information cannot be provided" regarding their potential GHG impacts.[241] This claim is not supported by the evidence and is in fact contradicted by it, as discussed above. The cumulative impacts analysis must analyze the projects in its cumulative projects list, as well as any probable future project that plans on sending CO_2 for sequestration at the CTV I Project (as discussed in detail, above in the discussion of project description and below in this letter's final section on cumulative impacts analysis).

Instead of discussing the cumulative projects the Draft EIR discloses, as well as other related cumulative projects the Draft EIR fails to disclose, the Draft EIR focuses on the CTV I Project's cumulative impacts together with the impacts of "past, present and reasonably foreseeable future oil and gas development including wells and abandonment activity," explaining this focus is "[d]ue to the proposed project's location within an existing oil and gas field."[242] This is underinclusive. While geographic proximity can be a factor in identifying cumulative projects, it is not the only determinative factor.[243]

The Draft EIR fails to explain why it focuses on the cumulative impacts of the CTV I Project with only the oil and gas development. It is riddled with vague statements like "impacts from oil and gas development in Kern County on cumulative GHG emissions were determined to remain significant and unavoidable despite implementation of mitigation measures"[244] that lack any explanation as to their relevance to the CTV I Project's cumulative analysis. Potentially, there is a connection between the oil field operations and CTV I because of the Project's usage of depleted oil and gas reservoirs, but that cannot explain the analysis, since the depleted reservoirs are already identified. It is unclear whether this connection stems from plans to

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[237] See, e.g., Draft EIR, Vol. 1 at 1-13 ("The project's cumulative contribution to GHG emissions after implementation of the recommended mitigation measures would remain cumulatively significant and unavoidable").
[238] *Communities for a Better Env't v. Cal. Resources Agency* (2002) 103 Cal.App.4th 98, 114, 126.
[239] CEQA Guidelines, § 15130(a)(1).
[240] CEQA Guidelines, § 15130(b)(1)(A).
[241] Draft EIR, Vol. 1 at 4.8-25.
[242] Draft EIR, Vol. 1 at 4.8-31.
[243] CEQA Guidelines, § 15130(b)(1)(A).
[244] Draft EIR, Vol. 1 at 4.8-32.

sequester more CO_2 sourced from oil and gas production. The Draft EIR must be revised to clarify this point, as well as the rest of the connection between the Project and future oil and gas development.

The Draft EIR's cumulative GHG impact analysis is legally inadequate, not supported by substantial evidence, and must be revised to address all the inaccuracies, inconsistencies, and unsupported assumptions, include all relevant cumulative projects, and explain its analysis.

5. The Draft EIR does not provide adequate mitigation for GHG impacts.

The GHG mitigation measures identified in the Draft EIR fail to meet CEQA's standards for effective, enforceable mitigation. The proposed measures are ineffective, unenforceable, and vague, and there is no evidence to support their efficacy. To the extent that some of the vagueness will be clarified in the future, the DEIR also illegally defers that mitigation.

Under CEQA, proposed mitigation measures must be "fully enforceable" through permit conditions, agreements, or other legally binding instruments.[245] Any proposed mitigation must also provide assurance that such implementation will in fact occur.[246] The proposed measures fail on all counts.

a. MM 4.8-1 constitutes inadequate and unlawfully deferred mitigation.

To mitigate what the Draft EIR finds to be a potentially significant impact from GHG emissions, it proposes a monitoring plan under MM 4.8-1. This mitigation measure requires that prior to injection, the owner/operator will submit "a monitoring plan that complies with all requirements of the EPA UIC permit" for the Project, to demonstrate the retention of the CO_2 in the reservoir. The Measure states that that the plan shall be submitted to the County, concurrent with submittal to the EPA for review, and that "[a] copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department."[247]

Given how crucial it is to guarantee that CO_2 stored in the reservoir will remain there, both for mitigating a potentially significant impact and for achieving the Project's stated goal of CO_2 storage, it would be expected the Draft EIR will develop a robust monitoring plan. However, the proposed Mitigation Measure is anything but robust.

In fact, all this Mitigation Measure does is reiterate an already existing rule – that CCS projects that receive a UIC permit from the EPA must prepare a monitoring, reporting, and verification (MRV) plan and submit it for the EPA's approval.[248] This Measure adds nothing to this rule except requiring that a copy of the approved plan will be provided to the County.

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[245] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, §15126.4(a)(2).
[246] *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1186–87.
[247] Draft EIR, Vol. 1 at 4.8-27.
[248] 40 C.F.R § 98.448.

Relying solely on the future EPA MRV plan is inadequate under CEQA and constitutes an impermissible deferral of mitigation. The EPA UIC permit is issued under the Safe Drinking Water Act. As a result, it does not, and cannot, cover all relevant aspects of monitoring for CO_2 leakage. This is evident simply from the fact that there are no storage effectiveness criteria in the Class VI federal regulations.[249] Specifically, Dr. DiGiulio notes that the monitoring plan submitted for the Project in the Class VI permit applications does not directly consider leakage from well penetrations – although this is the most likely source of loss of CO_2.[250]

A major flaw in relying on EPA's MRV plan is the fact that these plans lack clear performance standards. CEQA allows for details to be developed in future time, as long as the agency adopts specific performance standards the mitigation will achieve.[251] MRV plans that were developed under the EPA permit program have been heavily criticized for failing to include specific monitoring strategies, for containing ambiguous language, and for being difficult to verify and enforce.[252] By relying on EPA's future MRV plan for the CTV 1 Project, the Draft EIR impermissibly defers its mitigation.

The DiGiulio Report makes clear why reliance on the EPA MRV plan fails to comply with CEQA's requirement for effective mitigation. For example, Dr. DiGiulio notes that continuous monitoring in the Etchegoin Formation is important to detect leakage, but further notes that under the EPA permit application, there will be only one such well in the 26R Reservoir. A proper monitoring plan should analyze and support the number of required monitoring wells above confining zones to guarantee effective detection of leakage.[253]

The DiGiulio Report also explains that in the Corrective Action Plan filed with the EPA, CTV states that all wellbores within the Area of Review will be pressure tested prior to abandonment and will be reviewed to demonstrate adequate confinement "if necessary" and "if conditions allow". As Dr. DiGiulio notes, these statements are far too vague to be of any use,[254] and thus reliance on the plan cannot serve as enforceable and effective mitigation.

Finally, the requirement to submit a monitoring plan "[p]rior to any injection of CO2"[255] is vague and unenforceable. CO_2 injection will be ongoing in the Project. The Measure must be revised to clarify at what point exactly a monitoring plan should be submitted, clarify that the approval of such a monitoring plan will be a condition on each new injection from each source, and clarify and guarantee the means of enforcing the plan.

In particular, MM 4.8-1 must be revised to include a monitoring plan that will effectively address the potentially significant impact of CO_2 leakage or other release from the CTV 1

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[249] DiGiulio Report at 7.
[250] DiGiulio Report at 8.
[251] CEQA Guidelines, § 15126.4(a)(1)(B).
[252] Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* (Dec. 2023), https://environmentalintegrity.org/news/epas-rules-for-verifying-carbon-capture-projects-are-riddled-with-holes/.
[253] DiGiulio Report at 13.
[254] DiGiulio Report at 12.
[255] Draft EIR, Vol. 1 at 4.8-27.

Project. As explained in the DiGiulio Report, such monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage.[256] To the extent the revised measure is lacking any specific elements or details, it must at a minimum identify performance standards to be used in developing it, as required under CEQA.[257] Given the potential impacts of the GHG emissions from the Project, it is also crucial that the monitoring plan will be open for public comments and will require the approval of CARB in addition to the County.

Finally, and crucially, a monitoring plan alone will not fully mitigate the risk of leakage or release to the extent feasible. GHG mitigation measures must also include an action plan that addresses what will happen to address any release, mitigate fully the emissions from any release, and ensure the integrity of the reservoir and overall storage mechanism.

b. MM 4.8-6 is an ineffective, unenforceable, and impermissibly deferred mitigation measure.

The first part of MM 4.8-6 states as follows:

> The project shall offset all greenhouse gas emissions associated with the capture facility, and construction equipment not covered by the Cap and-Trade program or other mandatory greenhouse gas emission reduction measures through owner/operator reductions of greenhouse gas emissions as verified by the San Joaquin Valley Air Pollution Control District, through acquisition of offset credits from the California Air Pollution Control Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District, or through inclusion in an Emission Reduction Agreement, to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur. [258]

In essence, this Measure purports to offset any GHG operational emissions "associated with" the Project's capture facility (as well as some construction emissions) using the tool of emission credits, and claims to thus achieve a "no net increase" in GHG emissions from the Project construction or operations. This Measure is not only inappropriate and unlawful as mitigation, but also reveals a fundamental failure in the Project's ability to meet its objectives.

i. MM 4.8-6 goes against the Project's fundamental premises and objectives.

The CTV I Project is a carbon sequestration project. Its main goals are to permanently store CO_2 in the ground and support California's climate goals.[259] But MM 4.8-6 proposes to allow the Project to allow "acquisition of offset credits from the California Air Pollution Control

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[256] DiGiulio Report at 13.
[257] CEQA Guidelines, § 15126.4(a)(1)(B)
[258] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[259] Draft EIR, Vol. 1 at 1-5.

Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District", to offset any "emissions associated with the capture facility" and "to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur."[260] This Measure thus contemplates that the Project and associated facilities may emit substantial amounts of GHG emissions—potentially without limit—into the atmosphere, as long as they purportedly offset these emissions with emissions credits.

The notion of a carbon sequestration project that may use carbon credits to offset its own emissions is absurd, and undercuts the rationale behind carbon sequestration. An effective carbon sequestration project should be the place where CO_2 is being put in the ground physically and permanently, not a link in a chain of offsets that creates profits for its owners and harm to the public and the environment.

If a CO_2 sequestration project is allowed to offset its emissions through acquisition of offset credits, then the following scenario is possible: A GHG emitting facility that is looking to mitigate its GHG emissions can go and buy offset credits from certain registries. Alternatively, and higher in the hierarchy of preferred mitigation, that facility can send its CO_2 for sequestration at the CTV I Project and achieve the same GHG mitigation goals. The facility chooses sequestration, theoretically putting the CO_2 in the ground permanently. But the CO_2 the facility sends to CTV I may not stay in the ground; instead, CTV I may purchase the same offset credits the emitting facility could have bought in the first place, to offset the emissions from its sequestration project. The futility of this scenario is clear even before going into the many problems with relying on carbon offsets and before considering the added emissions from CO_2 transportation and the operations of the CTV I Project.

ii. MM 4.8-6's reliance on offset credits is not supported by the evidence.

Under CEQA, an agency must have specific evidentiary support for a conclusion that mitigation will be effective.[261] The Draft EIR lacks evidentiary support, however, that offset credits can achieve emission reductions.

Offset programs, in general, are a contentious tool for curbing GHG emissions, and there is mounting criticism in the scientific and environmental communities against using credits in the effort to stop climate change.[262] Research shows that nature-based solutions cannot effectively offset fossil fuel combustion due to the different nature of CO_2 emissions in the two

[260] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[261] See, e.g., *Sierra Club v. County of San Diego* (2014) 231 Cal.App.4th 1152, 1168.
[262] Amazon Watch, *Statement: Offsets Don't Stop Climate Change* (Oct. 6, 2021), https://amazonwatch.org/news/2021/1006-statement-offsets-dont-stop-climate-change.

categories,[263] and offsets are likely to increase GHG emissions rather than decrease them.[264] Environmental justice advocates have pointed out that offsets perpetuate environmental injustice by increasing the relative burden of pollution on already overburdened communities, including low-income communities of color, while GHG reduction is happening, if at all, elsewhere. [265]

There is also a consensus that, to be effective, offsets credits must be real, permanent, additional, verifiable, and enforceable.[266] Additionality is especially hard to ascertain: "additional" emission reductions are reductions not otherwise required by law or likely to occur anyway. Assembly Bill (AB) 32, California's landmark GHG reduction statute, clarifies that "additional" means "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur."[267] To be "additional," therefore, an offset credit must not result from actions otherwise legally required, *and* it must be in addition to any reduction that would otherwise occur. MM 4.8-6 fails to include any requirement for additionality of credits, nor for any of the other requirements listed above, and thus there is no support for the effectiveness of the mitigation measure.

The Draft EIR also lacks evidence that there exist any offset programs capable of ensuring that offsets are "additional." This is a particular concern given that MM 4.8-6 does not include any requirements regarding the offsets' origin, allowing for international offsets, which are especially challenging to verify.[268] There is also no support for the assumption there are enough GHG offset credits available to satisfy the mitigation measures' requirements. This problem is exacerbated by the fact that the Draft EIR fails to quantity the volume of emissions that will need to be mitigated using offsets.

iii. MM 4.8-6 is ineffective, unenforceable, and impermissibly deferred.

Even if offset credits could be, under certain conditions and limitations, a proper mitigation measure for GHG emissions, and even if they could be acceptable mitigation for a carbon sequestration project, MM 4.8-6 is inadequate under CEQA's mitigation requirements.

First, as mentioned before, there are no performance standards for offsets, and no requirement they will be real, permanent, additional, verifiable, and enforceable. Instead, the measure relies on offsets issues by different parties, including unidentified "third parties," to

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[263] Carton, W. at el, *Undoing Equivalence: Rethinking Carbon Accounting for Just Carbon Removal*, Frontiers in Climate (Apr. 16, 2021), https://www.frontiersin.org/articles/10.3389/fclim.2021.664130/full.
[264] Anderegg, W., *Gambling With the Climate: How Risky of a Bet Are Natural Climate Solutions?*, AGU Advances (July, 22 2021), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021AV000490.
[265] Amazon Watch, *Statement: Offsets Don't Stop Climate Change.*
[266] *Golden Door Properties, LLC v. County of San Diego* (2020) 50 Cal. App. 5th 467, 511.
[267] Health & Safety Code, § 38562(d)(2).
[268] *Golden Door Properties, LLC, supra*, 50 Cal.App.5th 467 at 513.

issue the credits. As courts have recognized, protocols adopted by voluntary market registries may not meet standards necessary to ensure that credits in fact reduce emissions.[269]

The only check on any offsets' effectiveness in mitigating GHG impact is the requirement that they will be "verified" by the San Joaquin Valley Air Pollution Control District (SJVAPCD) or through inclusion in an Emission Reduction Agreement. MM 4.8-6 thus impermissibly defers mitigation.[270] By leaving the decision on verification of the credits solely to the judgment of the SJVAPCD, without setting any performance standards and process for the verification and only generally requiring "no net increase," the Measure violates CEQA. "Simply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[271]

The option given in the Mitigation Measure to offset emissions through inclusion in an Emission Reduction Agreement is also invalid under CEQA, for the same reasons. Emission Reduction Agreements are not defined anywhere in the Draft EIR in the context of GHG emissions and are used by the Air District for reduction of certain other air pollutants, not GHGs. CARB's review of SJVAPCD Emission Reduction Credit System states with respect to GHG that:

> Ultimately, the impact of these GHG ERCs is not clear, as there is no currently authorized use in an NSR context consistent with District rules or in the context of GHG Cap and Trade programs. To CARB's knowledge, none of these GHG ERCs have been used.[272]

Finally, MM 4.8-6 is unenforceable. Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[273] Here, the Measure fails to specify in any detail how the Air District will quantify the emissions reductions it needs to achieve, or does achieve, through this measure, the process by which the offsets will be purchased, and proof of their purchase filed, or any enforcement mechanism to ensure that this Measure is actually implemented.

In fact, aside from vaguely stating that the Project "shall offset," the Mitigation Measure fails to state at what point any offset "shall" happen, or whether the Air District or the County will require offsets as a condition of approval of any permit.

The last part of MM 4.8-6 deals with future sources that will be sending CO_2 for injection in one sentence. It summarily states: "All sources providing CO_2 for injection must certify that

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[269] *Golden Door Properties, LLC, supra*, 50 Cal. App. 5th 467 at 511–12.
[270] *King & Gardiner Farms, supra*, 45 Cal.App.5th at 856.
[271] *Id.* See also *Sierra Watch v. County of Placer* (2021) 69 Cal.App.5th 86, 110; *Golden Door Properties, LLC, supra*, 50 Cal.App.5th 467 at 517.
[272] CARB Enforcement Division, *Review of the San Joaquin Valley Air Pollution Control District Emission Reduction Credit System* (June 2020) at 30, https://ww2.arb.ca.gov/sites/default/files/2020-06/SJV_ERC_FINAL_20200604.pdf
[273] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).

any additional CO_2 generated from the source capture facility has been mitigated to "no net increase" before injection at Carbon Terra Vault 1".[274]

This part of the Mitigation Measure aimed at future sources suffers from the same severe flaws as described above, only exacerbated. It is entirely ineffective and unenforceable, as it only requires vaguely that future CO_2 sources will "certify" that any "additional" CO_2 has been "mitigated to 'no net increase'". It fails to explain what type of certification can be used and under what conditions, or even to name the agency to whom such "certification" will be submitted and how it will be verified. It also fails to explain what "additional" means in the context of this Measure.

Moreover, the Measure fails to address in any way the carbon generated by *trucks* that will bring CO_2 for injection. As stated before, the Draft EIR, though it fails to provide any analysis on the issue, anticipates that some sources will ship their CO_2 using trucks. Such GHG emission sources must be addressed under the Draft EIR's GHG mitigation measures.

c. *MM 4.8-2 through MM 4.8-5 unlawfully rely on reporting requirements or existing or future regulations or plans, without demonstrating these measures meaningfully mitigate Project impacts.*

The remaining GHG mitigation measures do not, individually or together, succeed in mitigating GHG impacts.

MM 4.8-2 requires quarterly reporting on the amount of CO_2 injected into the CCS project, and the source of the CO_2.[275] While such reporting is essential, it is not enough, taken together with the other mitigation measures, to mitigate impacts to the extent feasible.

MM 4.8-3 merely requires permitted stationary sources to comply with the Cap-and-Trade regulation and implement Best Performance Standards (BPS) applicable to greenhouse gas reduction for Components at Light Crude Oil and Natural Gas Production, Natural Gas Processing Facilities.[276] But these BPS only apply to certain types of facilities, and if these facilities are not subject to Cap-and-Trade, this mitigation measure will not apply to them at all. Moreover, the Final Staff Report prepared for the SJVAPCD Climate Action Plan states explicitly that "[u]se of performance based standards is not a method of mitigating emissions."[277]

Similarly, MM 4.8-4 and MM 4.8-5 merely require compliance with SJVAPCD regulations (Rule 4401 and 4409) and regulations adopted or amended for methane.[278]

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[274] Draft EIR, Vol. 1 at 4.8-28.
[275] Draft EIR, Vol. 1 at 4.8-27.
[276] Draft EIR, Vol. 1 at 4.8-27.
[277] SJVAPCD, *Final Staff Report - Climate Change Action Plan: Addressing GHG Emissions Impacts under CEQA* (2009) at 59.
[278] Draft EIR, Vol. 1 at 4.8-27.

MM 4.8-3, MM 4.8-4, and MM 4.8-5 rely on existing or future regulations, without adding any standards or measures to mitigate potential impacts from GHG emissions. CEQA allows the use of compliance with regulatory standards as mitigation, but only where the regulatory standards ensure actual mitigation of project impacts to the extent feasible. CEQA therefore requires that a determination that compliance will be sufficient to prevent significant impacts be based on a project-specific analysis of potential impacts and the effect of regulatory compliance.[279]

C. The Draft EIR's Analysis and Mitigation of Energy Use Impacts is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the CTV I Project's impacts to energy resources. CEQA Guidelines, Appendix F lays out the following directives for proper discussion of a proposed project's energy impacts in an EIR:

> The goal of conserving energy implies the wise and efficient use of energy. The means of achieving this goal include:
>
> (1) decreasing overall per capita energy consumption,
>
> (2) decreasing reliance on fossil fuels such as coal, natural gas and oil, and
>
> (3) increasing reliance on renewable energy sources.[280]

The analysis required under CEQA thus provides the opportunity for project proponents to evaluate the energy consequences of their decisions.

The Draft EIR applies, as a threshold of significance, whether the Project will "result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation."[281] The Draft EIR concludes that:

> [C]onstruction activities associated with the proposed project would result in the consumption of petroleum-based fuels. However, there are no unusual project characteristics that would necessitate the use of construction equipment or vehicles that would be less energy efficient than at comparable construction sites in other parts of the state. Therefore, it is expected that construction fuel consumption associated with the proposed project would not be any more inefficient, wasteful, or unnecessary than at other construction sites in the region.[282]

In this conclusion, the Draft EIR applies, as a threshold, whether the Project would be "*more* inefficient, wasteful, or unnecessary than at other construction sites in the region." But

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[279] *Californians for Alternatives to Toxics v. Dept. of Food & Agric.* (2005) 136 Cal.App.4th 1.
[280] CEQA Guidelines, Appendix F, § 2.
[281] Draft EIR, Vol. 1 at 4.6-12.
[282] Draft EIR, Vol. 1 at 4.6-14.

CEQA instead requires an evaluation of whether this project is energy-efficient, not average; CEQA requires mitigation of impacts to energy consumption, where feasible. The claim that the Project has no significant impact on energy resources is thus not supported by substantial evidence. The EIR should require, for example, use of electricity-powered construction equipment and vehicles in all feasible applications.

Moreover, the Draft EIR does not provide sufficient information or analysis to evaluate the Project's overall relationship to energy consumption, and does not even address this question. CO_2 storage projects will often tend to substitute for, rather than facilitate, decreasing reliance on fossil fuels such as coal, natural gas, and oil. The Project's energy conservation analysis fails for many of the same reasons its project description, GHG impact analysis, and cumulative impact analysis are inadequate. In particular, an analysis that includes information about the relationship between Project CO_2 storage operations and Project CO_2 sources is necessary, to fully disclose and analyze whether and to what extent CTV I will facilitate development and use of fossil fuel infrastructure or extend the life of existing fossil fuel CO_2-emitting industries. The Draft EIR's failure to include any meaningful discussion of the Project's CO_2 sources renders the discussion inadequate to evaluate how the Project will decrease reliance on fossil fuels or increase reliance on renewable energy.

D. The Draft EIR's Analysis and Mitigation of Geologic Risks is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the significant geologic impacts of the CTV I Project in this region. These failures are unacceptable given the setting in which the Project may occur and render the Draft EIR defective as an informational document.

The expert report of Dr. Dominic DiGiulio addresses the numerous deficiencies in the County's analysis and why it underestimates the severity of the Project's geologic impacts in further detail. Dr. DiGiulio's analysis highlights the serious risk of CO_2 leaks from the storage reservoirs as well as seismic hazards on wellbores in the Elk Hills oil field, and concludes:

> Given the large number of well penetrations, high pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. . . .
>
> In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, neither the [Draft EIR] nor the Class VI permit applications should be approved.[283]

1. The Draft EIR must fully account for the significant risk of leaks due to existing wellbores at the Elk Hills oil field.

The Draft EIR fails to properly consider any of these issues because it fails at the outset to fully account for the geologic setting at the Elk Hills oil field. When analyzing a project's adverse environmental impacts under CEQA, "[t]he significance of an activity depends on the setting."[284] It is imperative that an EIR accurately and fully describe a project's environmental

[283] DiGiulio Report at 31–32.

[284] *Kings County Farm Bureau*, 221 Cal.App.3d at 718; see also CEQA Guidelines, § 15125.

setting because this description forms the baseline for evaluating its environmental impacts.[285] Indeed, the Draft EIR here must demonstrate not only that the CTV I Project's geologic impacts were adequately investigated but that these impacts were "considered *in the full environmental context.*"[286] It is impossible for the Draft EIR to fulfill its informational purpose if it is not adequately describing and considering the existing environment and geologic setting that may be impacted by the Project.

The Elk Hills oil field and its surrounding region have been deeply shaped by oil and gas drilling activity for many decades. Elk Hills is one of the oldest and largest oil fields in the U.S., discovered over 100 years ago, and is characterized by "the presence of a large number of well penetrations."[287] As discussed in the DiGiulio Report, "[l]eakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2" and the large number of wellbores at Elk Hills therefore "increases the possibility of leakage" which could be "catastrophic."[288]

These risks are exacerbated where, as here, wellbores have not been permanently plugged back to surface, and the Draft EIR contains discrepancies in the number of wellbores that require plugging.[289] Some recent estimates indicate that Elk Hills contains nearly 1,400 idle, unplugged wells that have not produced oil or gas for an average 14 years.[290]

Even if properly plugged, Dr. DiGiulio notes that wellbore integrity failure and leaks from plugged wells "is not uncommon," with research finding failure rates from 2-75%.[291] Yet the Draft EIR found an implausible 0% failure rate in both storage reservoirs, with no wellbores deemed deficient or requiring corrective action.[292]

The Draft EIR fails to acknowledge these issues or disclose the inherent and heightened risks of CO_2 storage in a depleted oil field like this one, which renders it lacking in substantial evidence to support its subsequent conclusions about impacts and mitigation.

2. The Draft EIR must be recirculated with the missing "Appendix 1."

In fact, many of the Draft EIR's conclusions about geologic impacts are "impossible to verify" due to missing details.[293] Dr. DiGiulio notes that the Draft EIR excludes critical information needed to assess wellbore integrity at the Elk Hills oil field and the likelihood of leaks from the storage reservoirs. Specifically, the Draft EIR repeatedly references an "Appendix

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[285] See CEQA Guidelines, § 15125(a).
[286] CEQA Guidelines, § 15125(c) (emphasis added).
[287] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem*, LA Times (Feb. 6, 2020), https://www.latimes.com/projects/california-oil-well-drilling-idle-cleanup/; DiGiulio Report at 3–4.
[288] DiGiulio Report at 3–4, 5; see also Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* at 5–6.
[289] DiGiulio Report at 10–11.
[290] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem.*
[291] DiGiulio Report at 9, 12.
[292] *Id.* at 12.
[293] *Ibid.*

1" that "lists the wells [in the field] individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements" but does not provide it in the document.[294] This "wellbore-by-wellbore evaluation" with these details and others like "each well's type, construction, date drilled, location, depth, and record of plugging and/or completion" is needed "to assess wellbore integrity issues prior to plugging to plug wells in a manner to minimize leakage to the extent possible."[295]

The Draft EIR thus violates CEQA's mandate for an EIR to "include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project."[296] Even if pieces of this information are included in EPA's Class VI permit materials or elsewhere, the County is required to include the full Appendix with the Draft EIR for public review and comment, and to use it to inform its own analysis of impacts and appropriate mitigation for the CTV 1 Project. The failure of the Draft EIR to include the Appendix means the County must recirculate it with the missing information discussed in the DiGiulio Report included, and provide an adequate public comment period on the recirculated draft.

3. The Draft EIR must address how seismic hazards will exacerbate potential geologic impacts.

The Draft EIR also does not accurately describe and consider the full environmental context related to seismic activity in the region. Although the Draft EIR notes that the County is in the highest seismic hazard zone and discusses the basic seismic history of the region,[297] it inappropriately narrows its analysis of impacts to the bounds of the Elk Hills oil field, which fails to capture potentially significant adverse geologic and safety impacts in the broader region. The analysis otherwise waves away further review of the potential impacts of natural or induced seismicity due to the project because "there are no known major faults within the project area."[298]

By contrast, Dr. DiGiulio classifies the impacts of seismicity on the Project area as "high risk" (vs. the Draft EIR's classification of "low to medium" risk) and recommends the County conduct a detailed seismicity evaluation in order to properly determine that seismicity will not impact containment of injected CO_2.[299] The report defines the appropriate "region of concern" as encompassing all seismic events within 200 kilometers from the storage reservoirs, discusses key seismic events in the region's history, and points out that the Draft EIR's discussion of seismic events within a smaller 100-kilometer range of the oil field is insufficient for ensuring the Project avoids catastrophic loss of containment.[300] Critically, the Draft EIR's seismic risk analysis fails entirely to consider legacy wells or the significant consequences of leaks through these wells.[301]

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[294] See, e.g., Draft EIR, Vol. 2, App'x E.2: EPA Class VI UIC Permit Application Narratives for the Elk Hills 26R Storage Project and the A1A2 Storage Project at 2019.
[295] DiGiulio Report at 11.
[296] *Laurel Heights*, *supra*, 47 Cal.3d at 405.
[297] Draft EIR, Vol. 1 at 4.7-13, 4.7-3.
[298] Draft EIR, Vol. 1 at 4.7-18.
[299] DiGiulio Report at 15–25.
[300] DiGiulio Report at 15–18.
[301] DiGiulio Report at 20.

The Draft EIR's omission of this requisite level of analysis renders the geologic impacts section lacking in substantial evidence to support its conclusions.

In addition, the County's dismissal of the risks of seismicity induced from injection of CO_2 at Elk Hills as "unlikely" is inconsistent with the scientific literature linking fluid injection into deep underground wells with earthquakes.[302] The DiGiulio Report notes "[e]ven in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of [magnitude] 4."[303] The report discusses numerous real-world examples of injection-induced seismicity that the Draft EIR fails to disclose or address when considering the impacts of the CTV I Project, including in particular incidents of CO_2 injection inducing seismic events.[304]

Dr. DiGiulio further explains that "[f]or induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the [Draft EIR] adequately consider induced seismicity."[305] Thus, the County cannot outsource its obligations to properly analyze and mitigate the potential impacts of induced seismicity by ceding those obligations to EPA, a tactic it deploys throughout the geologic impacts section.[306]

Given the risks of natural and induced seismicity and the fact that Kern County and the region surrounding the Elk Hills oil field is already one of the most seismically active in the state—the Central Valley is considered a "hot spot" where oil and gas wells and earthquakes are clustered in space[307]—the Draft EIR cannot dismiss potential impacts. Indeed, Dr. DiGiulio notes "[s]eismicity may be induced tens of kilometers away from large-scale injection" which further expands the impact area the County should consider for the Project well beyond the Elk Hills oil field.[308]

Potential impacts here could include damage to project infrastructure like pipelines, compressors, injection wells, or other wells in the oil field, damage to other structures in the

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[302] Draft EIR, Vol. 1 at 4.7-18; see, e.g., Goebel, T.H.W. et al., *Wastewater Disposal and Earthquake Swarm Activity at the Southern End of the Central Valley, California*, Geophys. Res. Lett., 43 (2016), 1092–99 (hydrogeological modeling reveals wastewater disposal likely contributed to seismicity via localized pressure increase along a seismically active fault, with results suggesting induced seismicity may remain undetected in California without detailed analysis of local geologic setting, seismicity, and fluid diffusion, and proximity of high-rate injectors and large active faults can cause noticeable earthquakes under certain geologic conditions).

[303] DiGiulio Report at 26.

[304] DiGiulio Report at 26–27.

[305] DiGiulio Report at 28.

[306] See Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects*.

[307] Kang, M. et al., *Potential Increase in Oil and Gas Well Leakage Due to Earthquakes*, Environ. Res. Commun. (2019), 1: 121004 at 3, https://doi.org/10.1088/2515-7620/ab576e.

[308] DiGiulio Report at 26–27; see also Kuchment, *Drilling for Earthquakes*, Scientific American (2016), 315, 1, 46–53, https://www.scientificamerican.com/article/drilling-for-earthquakes/ ("Evidence suggests that earthquake risks can spread for miles beyond the original disposal sites and can persist for a decade or more after drilling stops.").

region like roads and buildings, and dangerous CO_2 leaks to air and groundwater that harm the environment and health of nearby communities.[309] Even ground shaking from small- to moderate-sized earthquakes is consequential for a CO_2 repository and capable of creating leakage pathways to the surface.[310] The omission of this information violates CEQA's mandate that the data in an EIR "must be presented in a manner calculated to adequately inform the public and decision makers, who may not be previously familiar with the details of the project," and to give the readers "a better road map to the information it intends to convey."[311]

Overall, the County fails to provide substantial evidence to support the assumptions and conclusions in the geologic impacts section.

4. The Draft EIR fails to adequately address cumulative geologic impacts.

The Draft EIR's failures described above taint its cumulative impact analysis and render it inadequate under CEQA. While it acknowledges the impacts of cumulative induced seismic activity from the CTV I Project are significant and unavoidable, it otherwise waves away all other geologic impacts and fails to conduct further analysis on the nature and magnitude of the significant risks "due to the uncertainty of the implementation of multiple [CCS] projects and the ability to simultaneously cease injection during a[] [seismic] event."[312] The Draft EIR's bare conclusion violates CEQA.[313]

As discussed throughout these comments, the Draft EIR must also address "probable future projects."[314] This includes the numerous other CO_2 sources being prepared for CTV I as well as further industrial development that is expected in the region in connection with the Project.

5. The Draft EIR fails to adopt all feasible mitigation to address geologic risks.

The Draft EIR sets forth mitigation measures to address the geologic impacts of the CTV I Project that are wholly inadequate under CEQA. The DiGiulio Report details numerous deficiencies in the County's mitigation measures and why they must be addressed.

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[309] See, e.g., Millman, *California Earthquakes Caused $200 Million in Damage, Report Says*, Wall Street Journal (July 24, 2019), https://www.wsj.com/articles/california-earthquakes-caused-200-million-in-damage-report-says-11564006544 (pair of recent 6.4 and 7.1 magnitude earthquakes in Kern County caused about $200 million in property damage alone, not including damage to infrastructure such as roads or to a nearby naval base); Natural Resources Defense Council (NRDC), *Drilling in California: Who's at Risk?* (2014) at 9, https://www.nrdc.org/sites/default/files/california-fracking-risks-report.pdf.

[310] Zoback, M. & Gorelick, S., *Earthquake Triggering and Large-Scale Geologic Storage of Carbon Dioxide*, 109 PNAS 10164 (2012) at 10165–66, https://doi.org/10.1073/pnas.1202473109.

[311] *Vineyard Area Citizens, supra*, 40 Cal. 4th at 443.

[312] Draft EIR, Vol. 1 at 4.7-24 to 4.7-25.

[313] *Sierra Club, supra*, 6 Cal.5th at 519.

[314] Pub. Resources Code, § 21083(b)(2).

The Draft EIR acknowledges that earthquakes may disturb surface and subsurface facilities like wellbores at the Project site and could result in loss, injury, or death.[315] It also acknowledges that the site may be subject to strong ground shaking that could cause structural damage and other Project components that could injure people.[316] Thus, the County must adopt all feasible mitigation.

MM 4.7-1 requires CRC to prepare a comprehensive seismic activity monitoring plan that includes connection to the Statewide seismic monitoring program of the California Seismic Network and compliance with state requirements, including "[a]ppropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; [i]dentification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures."[317]

The elements of MM 4.7-1 are inadequate and do not represent all feasible mitigation for the impacts of earthquakes and ground shaking. The DiGiulio Report points out that, while a seismic monitoring plan would be able to detect an earthquake, it does not reduce damage to surface and subsurface facilities, and thus the impacts should be considered significant and unavoidable, rather than less than significant as the Draft EIR concludes.[318]

The DiGiulio Report provides numerous recommendations for seismic monitoring network design that are missing and should be included in MM 4.7-1 to comply with CEQA's requirement to adopt all feasible mitigation.[319] As the report notes, "monitoring of natural seismicity is not mitigation."[320]

In addition, MM 4.7-1 is riddled with vague and indefinite terms. Under CEQA, a mitigation measure must include criteria or performance standards against which the mitigation's actual implementation can be measured.[321] MM 4.7-1, however, is a laundry list of vague actions such as "appropriate" subsurface monitoring, "[i]dentification of hazards and conditions," and "notification protocols for all applicable agencies and emergency procedures."[322] The Draft EIR must be revised to include measurable and enforceable mitigation measures to address the Project's impacts. Open-ended and therefore potentially meaningless terms in a mitigation measure that will be developed at an unspecified time in the future also violate CEQA's requirements for deferred mitigation.

MM 4.7-1 is also effectively unenforceable because the Draft EIR does not contain permit conditions, agreements, or other legally binding instruments that ensure the seismic monitoring plan will be prepared and implemented, and who will enforce it.[323] The Measure must specify that no construction or grading permits shall be issued, and no activities expected to

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[315] Draft EIR, Vol. 1 at 4.7-17.
[316] Draft EIR, Vol. 1 at 4.7-18.
[317] Draft EIR, Vol. 1 at 4.7-17.
[318] DiGiulio Report at 23–24.
[319] DiGiulio Report at 28–30.
[320] DiGiulio Report at 23.
[321] *San Joaquin Raptor Rescue Ctr.*, *supra*, 149 Cal.App.4th at 670.
[322] Draft EIR, Vol. 1 at 4.7-17.
[323] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4(a)(2).

cause earthquakes or ground shaking may otherwise commence, unless and until the County, EPA Region 9, CARB, and California Seismic Network all approve the seismic monitoring plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[324]

The DiGiulio Report points out that the Draft EIR's claim that mitigation of strong ground shaking "is typically provided by designing structures in accordance with the latest edition of the California Building Code" is flawed.[325] Because the Building Code does not address wellbore integrity, compliance would not mitigate potential impacts for this Project, thus the impacts should be considered significant and unavoidable, not less than significant.[326]

It is important to note that merely requiring compliance with agency regulations or other existing requirements like the California Building Code does not conclusively indicate that the Project would not have a significant and adverse impact. Those legal requirements may not be strong enough to protect against environmental impacts. In *Kings County Farm Bureau v. City of Hanford*, for example, the court found that the fact that EPA and the local air pollution control district had issued the necessary air emission permits for the construction of a coal fired cogeneration plan did not nullify the CEQA requirement that the lead agency analyze the significant air quality impacts of the entire project.[327] Similarly here, the Draft EIR cannot rely on the Building Code to conclude that impacts would not be significant based on those requirements, without at least describing what those requirements are and how they would reduce the Project's geologic impacts to less than significant.

MM 4.7-3 is also inadequate and does not represent all feasible mitigation for the impacts of unstable soil or land that could result in landslides, subsidence, liquefaction, or collapse. The Measure states that CRC "shall implement all requirements of a site-specific geotechnical report" with no further detail or direction.[328] This language is vague and indefinite, and defers development of the geotechnical report until an unspecified time in the future. The Draft EIR must be revised to include measurable and enforceable terms for the report to address the Project's impacts. Moreover, without any permit conditions or other legally binding instruments to ensure the report will be prepared and implemented, this measure is entirely unenforceable. The Draft EIR must specify that no permits shall be issued and no activities expected to cause landslides, subsidence, liquefaction, or collapse may begin until the County and other relevant agencies approve the report.

The flaws in the Draft EIR's analysis of geologic risks also impacts its development of mitigation measures to address cumulative impacts. After acknowledging significant and unavoidable cumulative impacts, the Draft EIR makes no attempt to adopt feasible mitigation, claiming "there are no other feasible and reasonable mitigations available" other than the

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[324] *King and Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET, supra,* 218 Cal.App.4th at 738.
[325] Draft EIR, Vol. 1 at 4.7-18.
[326] DiGiulio Report at 24.
[327] *Kings County Farm Bureau, supra,* 221 Cal.App.3d at 716.
[328] Draft EIR, Vol. 1 at 4.7-21.

deficient measures discussed above.[329] This failure violates CEQA, particularly given the analysis and recommendations in the DiGiulio Report.

In addition to addressing the deficiencies in the Draft EIR's current mitigation measures for geologic impacts and strengthening its seismic monitoring and mitigation plan measures, the DiGiulio Report recommends numerous additional feasible mitigation measures that the County should adopt to address the CTV I Project's serious impacts. One example that would protect nearby communities—and reflect measures already considered for other impacts in the Draft EIR—is to "determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s)."[330]

E. The Draft EIR's Analysis and Mitigation of CO_2 Pipeline Safety Hazards is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the serious carbon dioxide pipeline safety hazards of the CTV I Project. The expert report of Richard Kuprewicz (attached as Attachment C, hereafter "Kuprewicz Report") addresses the numerous deficiencies in the County's analysis in further detail and why they obscure the severity of the Project's pipeline safety impacts. The issues raised in the report highlight why the Draft EIR is defective as an informational document.

1. The Draft EIR fails to provide critically important pipeline information.

As the Kuprewicz Report concludes, "[i]mportant pipeline information is missing in the [Draft EIR] that will not permit decisionmakers to make an informed decision about this Project."[331] The report offers a list of key examples of the Draft EIR's "major shortcomings" and failure to disclose critical details about the Project.[332]

The missing details about the nature of the CTV I Project's pipeline construction and operations prevent understanding of the applicable regulations and safety jurisdiction of relevant agencies, and thus a complete analysis and appropriate mitigation. The Draft EIR also contains inaccurate and misleading details that obscure a full understanding of potential pipeline safety impacts. For example, the Kuprewicz Report discusses the Draft EIR's attempts to minimize the extent of impacts from the Satartia, MS pipeline rupture.[333] Relatedly, the Draft EIR also completely fails to address the possibility of a CO_2 injection well blowout, which "can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases."[334]

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[329] Draft EIR, Vol. 1 at 4.7-25.
[330] DiGiulio Report at 5.
[331] Kuprewicz Report at 2.
[332] *Id.* at 2–5.
[333] *Id.* at 6.
[334] *Id.* at 6–7.

The deficiencies in the Draft EIR are particularly consequential given the history of explosions and disasters that have harmed people in pipeline-related incidents,[335] and the ongoing harms faced by communities in the Elk Hills region due to oil and gas activity. In fact, as recently as February 2024, a pipeline burst in Bakersfield, releasing barrels of oil on a public street next to Buena Vista Elementary School.[336] Between January 1, 2010, and January 19, 2023, a total of 8,140 pipeline incidents were reported to the Pipeline and Hazardous Materials Safety Administration (PHMSA), an average of 1.7 incidents per day. Hazardous liquid pipelines (which encompass CO_2 pipelines) accounted for more than half of these incidents.[337] The DiGiulio Report also discusses at length examples of large-scale CO_2 releases and their impacts on neighboring communities.[338]

Notably, an earlier similar carbon capture proposal in the Elk Hills oil field that would have compressed CO_2 from a hydrogen plant and transported it to the field via pipeline to 25 injection wells for enhanced oil recovery found serious safety risks.[339] Specifically, the project risk assessment for its approximately 3 mile pipeline—about a quarter of the length of the CTV I Project's planned pipelines—determined that a large amount of CO_2 could be released into the atmosphere if it failed.[340] Studies find that exposure to large amounts of CO_2 could lead to harmful impacts like irritation, chronic or irreversible tissue damage, or narcosis, and to irreversible health effects, impairing, or even death for close exposure to the release.[341] None of these issues are addressed in the Draft EIR, rendering it lacking in substantial evidence to support its conclusions.

The Draft EIR's failures are particularly stark given the evidence that most CCS pipelines fall largely within environmental justice communities, like those surrounding Elk Hills, that live in close proximity to industrial pollution.[342]

Given its serious deficiencies, the Draft EIR's dismissal of all pipeline-related impacts, including cumulative impacts, as less than significant is not supported by substantial evidence.

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[335] See, e.g., Zegart, Dan, *The Gassing of Satartia.*

[336] LaVigne, *Pipe Burst Spills Oil in Front of Buena Vista Elementary School*, KERO-TV (Feb. 8, 2024), https://www.turnto23.com/news/in-your-neighborhood/bakersfield/pipe-burst-spills-oil-in-front-of-buena-vista-elementary-school.

[337] FracTracker Alliance, *2022 Pipeline Incidents Update: Is Pipeline Safety Achievable?* (Feb. 1, 2023), https://www.fractracker.org/2023/02/2022-pipeline-incidents-update-is-pipeline-safety-achievable/.

[338] DiGiulio Report at 4–5.

[339] Submitted by Occidental of Elk Hills, Inc. to Cal. Dept. of Conservation, *Proposed Enhanced Oil Recovery Project (Phase 1), Underground Injection of Carbon Dioxide Gas, Stevens Reservoirs – T30, 31S, R23, 24E, Sections 33S, 34S, 35S, 2G, 3G, & 4G, Engineering Study, Geologic Study, and Injection Plan* (Oct. 2, 20212) at 1, 6.

[340] Stantec, *Hydrogen Energy Center Application for Certification Amendment –Attachment D: Hazards Assessment of CO_2 Supply Line* (Apr. 12, 2011) at 7.

[341] *Id.* at 6–7.

[342] Rota, M., *Carbon Dioxide Waste Capture and Injection: A False Solution for Louisiana and the World* (2023), https://healthygulf.org/carbon-waste-injection-false-solution-for-louisiana/.

2. The Draft EIR fails to adopt all feasible mitigation to address pipeline safety hazards.

Because of the missing and inaccurate information regarding CO_2 pipeline safety issues, it is impossible for the Draft EIR to satisfy CEQA's requirement to adopt all feasible mitigation measures for these impacts. The proposed measures are also ineffective, unenforceable, and vague, and illegally defer mitigation.

For example, MM 4.9-4 requires a construction permit site plan for all CO_2 pipelines, which will be reviewed and approved by the County and California State Fire Marshall (OSFM), noting that PHMSA has delegated CO_2 pipeline oversight to OSFM.[343] In addition to this Measure being vague and improperly deferring the plan to an unspecified future date, it is unclear whether OSFM actually has proper jurisdiction over the CTV I Project's CO_2 pipelines. As discussed in the Kuprewicz Report, the Draft EIR's failure to provide CO_2 purity information and clearly distinguish between facility and injection pipelines impacts whether either agency has jurisdiction and responsibility for the Project.[344] The report also highlights that federal pipeline safety regulations are seriously inadequate, thus the County cannot rely on compliance alone to avoid fulfilling its own separate obligations under CEQA to properly assess and mitigate impacts.[345]

As another example of the Draft EIR's deficient mitigation measures, MM 4.9-10 only requires compliance with EPA's Class VI permit before injection can begin.[346] As discussed throughout these comments, merely requiring compliance with existing regulations or other requirements like the Class VI requirements does not conclusively indicate that the Project would not have significant and adverse impacts.

These highlighted examples are just a sample and illustrate the overall failures of the Draft EIR to analyze and adopt all feasible CO_2 pipline safety mitigations for the CTV I Project. The Kuprewicz Report recommends additional feasible mitigation measures that the County should adopt to address CO_2 pipeline impacts, including, as noted elsewhere, that the County should adopt setbacks from the pipelines.[347]

F. The Draft EIR's Analysis and Mitigation of Water Supply Impacts is Inadequate.

An accurate analysis of the CTV I Project's impact on the local water supply is crucial because water is scarce in Kern County and groundwater pumping has occurred at unsustainable levels for decades, resulting in overdraft conditions region-wide, county-wide, and within the

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[343] Draft EIR, Vol. 1 at 4.9-57 to 4.9-58.
[344] Kuprewicz Report at 2–3.
[345] *Id.* at 5.
[346] Draft EIR, Vol. 1 at 4.9-60.
[347] Kuprewicz Report at 4–5; DiGiulio Report at 5; see also Hillebrand, M. et al., *Toxicological Risk Assessment in CO_2 Capture and Storage Technology*, International Journal of Greenhouse Gas Control 55 (2016) 118–43 (concentrations of CO_2 releases from pipelines are function of distance, thus safety distances have to be calculated wherein no hazardous concentrations are reached, varying between <1 m and 7.2 kilometers).

Project Area. Unfortunately, the Draft EIR fails to adequately disclose and analyze water supply impacts and correspondingly fails to adopt all feasible mitigation.

As an initial matter, it is worth noting that the Draft EIR is confusing because the header for the section on Utilities and Service Systems—one of the several sections that address water supply issues—is mislabeled as "4.17 Utilities and Service Systems." The section on Utilities and Service Systems is actually section 4.19. The erroneous header should be corrected because it is confusing to the reader and complicates navigation of the document.

1. The Draft EIR's description of the environmental and regulatory setting for water supply is inadequate.

The Draft EIR is misleading and fails as an informational document because, remarkably, it fails to acknowledge the most basic fact about water supply in Kern County: there is "no surplus water available" in the County to meet domestic and/or irrigation demands, meaning that any use of municipal and industrial ("M&I") quality water by the proposed CTV I Project necessarily "reduces potential supplies for other purposes and users."[348] The Draft EIR should disclose this reality upfront to the public and decisionmakers.

The details that the Draft EIR does provide downplay the Project's water supply impacts and are inadequate. For example, in describing the relevant "Environmental Setting" for the CTV I Project's impact on water supply, the Draft EIR merely notes that "[t]he project site is located within the Tulare Lake Basin," which "is ranked as 'high priority' in a statewide ranking of groundwater importance."[349] The Draft EIR also notes "[t]he Kern County Subbasin ('Subbasin') is the specific groundwater subbasin in which the project resides."[350]

To meaningfully inform readers, the Draft EIR must explain the significance of the Tulare Lake Basin's designation of "high priority" and offer more details on conditions in the Tulare Lake Basin generally and the Kern County Subbasin specifically.

The Tulare Basin is designated as "high priority" both because the region is heavily reliant on groundwater and because groundwater supplies are in a condition of "critical overdraft."[351] Similarly, the Kern County Subbasin has been identified as "high priority," reflecting that the area is "critically overdrafted" and suffers from related problems including

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[348] Kern County Planning & Natural Resources Dept., *Draft Supplemental Recirculated Environmental Impact Report for Revisions to Title 19-Kern County Zoning Ordinance, Supplemental Water Supply Baseline Technical Report* (July 2020) at 4, 58.
[349] Draft EIR, Vol. 1 at 4.10-1.
[350] Draft EIR, Vol. 1 at 4.10-2.
[351] Draft EIR, Vol 2., Water Supply Assessment for the Carbon Terravault 1 Project at 2–3.

"land subsidence and groundwater quality degradation."[352] Persistent overdraft of groundwater also "dries up wells."[353]

Although the Draft EIR acknowledges that the Kern County Subbasin, "as a whole, has an overdraft of 324,326 acre-feet per year over the baseline conditions,"[354] nowhere is the significance of this fact explained.

The Draft EIR is similarly misleading and incomplete in its description of the regulatory setting for water supply. The Draft EIR includes a general discussion of the Sustainable Groundwater Management Act (SGMA) and how it is being implement in the Project Area.[355] As part of this discussion, the Draft EIR notes the status of six groundwater sustainability plans (GSPs) that have been prepared for the San Joaquin Valley Kern County Subbasin.[356] However, nowhere does the Draft EIR explain that SGMA applies to Kern County and the Project Area because the Act was designed to address chronic groundwater overdraft and its negative consequences.

Further, the Draft EIR neglects to address whether or how the six GSPs will affect the available water supplies in the Kern County Subbasin generally or for the Project specifically. Although the Draft EIR indicates that state authorities have determined that the six GSPs are deficient in some respects, the Draft EIR also confirms that, under SGMA, local Groundwater Sustainability Authorities are still "required to begin implementation of the plans . . . while working to amend the plans and address the deficiencies."[357] The Draft EIR should address the expected consequences of the GSPs—if any—on the proposed CTV I Project and its planned operations and water use.

2. The Draft EIR's analysis of the Project's impact on water supply is contradictory, inaccurate, and misleading.

The Draft EIR fails as an informational document because it does not clearly explain the source or amount of water that will be used by the Project.

First, the Draft EIR makes conflicting statements about the source of water to be used by the CTV I Project. In section 4.10, the Draft EIR states: "[t]he proposed project would use water during construction and for operation of the project. Water for the project would be supplied by

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[352] Draft, EIR, Vol. 2, West Kern Water District, Urban Water Management Plan 2020 Update (June 2021) at 34

[353] Rachel Becker, *San Joaquin Valley growers may face probation for failing to protect groundwater*, Cal Matters (Oct. 12, 2023), https://calmatters.org/environment/2023/10/san-joaquin-valley-groundwater/.

[354] Draft EIR, Vol. 1 at 4.10-35, 4.19-2, 4.19-21 to 4.19-22.

[355] Draft EIR, Vol. 1 at 4.10-15 to 4.10-17, 4.19-7 to 4.19-8.

[356] Draft EIR, Vol. 1 at 4.10-16 to 4.10-17, 4.19-8; see also id. at 4.19-13 to 4.19-14.

[357] Draft EIR, Vol. 1 at 4.10-17, 4.19-8, 4.19-14.

the WKWD from existing water allocations for Elk Hills and CRC."[358] Further, according to section 4.10, "all water would be trucked to the site from the WKWD." [359]

The foregoing description of the source of the Project's water supply is contradicted by text in section 4.19 which states that—for Project operations—"[w]ater to operate the carbon capture and storage (CCS) facilities is proposed to be sourced from produced water from existing oil and gas operations within Elk Hills."[360]

Second, no matter the source, the Draft EIR inaccurately and misleadingly describes the Project's water supply demand. Table 4.19-2 describes the Project's water demand as follows:

Table 4.19-2: Water Supply Availability

	Allotment (acre-feet per year)	Project Demand	Usage of Water Allotment
Elk Hills	3,000		
CRC	2,200		
Construction (18 months)		75 acre-feet	1.4%
Operation (per year)		19.49 acre-feet	0.37%
Total	5,200	94.49 acre-feet	1.77%

Key:
CRC = California Resources Corporation

This table is clearly wrong. The table incorrectly combines a one-time water demand for construction (75 acre-feet) with an annual operational demand (19.49 per year) and concludes that the "Total" Project demand is 94.49 acre-feet. But this is not an accurate total. Just the first phase of the Project is expected to last 26 years,[361] meaning that operational water demand will amount to at least 506.74 acre-feet (19.49 acre-feet annually x 26 years). The Draft EIR must be revised to eliminate Table 4.19-2, which is inaccurate and misleading. Further, the Draft EIR must disclose how much water the Project will use over its full operational lifetime.

3. The Draft EIR's finding that the Project will not substantially reduce groundwater supplies is not supported by substantial evidence.

The Draft EIR offers several reasons to support its conclusion that the CTV I Project will not substantially decrease groundwater supplies, all of which are erroneous.

First, the Draft EIR states: "Project operation would not rely on locally sourced groundwater wells, as all water would be trucked to the site from the WKWD [West Kern Water District]." [362] But WKWD supplies the water it provides from "groundwater within the Kern

[358] Draft EIR, Vol. 1, at 4.10-34.
[359] Draft EIR, Vol. 1 at 4.10-35.
[360] Draft EIR, Vol. 1 at 4.19-19.
[361] Draft EIR, Vol. 1 at 1-6, 2-1, 3-2, 3-12.
[362] Draft EIR, Vol. 1 at 4.10-35.

County subbasin,"[363] meaning the Project's water use will still impose a burden on local groundwater supplies.

Second, the Draft EIR asserts that, even accounting for pre-Project water use at the Project site, water use is expected to remain below the WKWD's future water budget for CRC and Elk Hills, which affords 5,200 acre-feet per year.[364] As an initial matter, it is unclear if the future water budget adopted for the Project site by WKWD in 2020 remains valid, given that the Kern Groundwater Authority (KGA) is currently responsible for an annual overdraft of 239,346 acre-feet per year,[365] and state authorities have disapproved KGA's proposed Groundwater Sustainability Plan for the area.[366]

In any event, the fact that the WKWD may have budgeted for operations at the site does not mean that the Project's expected water use will not have a significant impact. As noted above, there is no surplus water in Kern County, groundwater in the Kern Subbasin is suffering from critical overdraft, and the water to be used by the Project will all be sourced from groundwater. Whether water use at the site was anticipated or not, the Project will still be using substantial quantities of groundwater.

Third, the Draft EIR avers that, "[s]hould the project require water supplies in excess of the allotment from the District, impacts to water supplies would be considered potentially significant. In order to address this, MM 4.19-1 would be implemented, ensuring that any groundwater or reclaimed water used is accounted for and regulated."[367]

The Draft EIR's adoption of MM 4.19-1 does not support a finding that the Project's groundwater use will be mitigated to a level of insignificance. That is because MM 4.19-1 in no way limits or mitigates the Project's water use. Rather, the Measure just specifies that the Project Owner/operator shall "provide information on any groundwater . . . that will be used," and County officials, in turn, "shall compile the water use information in a report" to be posted online annually.[368] This measure does not reduce or limit water use; it merely requires that "that any groundwater . . . used is accounted for."[369]

4. The Draft EIR fails to adopt all feasible mitigation for the Project's cumulative impacts on water supply.

Putting aside the Draft EIR's unsupported finding that the Project will not have a significant direct impact on groundwater supplies, the Draft EIR does acknowledge that "the cumulative impacts of any use of groundwater in the area are considered significant."[370] Consequently, the County must adopt all feasible mitigation to address this cumulative impact.

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[363] Draft EIR, Vol. 1 at 3-34; accord 4.19-2 (stating "WKWD primarily pumps groundwater").
[364] Draft EIR, Vol. 1 at 4.19-20 to 4.19-21.
[365] See, e.g., Draft EIR, Vol. 1 at 4.19-21
[366] See, e.g., Draft EIR, Vol. 1 at 4.19-13 to 4.19-14.
[367] Draft EIR, Vol. 1 at 4.10-35.
[368] Draft EIR, Vol. 1 at 1-65, 4.19-21 to 4.19-22.
[369] Draft EIR, Vol. 1 at 4.19-27.
[370] Draft EIR, Vol. 1 at 4-10-43.

The Draft EIR identifies several mitigation measures that will purportedly address this significant cumulative impact on water supply: MMs 4.9-1, 4.10-1, 4.10-2, 4.10-3, 4.10-4, 4.10-5, and 4.19-1.[371] But none of these measures will actually reduce the Project's impact on groundwater supplies:

- MM 4.9-1 provides worker training on the handling of hazardous substance,[372] but the Project site is not a source of groundwater for municipal and industrial (M&I) uses, which is supplied from elsewhere by WKWD.[373]

- MMs 4.10-1 through 4.10-5 all address onsite operations (i.e., stormwater measures and management of drilling muds, drilling fluids, and produced water)[374] but, again, the Project site is not a source of groundwater for M&I uses, which is supplied from elsewhere by WKWD.

- MM 4.19-1, as discussed above, merely requires reporting on groundwater use, and does not limit its use in any way.

Consistent with CEQA's requirement to adopt all feasible mitigation, the County should require the following feasible measures to mitigate the Project's impacts on local groundwater supplies:

- The County should identify specific purposes for which the Project may use M&I quality water—limited to those purposes for which such high-quality, freshwater is truly necessary—and direct that all other water uses in the Project area shall be met by recycling oil field-produced water. The Draft EIR indicates that such recycling and reuse of oil filed-produced water already occurs at the site.[375] The County should make this voluntary practice mandatory.

- The County should set a cap on the CTV I Project's water use. According to the Draft EIR, if construction activities (75 acre-feet) and operational activities (19.49 acre-feet) were to occur in the same year, the Project's water demand would total 94.49 acre-feet annually.[376] The Project should be held accountable for its estimated water needs and limited to an annual cap of 95 acre-feet per year or less for its CCS operations. In setting the cap, the County should subtract any use(s) included in the Project's estimated water demand that could be met by recycling oil field-produced water.

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[371] Draft EIR, Vol. 1 at 4.10-44.
[372] Draft EIR, Vol. 1 at 1-45, 4.9-55.
[373] Draft EIR, Vol. 1 at 4.10-7 to 4.10-8 (noting "there is no appreciable quantity of groundwater in the project area" and "any groundwater encountered in this area is generally unusable"); 4.19-2 (stating WKWD's "[w]ater supply is obtained within the District from wells located in the northeast corner of the District in the underflow area of the Kern River Basin and from an area north and adjacent to the State of California's Tule Elk Reserve.").
[374] Draft EIR, Vol. 1 at 1-52 to 1-55, 4.10-29 to 4.10-33.
[375] Draft EIR, Vol. 1 at 4.10-8.
[376] Draft EIR, Vol. 1 at 4.19-21.

- The County should levy and collect an annual "fair-share" fee from the Owner/operator to be paid to the KGA to account for the Project's contribution to cumulative impacts on local groundwater supplies that KGA must mitigate pursuant to SGMA.

5. The Draft EIR inadequately analyzes and mitigates disposal of oil field-produced water.

The Draft EIR notes that "[a] significant percentage of the oil field-produced water in the project area is either recycled into the same geologic zones from which it was produced or is sequestered in deeper zones that are isolated from sources of drinking water."[377] Water that is not recycled or sequestered underground requires disposal. According to the Draft EIR, produced water "may also be transported, via truck or pipeline to existing wastewater treatment facilities permitted to receive production water for disposal" or "stored in surface impoundments where it percolates into groundwater and/or evaporates."[378]

The Draft EIR is inadequate as an informational document because it does not specify what percentage of the oil field-produced water is currently (in the oil field) or will be (for the Project) recycled and reinjected onsite as opposed to disposed of in some other way. Instead, the Draft EIR merely surmises that "very little water is disposed of . . . because purchasing fresh water is more expensive than recycling water."[379] The Draft EIR can and should be more specific to inform the public and decisionmakers; it should detail current water disposal volume(s) and practice(s) at the Project site and how these are expected to change, if at all, with the construction and operations of the proposed CCS facility.

It is important that the Draft EIR accurately address the fate of oil field-produced water because it has consequences for the CTV I Project's impacts:

- As the Draft EIR suggests, a high rate of recycling would lessen the degree to which the Project will compete with other users for scarce municipal and industrial-quality water.[380]

- Conversely, if transportation of the oil field-produced water by truck or pipeline is required for disposal, related environmental impacts must be evaluated and mitigated. For example, the Draft EIR notes that truck traffic impacts air quality.[381]

- Surface disposal of oil field-produced water in ponds also threatens impacts that should be disclosed if the practice will occur. "Because it was commingled with hydrocarbons in the formation," produced water "typically contains chemicals associated with the formations, such as salts, oils and greases, inorganic and organic chemicals, and naturally occurring radioactive material, that exceed state and federal standards for drinking

[377] Draft EIR, Vol. 1 at 4.10-8.
[378] Draft EIR, Vol. 1 at 4.9-7.
[379] Draft EIR, Vol. 1 at 4.10-8.
[380] Draft EIR, Vol. 1 at 4.10-8.
[381] See, e.g., Draft EIR, Vol. 1 at 4.3-63, 4.3-66, 4.3-72.

water."[382] Disposal in surface impoundments can therefore increase air pollution as well as contaminate the soil and harm biological resources.

Although the Draft EIR does not analyze the impact, the Draft EIR seems to contemplate that surface impoundments will, in fact, be used for disposal of oil field-produced water. More specifically, MM 4.10-5 states: "[t]he Owner/operator shall not discharge produced water into any surface disposal facility unless the facility has received the Waste Discharge Requirements from the Central Valley Regional Water Quality Control Board, or the need for Water Discharge Requirements has been waived by the Central Valley Regional Water Quality Control Board."[383] Likewise, MM 4.1-2 states: "[s]umps and ponds shall be permitted only to the extent authorized by the Central Valley Regional Water Quality Control Board . . . and shall comply with all applicable legal requirements and mitigation measures for . . . percolation or evaporation ponds for produced water."[384]

If the CTV I Project proposes to use such surface impoundments at the Project site, the extent to which they may be used and the impacts of such use must be disclosed. An adequate impact analysis is necessary to inform the development of all feasible mitigation measures and to include meaningful public input on the impacts and proposed mitigation.

G. The Draft EIR's Analysis and Mitigation of Biological Resources Impacts is Inadequate.

1. The Draft EIR must account for the threatened, endangered, and sensitive animal and plant species in the Central Valley and Elk Hills oil field.

The Elk Hills oil field and surrounding area is known to support high densities of species protected by state and federal law. The California Department of Fish and Wildlife (CDFW) has specifically called out several species known to be supported in the area through prior biological surveys, including the blunt-nosed leopard lizard, giant kangaroo rat, San Joaquin kit fox, Swainson's hawk, San Joaquin antelope squirrel, American badger, short-nosed kangaroo rat, burrowing owl, California glossy snake, and California jewelflower.[385] CDFW recommended additional surveys for special status plant species and also noted the potential for San Joaquin pocket mouse.[386] In addition, CDFW shared with the California Geologic Energy Management Division (CalGEM) in 2022 that "there is potentially suitable habitat [in the Elk Hills oil field] within the well pad footprints and/or adjacent to the wells that can serve as refugia, denning, breeding, foraging, and dispersal habitat" for additional species "likely to occur within th[e] oil field," including the Tipton kangaroo rat, tricolored blackbird, Temblor legless lizard, Kern mallow, San Joaquin woolly threads, Buena Vista Lake shrew, LeConte's thrasher, loggerhead shrike, Tulare grasshopper, San Joaquin coachwhip, California glossy snake, coast horned lizard,

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[382] Draft EIR, Vol. 1 at 4.9-7.
[383] Draft EIR, Vol. 1 at 4.10-33.
[384] Draft EIR, Vol. 1 at 4.1-23.
[385] Letter from Bob Stafford, California Department of Fish and Wildlife, to Cindi Hoover, Kern County Planning & Natural Resources Dept. (April 6, 2022), Draft EIR, Vol. 2, App'x A.2: Comment Letters at 148.
[386] *Id.* at 159, 162.

western pond turtle, western spadefoot, prairie falcon, California horned lark, and Crotch bumble bee.[387] That 2022 letter also notes that several special-status plant species may occur in the oil field, including California Rare Plant Rank species Horn's milk-vetch, heartscale, Lost Hills crownscale, slough thistle, recurved larkspur, Temblor buckwheat, Tejon poppy, alkali-sink goldfields, pale-yellow layia, showy golden madia, California alkali grass, and oil neststraw.[388]

Table 1. *Threatened, Endangered and Sensitive Animals, Plants, and Plant Communities of the Elk Hills Area (threatened and endangered species are bolded)*

Common Name	***Scientific Name***	***Federal/State Status***	***CDFW Letter[389]***
	Plants		
California jewelflower	***Caulanthus californicus***	***FE/CE, 1B.1***	**1, 2**
San Joaquin woollythreads	***Monolopia congdonii***	***FE/1B.2***	**2**
Kern mallow	***Eremalche parryi ssp. kernensis***	***FE/1B.2***	**2**
Horn's milk-vetch	*Astragalus hornii var. hornii*	*S/1B.1*	2
heartscale	*Atriplex cordulata var. cordulata*	*S/1B.2*	2
Lost Hills crownscale	*Atriplex coronata var. vallicola*	*S/1B.2*	2
Slough thistle	*Cirsium crassicaule*	*S/1B.1*	2
recurved larkspur	*Delphinium recurvatum*	*S/1B.2*	2
Temblor buckwheat	*Eriogonum temblorense*	*S/1B.2*	2
Tejon poppy	*Eschscholzia lemmonii ssp. kernensis*	*S/1B.1*	2
alkali-sink goldfields	*Lasthenia chrysantha*	*--/1B.1*	2
pale-yellow layia	*Layia heterotricha*	*S/1B.1*	2
showy golden madia	*Madia radiata*	*S/1B.1*	2
California alkali grass	*Puccinellia simplex*	*S/1B.2*	2
oil neststraw	*Stylocline citroleum*	*S/1B.1*	2
	Insects		
Crotch bumble bee	*Bombus crotchii*	*--/WL*	2
	Amphibians		
western spadefoot	*Spea hammondii*	*S/SSC*	2
	Reptiles		
Temblor legless lizard	*Anniella alexanderae*	*Under Review / Candidate*	2
western pond turtle	*Actinemys marmorata*	*/SSC*	2
California glossy snake	*Arizona elegans occidentalis*	*--/SSC*	1, 2
blunt-nosed leopard lizard	***Gambelia sila***	***FE/CE, FP***	**1, 2**
San Joaquin coachwhip	*Masticophis flagellum ruddocki*	*--/SSC*	2

[387] Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW (revised Aug. 12, 2022) at 1.
[388] *Id.* at 6.
[389] CDFW Letter 1: Letter from Bob Stafford, Cal. Department of Fish & Wildlife, to Cindi Hoover, Kern County Planning & Natural Resources Dept. (April 6, 2022), Draft EIR, Vol. 2, App'x A.2: Comment Letters at 148; Letter, 2: Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW (revised Aug. 12, 2022).

coast horned lizard	*Phyrnosoma blaimvillii*	*/SSC*	2
	Birds		
burrowing owl	*Athene cunicularia*	*S/SSC*	1, 2
tricolored blackbird	***Agelais tricolor***	***CT***	**2**
loggerhead shrike	*Lanius ludovicianus*	*/SSC*	2
California horned lark	*Erempohila alpestris actia*	*/WL*	2
prairie falcon	*Falco mexicanus*	*/WL*	2
Le Conte's thrasher	*Toxostoma lecontei*	*S/SSC*	2
Swainson's hawk	***Buteo swainsoni***	***CT***	**1, 2**
	Mammals		
Nelson's (San Joaquin) antelope squirrel	***Ammospermophilus nelsoni***	***S/CT***	**1, 2**
giant kangaroo rat	***Dipodomys ingens***	***FE/CE***	**1, 2**
short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	*S/SSC*	1, 2
Tipton kangaroo rat	***Dipodomys nitratoides nitratoides***	***FE/SE***	**1, 2**
Buena Vista Lake shrew	Sorex *ornatus relictus*	*FE/SSC*	2
Tulare grasshopper mouse	*Onychomys torridus tularensis*	*S/SSC*	2
San Joaquin pocket mouse	*Perognathus inornatus*	*--/SSC*	1
American badger	*Taxidea taxus*	*--/SSC*	1, 2
San Joaquin kit fox	***Vulpes macrotis mutica***	***FE/CT***	**1, 2**

Federal Designation

FE—Federally listed as endangered

FT—Federally listed as threatened.

S—BLM Sensitive Species.

State Designation

CE—State listed as endangered.

CT—State listed as threatened. Species that although not presently threatened in California with extinction are likely to become endangered in the foreseeable future.

SSC—California Department of Fish and Wildlife's "Species of Special Concern." Species with declining populations in California.

WL—Watch List

1B.1—Plant rare, threatened or endangered in Cal. and elsewhere, and very threatened in Cal.

1B.2—Plant rare, threatened or endangered in Cal. and elsewhere, and fairly threatened in Cal.

Many of these same species were listed in the letter the Center for Biological Diversity, Central Valley Air Quality Coalition, and Central California Environmental Justice Network submitted in response to the Notice of Preparation for the Project, based on species found in the U.S. Geologic Survey quadrangles surrounding the Project site.

2. The Draft EIR must address construction and operation impacts to species.

Though the Draft EIR claims there are no significant and unavoidable Project impacts to biological resources, this misses the mark and reflects a failure to account for the evidence

showing that operating CCS projects can be severely detrimental, or even deadly, to wildlife, plants, and habitats.

The Project poses risks to biological resources from leakage and uncontrolled blowouts of compressed CO_2 from pipelines and injection wells.[390] Compressed CO_2 forms a low dense cloud that can spread long distances from the release site and sicken and asphyxiate living things, including plants and animals.[391] CO_2 injection in oil fields and CO_2 pipeline transport have resulted in leakage and blowouts in several states that have caused wildlife deaths and significant habitat degradation. For example, a CO_2 injection well blowout in the Tinsley field, Mississippi, took 37 days to bring under control and killed deer, birds, fish, and other animals.[392] The blowout ejected CO_2 along with mud and drilling fluids, requiring the removal of 27,000 tons of drilling mud and contaminated soil and 32,000 barrels of liquids, and causing extensive habitat damage.[393] Other examples of CO_2 harms to wildlife and plants, and research on this topic, include:

- In 1986, a sudden, catastrophic release of CO_2 from Lake Nyos in Cameroon killed 1,700 people and 3,000 cattle. The CO_2 spread 10 km from the lake. Bird, insect, and small mammal populations in the area were not seen for at least 48 hours after the event.[394]

- Experiments with controlled injections of CO_2 into soil showed adverse effects on plants in response to CO_2 exposure. Biomass changes were seen in all plants studied; for example, clover plants decreased by 79% while grass decreased by 42%. The researchers' overarching conclusion was that elevated concentrations of soil CO_2 damages both soil microbiology and growing vegetation.[395]

- Other research on CO_2 and plants showed reduced plant growth and extensive mortality where CO_2 concentrations were greatest in the soil. For the plants that survived, root and shoot growth was significantly lower than in controls. Reproductive variables such as

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[390] The Project's Biological Study Area (BSA), for example, includes "everything within the limits of the project footprint (the carbon capture and storage [CCS] Surface Land Area) and a 250-foot survey buffer, where feasible." Draft EIR, Vol. 1 at 4.4-3. Accordingly, the impacts to species from CO_2 leaks and blowouts must be considered within the scope of the BSA.

[391] See Pipeline Safety Trust and AccuFacts, *CO_2 Pipelines: Dangerous and Under-Regulated* (March 2022), https://pstrust.org/wp-content/uploads/2022/03/3-23-22-Final-Accufacts-CO2-Pipeline-Report2.pdf.

[392] Zegart, *The Gassing of Satartia.*

[393] Amy, *Oil spills in Mississippi, Alabama lead to $3.5 million in penalties for the company,* Clarion Ledger (Apr. 30, 2019), https://www.clarionledger.com/story/news/2019/04/30/oil-spills-penalties-mississippi/3625587002/.

[394] Kling, G.W. et al., *The 1986 Lake Nyos Gas Disaster in Cameroon, West Africa*, 236 Science 169 (1987).

[395] Smith, K.L. et al., *Environmental Impacts of CO2 Leakage: Recent Results from the ASGARD Facility, UK*, 37 Energy Procedia 791 (2013).

number of seeds per plant and seed dry weight per plant were also reduced compared to controls.[396]

The Draft EIR's analysis must also consider the impacts posed to burrowing species in the Project site, including the area in which the CO_2 plume is expected to spread. (The Draft EIR acknowledges that construction could cause loss of burrows and dens during construction at p. 4.4-40, but not during Project operation.) Burrowing animals are particularly vulnerable to death from CO_2 suffocation in the event of CO_2 pipeline or injection well blowout, since released CO_2 could fill nearby burrows where animals are resting or retreating. Federally listed burrowing species in the Project area include the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and blunt-nosed leopard lizard.

3. The Draft EIR must comply with CEQA's biological resources review requirements.

Protecting biological resources is a fundamental tenet of CEQA. Under Public Resources Code section 21001(c), it is the policy of the state to "[p]revent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities." EIRs must provide an in-depth analysis of whether a project will: Reduce substantially the habitat of a fish or wildlife species; Cause a fish or wildlife population to drop below self-sustaining levels; Threaten to eliminate a plant or animal community; or Reduce substantially the number or restrict the range of an endangered, rare, or threatened species.[397]

In addition to review under CEQA, when a project has the potential to significantly impact a species listed under the federal or California Endangered Species Act, consultation with wildlife agencies and an Incidental Take Permit are required.[398]

4. The Draft EIR's reconnaissance surveys are deficient.

There are deficiencies in the reconnaissance surveys that the Draft EIR relies upon to identify potentially impacted species. In evaluating whether a project will affect endangered, rare, or threatened species, lead agencies can use reconnaissance-level surveys, rather than protocol-level surveys or other methods, only where the choice of methodology is supported by substantial evidence.[399]

Of the 39 species CDFW identified as potentially occurring in the Project area (see Table 1 in section VI.G.1), the Draft EIR identifies just 27 that may be potentially affected by the Project following literature, database analysis, and reconnaissance surveys in September – December 2022. But the initial database review and reconnaissance surveys were insufficient to identify all sensitive species that may potentially occur in the Project area. In particular, despite the poor timing of the reconnaissance surveys to detect many species, the Draft EIR relies on the

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[396] Al-Traboulsi et al., *Potential Impact of CO2 Leakage from Carbon Capture and Storage (CCS) Systems on Growth and Yield in Spring Field Bean*, 80 Environ. Exper. Botany 43 (2012).
[397] CEQA Guidelines, § 15065(c)(1).
[398] Cal. Fish and Game Code, § 2081; Endangered Species Act, § 10.
[399] *Gray, supra*, 167 Cal.App.4th at 1124.

database review and reconnaissance surveys to exclude the Tipton kangaroo rat and several plant species that CDFW has noted occur or have the potential to occur near the Project site.

a. Tipton Kangaroo Rat

CDFW wrote in comments on the scoping phase of the Project that Tipton kangaroo rat "have been documented to occur near the Project site" and that suitable habitat is present for the species to "occupy or colonize the Project."[400] CDFW went on to recommend a trapping plan to determine the presence of Tipton kangaroo rat, to be reviewed and approved by CDFW prior to execution, and that "these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities in order to determine if impacts . . . could occur."[401] Contrary to CDFW's recommendation, the Biological Analysis Report did not include a plan submitted to and approved by CDFW and did not take place between April 1 and October 1. As expected, no Tipton kangaroo rat were observed during winter reconnaissance surveys. Rather than include this species for further evaluation in protocol-level surveys, it was removed from consideration with the following rationale: "The BSA is outside of the known geographic range (east of the California aqueduct) of the species."[402] This statement is not supported by substantial evidence and is contradicted by multiple letters from CDFW. The species should have been included in the Draft EIR as potentially occurring in the Project area to ensure it was included in future surveys and covered by mitigation measures.

b. Special Status Plants

CDFW identified multiple plant species that may be located in the Project area. The agency recommended in comments on the Notice of Preparation for the Project that Project sites should be surveyed "by a qualified botanist following the 'Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities' . . . . This protocol, which is intended to maximize detectability, includes the identification of reference populations to facilitate the likelihood of field investigations occurring during the appropriate floristic period."[403] The protocol is "meant to help people meet California Environmental Quality Act (CEQA) requirements for adequate disclosure of potential impacts to plants" and further recommends that field surveys be conducted multiple times during flowering or fruiting, when plants will be evident and identifiable.[404] The Draft EIR's methodology and recommendations are at odds with this protocol.

Surveys are particularly important because information in databases is voluntarily submitted and is "obtained opportunistically and is often focused on protected lands or on lands where development has been proposed."[405] CDFW identified with aerial imagery that many plant species could be impacted by the development in the Elk Hills oil field, including Horn's milk

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[400] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[401] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 155.
[402] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1701.
[403] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 159.
[404] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (Mar. 2018) at 1.
[405] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1618.

vetch, slough thistle, alkali-sink goldfields, pale-yellow layia, and California alkali grass.[406] CDFW further stated that:

> [i]n order to adequately assess any potential impacts to biological resources, focused biological surveys are advised to be conducted by a qualified wildlife biologist during the appropriate survey period(s) in order to determine whether or not any special status species may be present within the well development areas and prior to any ground-disturbing activities. Survey results can then be used to inform the level of environmental review and identify any mitigation, minimization, and avoidance measures necessary to reduce potential impacts to special status biological resources to less than significant.[407]

The Biological Analysis Report also appears to recognize the importance of surveys to supplement information in databases. It says that "the absence of recorded occurrence in these databases at any specific location does not preclude the possibility that a special-status resource may be present, which is why site-specific surveys were undertaken." However, it is not clear if the determination of whether species had the potential to occur was made prior to or after reconnaissance surveys.[408] And, if made after reconnaissance surveys, the "site-specific surveys" conducted for the Biological Analysis Report are not the same as the surveys recommended by CDFW to determine the species in the Project area and develop mitigation. For example, they were conducted between September and December, outside bloom times. There is also no evidence that the surveyors possess specific plant knowledge or have experience "conducting floristic botanical field surveys" or that the surveys followed other requirements in CDFW's 2018 protocols for surveying document.[409] CDFW's protocol specifically states that it is inappropriate to conduct "'[f]ocused surveys' that are limited to habitats known to support special status plants or ***that are restricted to lists of likely potential special status plants***" because they "are not adequate to identify all plants in a project area to the level necessary to determine if they are special status plants,"[410] but this is exactly what the Draft EIR proposes.[411]

5. The Draft EIR's proposed mitigation measures are unsupported and/or insufficient.

A large number of species-specific mitigation measures lack support, ignore scientific evidence, and/or expert agency recommendations submitted during the scoping period, fail to

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[406] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 151.
[407] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 146–47.
[408] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1618 ("The results of the database inquiries were reviewed to develop a comprehensive list of sensitive biological resources that may be present on or in the vicinity of the Project site (see Table A-1 in App'x A). This list was then evaluated against existing site conditions observed during the biological field surveys of the BSA to determine which special-status resources have the potential to occur and then the potential for impacts to those resources as a result of the implementation of the Project.").
[409] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* at 11.
[410] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* at 4.
[411] Draft EIR, Vol. 1 at 4.4-57.

adhere to legal requirements, and ultimately must be substantially revised. Further, the Draft EIR lacks entirely mitigations for specific species or offers vague and/or yet-to-be-determined mitigation plans that must be specified and recirculated for comment from the public and experts.

a. Blunt-nosed Leopard Lizard

The blunt-nosed leopard lizard (BNLL) is a Fully Protected species in California and the proposed Project is located in "what is known as the highest quality BNLL habitat" within the oil field.[412] The Draft EIR fails to provide sufficient mitigation measures to detect the species and avoid take, just as it fails to adequately respond to concerns, evidence, and suggestions offered by the CDFW during the Project scoping period. And as a minor initial matter, the Draft EIR mischaracterizes the BNLL as a snake.[413] It is instead a rather large lizard that is part of the iguana family. This error should be corrected.

Surveys

First, the Draft EIR ignores the CDFW's concerns about survey protocols. The proposed mitigation measures provide that "[n]o more than one year prior to ground disturbing activities, focused surveys . . . shall be conducted in all potential" habitat" (MM 4.4-9(b)); as well as "[w]ithin 30 days before any ground-disturbing activities in special-status species habitat, the qualified biologist shall conduct a pre-disturbance survey" (MM 4.4-1(C)). But as the CDFW pointed out in their scoping comment: "Protocol-level surveys for BNLL are not synonymous with 30-day 'preconstruction surveys' often recommended for other wildlife species. In addition, the BNLL protocol specifies different survey effort requirements based on whether the disturbance results from maintenance activities or if the disturbance results in habitat removal (CDFW 2019)."[414] The Draft EIR does not address the difference between protocol-compliant surveys and 30-day preconstruction surveys, or the difference in survey type based on Project activity and impact. The BNLL mitigation measures for surveys must provide more specifics on how the proposed surveys will comply with the nuances in the protocols.

Second, the mitigation measures must be clearer on the timing of the one-year survey and provide more explanation for how the timing will fit with the BNLL's complex lifecycle and the fact that the species can remain below ground for years at a time. MM 4.4-9 says only that "focused surveys . . . shall be conducted" within a year of construction. The BNLL breeds from May to June, and eggs hatch in July and August.[415] The species is then active during the day in the spring, summer, and fall months, though adult activity decreases during the hot summer months of July and August, just as the hatchlings emerge from the burrows.[416] At that point, adults generally retreat into their burrows for the winter. Hatchlings stay out until October or

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[412] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.
[413] Draft EIR, Vol. 1 at 4.4-45.
[414] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.
[415] California Herps, *Blunt-Nosed Leopard Lizard - Gambelia sila*, https://californiaherps.com/lizards/pages/g.sila.html (last accessed Mar. 1, 2024).
[416] U.S. Fish and Wildlife Service (FWS), *Blunt-Nosed Leopard Lizard*, https://www.fws.gov/species/blunt-nosed-leopard-lizard-gambelia-silus (last accessed Mar. 1, 2024).

November, before going into burrows.[417] Adults are capable of remaining below ground for two winters when poor environmental conditions, such as drought, are present.[418] The Mitigation Measure for longer-term surveys must therefore account for detecting both adult and juvenile lizards, as well as the fact that adults may remain underground for two years in a row.

Deferred Mitigation

MM 4.4-9(c) says that if BNLL are found during surveys, an "avoidance plan shall be prepared." The Mitigation Measure then recommends certain minimum actions to be included in the plan, such as a Worker Awareness Program and a speed limit.[419]

But the County cannot defer creation of a mitigation measure until a problem is detected. Under the CEQA rule against improper deferred mitigation, an EIR may not outline a mitigation measure in overly general terms, leaving the details to be decided at a later time, without setting performance standards or showing how the impact can be mitigated as described in the EIR.[420] Formulation of a measure's specific requirements for biological impacts may be permissible if the measure refers to the options that will be considered and the measure identifies specific performance standards.[421] All of these required safeguards and specifics are lacking in MM 4.4-9(c).

Cumulative Analysis

The CDFW recommended in the scoping period that the County perform a "robust cumulative impact analysis" of the BNLL because of the "significant loss of habitat for the species," the fact that the Project area and surrounding lands "contain some of the highest quality remaining habitat" for the BNLL, and that any "ground disturbing activities . . . may have the potential to significantly impact" populations.[422] The Draft EIR entirely ignores this recommendation and it is not reflected either in the analysis or the mitigation measures. There is no explanation for why CDFW's recommendation was ignored. The County must take up this recommendation and adjust its analysis and mitigation measures accordingly.

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[417] *Id.*
[418] *Id.*
[419] *Id;* see also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius" until additional measures are determined).
[420] CEQA Guidelines, §15126.4(a)(1)(B); *Preserve Wild Santee v. City of Santee* (2012) 210 CA4th 260, 280 (rejected measure calling for management of species without specifying performance standards or other guidelines for that management); *San Joaquin Raptor Rescue Ctr., supra,* 149 CA4th at 669 (measure specifying that future surveys for special status species be completed and undefined habitat management plan be developed in response to surveys found legally inadequate).
[421] *Clover Valley Found. v. City of Rocklin* (2011) 197 CA4th 200, 237 (requirement that permits be obtained from Department of Fish and Wildlife and Corps of Engineers served as performance standards supporting agency's determination that impact to listed species and its habitat would be mitigated); see also *Rialto Citizens for Responsible Growth v. City of Rialto* (2012) 208 CA4th 899, 945; *Cal. Native Plant Society, supra,* 172 CA4th at 621; *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 CA4th 777, 794; *Defend the Bay v. City of Irvine* (2004) 119 CA4th 1261, 1275.
[422] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.

Buffer Zones

The mitigation measures for BNLL buffer areas fail to match the analysis and evidence CDFW provided in the scoping period. CDFW sought to determine the appropriately sized buffer to create a "reasonable chance of preventing take."[423] The agency reviewed the best available scientific information on the area which individual BNLL use and the distances that individuals are known to move between points.[424] They summarized relevant findings and concluded that the buffer area would need to be 164 acres *at a minimum* to avoid take.[425]

Rather than grapple with this informed and reasoned recommendation, the mitigation measures for the BNLL are vastly under-protective. MM 4.4-9(a) provides only a 50-foot buffer where ground-disturbing activities could impact suitable burrows. MM 4.4-9(b) prescribes a 250-foot buffer if the species is detected. (Even here, it is unclear what "detected" means—the same Mitigation Measure states that no buffer is needed if no BNLL "is observed," but "observation" may not be the same as detecting signs of the lizard.)[426]

The Draft EIR's prescribed 50-foot buffer is 2% of the CDFW recommendation, and the 250-foot buffer only 10% of the CDFW recommendation. Moreover, the evidence the CDFW analyzed showed the *minimum* home range for the BNLL to be 1.1 acres (with other findings extending up to nearly 22 acres). One acre is 660 feet long—meaning the buffers in the mitigation measures are not even half of the bare minimum space needed to protect the species. These buffers simply fall far short of what is needed to meet the County's legal obligations and avoid take of the species. The Draft EIR offers no explanation for running counter to the best available scientific evidence of what might be reasonable to avoid take.

b. San Joaquin Kit Fox

There is both high likelihood of San Joaquin Kit Fox (SJKF) presence and occupation of the Project site and a need for strong mitigation measures. Per the CDFW, SJKF "may be attracted to the Project area due to the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance."[427] Mitigations must eliminate or substantially limit the likelihood of den collapse, inadvertent entrapment, reduced reproductive success, reduction in health and vigor of young, and direct mortality of individuals.[428]

The current SJKF mitigation measures are deficient and fail to align with scientific evidence and/or legal requirements in several ways. First, the CDFW was clear in its scoping comment that avoiding Project impacts to SJKF "is likely infeasible," and this Project warrants

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[423] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 151.
[424] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 151.
[425] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 152–53 (going on to explain that there is "a reasonable plan for avoidance is to assume that the lizard might utilize up to 98.8 acres in any direction from where it was observed," and assuming a circular home range, the diameter would be 2340.8 feet, or a 395-acre circle as a buffer).
[426] See also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius until additional measures are determined).
[427] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 153.
[428] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 153.

consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities.[429] This is because the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity."[430]

Second, while MM 4.4-6 provides for buffers around potential and confirmed dens, it also directs that any dens that "cannot be avoided" will be removed. Calling for den removal fails to align with evidence provided during the scoping period that kit fox relocation is complex and likely to fail.[431] The Mitigation Measure further fails to propose how exactly den "excavation" will occur, if/where relocation will happen, and how relocation will take into account critical factors such as expense, available habitat, impact on existing populations, and documentation.[432] Den removal also implicates species take which, as noted below, requires a separate ITP than what the County currently claims covers Project activities.[433] The Mitigation Measure also fails to acknowledge the USFWS's guideline that occupied natal or pupping dens will not be destroyed until the foxes have vacated, thus requiring postponement of Project activities.[434] Details such as these must be included in the mitigation measures so that all parties (including the Project developer, workers, and local regulators) are aware of their obligations and limitations.

Third, other measures to project the SJKF do not align with CDFW and USFWS recommendations. (Of note, MM 4.4-6 directs the reader to other measures "including capping pipes, covering trenches, adding exit ramps to excavated areas" at MM 4.4-15. But MM 4.4-15 concerns wetlands and waters, whereas 4.4-13 concerns additional measures to avoid adverse impacts to species, such as speed limits and covering open trenches. This drafting error should be corrected.) For example, the CDFW recommends all perimeter fencing be raised 5 to 7 inches above ground level to allow SJKF movement through the Project site and to minimize impacts to SJKF habitat connectivity.[435] MM 4.4-13(h) prescribes perimeter fencing to be 4 inches off the ground—meaning, this fencing would be too short for the SJKF to pass. The USFWS also recommends that new sightings of kit fox shall be reported to the California Natural Diversity Database.[436] The County should amend its mitigation measures to take into account these expert agency recommendations.

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[429] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[430] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 154.
[431] Bremner-Harrison, S. et al., *Feasibility and Strategies for Translocating San Joaquin Kit Foxes to Vacant or Restored Habitats* (2007), https://esrp.csustan.edu/publications/pdf/esrp_2007_kitfoxreloction_w.pdf.
[432] See *id.* at 3-7.
[433] See, e.g., FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 4 (2011), https://www.fws.gov/sites/default/files/documents/survey-protocols-for-the-san-joaquin-kit-fox.pdf (emphasizing that "Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the Service" and that if "at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described [therein] should be resumed").
[434] *Id.* at 4 (2011).
[435] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[436] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.

c. Giant Kangaroo Rat, Tipton Kangaroo Rat, Short-Nosed Kangaroo Rat, and San Joaquin Antelope Squirrel

As an initial matter, the Draft EIR must correct its omission of the Tipton Kangaroo Rat from the Draft EIR. According to CDFW, the Giant Kangaroo Rat (GKR), Tipton Kangaroo Rat (TKR), and Short-Nosed Kangaroo Rat (SNKR) "have been documented to occur near the Project site (CDFW 2022), and the Project Area supports some of the best GKR habitat present in the Elk Hills oil field."[437] It is unclear why the Draft EIR's list of Special Status Animal Species that could occur onsite fails entirely to include the TKR.[438] This omission must be corrected, not just in the table but in the surveys of species at the site, analysis of impacts, and biological resources mitigation measures.

Regarding surveys, the CDFW recommended trapping surveys for the GKR, TKR, and SNKR, to be conducted according to trapping plans developed in consultation with CDFW.[439] CDFW further recommended that these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities.[440] Once completed, they requested that all survey results be sent to CDFW.[441] Without explanation or evidence to explain why it would not have to conduct such surveys (including for the TKR), the Draft EIR does not take up any of these recommendations. Relatedly, the CDFW recommended seeking ITPs upon detection of any of the protected rat species; it does not appear the Project has done this.[442]

While the Draft EIR's 50-food den buffer aligns with the CDFW recommendation,[443] the mitigation measures ignore the CDFW's caution that buffers may not be sufficient to ensure that the species can "freely disperse to and from burrows."[444] Inhibiting the movement of these protected species could be considered "capture" and/or result in prohibited species take.[445] To address this, the CDFW recommended that no burrow be surrounded more than 180 degrees around by development activities.[446] The Draft EIR ignores this recommendation without explanation or evidence. The mitigation measures should adopt this 180-degree protection in addition to buffers around rodent dens.

The issues above are similar with the San Joaquin antelope squirrel (SJAS), which is known to occur throughout the Elk Hills oil field.[447] Like the rat species, the CDFW

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[437] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154; *see also* Draft EIR, Vol. 1 at 4.4-38 (noting that the USFWS published a recovery plan for species in the San Joaquin Valley, including the TKR, identifying it as a "keystone" species).
[438] Draft EIR, Vol. 1 at Table 4.4-4.
[439] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[440] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[441] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[442] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154–55 (stating that "the existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").
[443] Draft EIR, Vol. 1 at Table 4.4-6.
[444] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[445] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[446] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[447] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 156.

recommended that no SJAS burrow be surrounded more than 180 degrees around by development activities.[448] The Draft EIR fails to adopt this measure and fails to offer explanation or evidence that omitting this protection would somehow avoid capture and/or take. The CDFW also informed the County of the need for a separate ITP permit for SJAS take.[449]

d. Swainson's Hawk

Swainson's hawks have been documented to occur in the areas bordering the Elk Hills oil field, and the habitat type present provides suitable foraging and nesting habitat.[450] Despite this, the Draft EIR lacks any mitigation measures specific to the species.

The CDFW recommended specifically for the Swainson's hawk that, upon discovery of an active nest, a minimum half-mile buffer be delineated and that such a buffer be maintained until the breeding season ends or a qualified biologist determines the birds have fledged.[451] Instead, MM 4.4-8 (which broadly covers all bird nests) provides that if a nest is detected, it will be continuously surveyed for 24 hours to establish behavior baseline prior to construction; then continuously monitored to detect any behavioral changes. Monitoring of a nest falls short of an immediate buffer and the Draft EIR does not provide evidence that simple monitoring will be sufficient to reduce adverse impacts to the species. Further, the Measure does not clarify who will do the 24-hour monitoring or the continuous behavioral monitoring; at the very least this must be a qualified biologist selected by the County.

The Draft EIR also entirely fails to address the loss of Swainson's hawk foraging habitat and tree removal, two concerns CDFW raised during the scoping period.[452] The CDFW provided reasoned and supported recommended mitigations to address these concerns that must be incorporated into the Draft EIR.

e. Burrowing Owl

Burrowing owls have been documented in the Project vicinity, per CDFW.[453] The Project has the "potential to significantly impact local [] populations" and, and as described in CDFW's "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), "excluding and/or evicting [burrowing owls] from their burrows is considered a potentially significant impact under CEQA."[454]

The CDFW's Staff Report is clear that Project-specific CEQA mitigation is important for burrowing owls and unless otherwise provided in a state, local, or regional conservation strategy, mitigation measures must incorporate the following four principles: 1) use of the precautionary principle; 2) use of mitigation effectiveness monitoring and reporting, as well as adaptive management; 3) protect and conserve owls in wild, semi-natural, and agricultural habitats; and 4)

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[448] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 156.
[449] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 157.
[450] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 157.
[451] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 158.
[452] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 158.
[453] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.
[454] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.

protect and conserve natural nest burrows or surrogates.[455] The Staff Report then lists best practices for mitigation measures grounded in scientific literature.[456] These include, broadly, avoidance, pre-construction surveys, site surveillance, and buffer zones.[457]

The Draft EIR does not take the CDFW's scoping comment or Staff Report fully into account, leaving its burrowing owl mitigations insufficient to reduce adverse impacts and unsupported by any evidence.

First, accurate surveys to detect burrowing owl presence is key, and CDFW suggested during the scoping period that the Project conduct "three or more surveillance surveys" with each visit occurring at least three weeks apart during peak breeding season (April 15 to July 15).[458] Mitigation Measure 4.4-1 provides only that "any required focused/protocol surveys shall be conducted . . . with protocol survey timelines." The Draft EIR does not address the guideline for three or more surveillance surveys for owls, nor does it contain evidence or an explanation for why this approach would not be taken.

Second, MM 4.4-4 provides that burrowing owls present in the Project area or within 500 feet outside the breeding season "may be moved away . . . using passive relocation techniques." While this measure pledges to follow CDFW guidelines, the Draft EIR fails to acknowledge that according to the CDFW, "excluding birds from burrows is not a take avoidance, minimization, or mitigation method and is instead considered a potentially significant impact under CEQA."[459] The Draft EIR must therefore acknowledge that displacing owls is an impact and analyze it as such. Should MM 4.4-4 maintain the approach of displacing owls, it must also incorporate the CDFW's guideline that burrow exclusion be conducted only by qualified biologists and only during the non-breeding season, and that occupied burrows be replaced with artificial ones at a ratio of 1:1.[460]

Finally, there is no logical connection between the full suite of impacts to burrowing owls named in the Draft EIR and the mitigation measures named. The Draft EIR acknowledges that "[n]oise, vibration, and increased human activity" from construction "could alter the daily behaviors of individual owls and affect foraging success, displace owls from their burrows, or lead to nest failure."[461] The Draft EIR then claims MMs 4.4-1, -3, -4, -11, and -13 "would reduce impacts,"[462] but these Measures on their face do not fully address the impacts. MM 4.4-1 concerns surveys, MMs 4.4-3 and -4 address buffers and owl nest exclusion, MM 4.4-11 describes worker education, and MM 4.4-13 lists additional measures such as trash and dust control. The Measures listed are a start, but the Draft EIR does not fully connect how they will

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[455] CDFW, *Staff Report on Burrowing Owl Mitigation, State of California* (March 7, 2012) at 3–4, https://www.sandiegocounty.gov/content/dam/sdc/pds/ceqa/JVR/AdminRecord/IBR/RTCReferences/3a%20CDFG%202012_Staff%20Reports%20on%20Burrowing%20Owl%20Mitigation.pdf.
[456] *Id.* at 8.
[457] *Id.* at 8–10.
[458] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.
[459] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 161 (citing the CDFW Staff Report).
[460] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 161.
[461] Draft EIR, Vol. 1 at 4.4-46.
[462] Draft EIR, Vol. 1 at 4.4-46.

address noise, vibration, and other impacts that could alter the daily behaviors of owls; the impacts are therefore left unmitigated.

f. Nocturnal Species

There are six protected nocturnal species in the Project area,[463] but the mitigation measures fail to adequately reduce impacts to these species (and other species) from the array of nighttime Project activities expected to occur.

As an initial matter, the Biological Resources section acknowledges that construction could occur at night and therefore require lighting that may affect diurnal and nocturnal wildlife.[464] But elsewhere in the document, the Draft EIR states that nighttime Project activities could include "drilling activities, vehicle and equipment activities supporting drilling, and safety and security lighting for areas, such as construction yards, work areas, vehicle and equipment parking areas, and staging and laydown areas,"[465] and that Class VI well drilling "typically run[s] continuously, 24 hours a day" for "up to 60 days."[466] The full range of nighttime activities mentioned in other parts of the Draft EIR must be incorporated, analyzed, and mitigated in the Biological Resources section.

Perhaps because of this disconnect, the only nighttime-related mitigation measure for species merely directs use of "directing lighting" and compliance "with applicable lighting mitigation measures."[467] Nighttime lighting is harmful to nocturnal species, but lighting is far from the only impact of nighttime construction and other activities that needs to be mitigated. (Moreover, the lighting mitigation is far too vague to be evaluated or measured and must be revised to include specifics and information about enforcement.) For example, the San Joaquin kit foxes "are known to sometimes rest and play near the den entrance in the afternoon, but most above-ground activities begin near sunset and continue sporadically throughout the night."[468] Accordingly, for that species, the U.S. Fish and Wildlife Service recommends that "[n]ight-time construction should be minimized" and if it does occur, "then the speed limit should be reduced to 10-mph" and "[o]ff-road traffic outside of designated project areas should be prohibited."[469]

The County must therefore develop mitigation measures to address the full array of impacts to nocturnal species from activities such as traffic, noise, vibrations, and continuous

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[463] The species are the California glossy snake, Draft EIR, Vol. 1 at 4.4-44, 4.4-18; the giant kangaroo rat, *id.* at 4.4-22 (noting that "suitable burrows with diagnostic signs of kangaroo rat were observed" during surveys); the short-nosed kangaroo rat, *id.* at 4.4-22; the San Joaquin pocket mouse, *id.* at 4.4-22; the American badger, *id.* at 4.4-23 (noting that "dens displaying signs consistent with the use of a badger were observed" in the Project area); and the San Joaquin kit fox, *id.* at 4.4-23.
[464] Draft EIR, Vol. 1 at 4.4-40.
[465] Draft EIR, Vol. 1 at 4.1-24.
[466] Draft EIR, Vol. 1 at 4.1-25.
[467] Draft EIR, Vol. 1 at 4.4-13.
[468] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 3.
[469] *Id.* at 5.

drilling. The County must also develop measures to address impacts to daytime species whose rest and other behaviors might be disrupted by nighttime disturbances and continuous drilling.

g. Worker Environmental Awareness Program

Mitigation Measure 4.4-11 to create a Worker Environmental Awareness Program is a good start but, as written, falls short of the County's legal requirements and could benefit from adopting recommendations by other agencies.

For one, the Draft EIR defers development of the program, stating only in MM 4.4-11 that it "shall be developed." As noted earlier in this comment section, the County cannot defer development of a mitigation measure and instead must provide specifics prior to finalizing the Draft EIR. A worker educational program is not the type of mitigation that requires further data or inputs from operations to prescribe measures, nor is it impractical or infeasible to devise the specifics of such a program now.[470]

One template the County could consider comes from the USFWS regarding the SJKF. They recommend an employee education program that does the following:

> The program should consist of a brief presentation by persons knowledgeable in kit fox biology and legislative protection to explain endangered species concerns to contractors, their employees, and military and/or agency personnel involved in the project. The program should include the following: A description of the San Joaquin kit fox and its habitat needs; a report of the occurrence of kit fox in the project area; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of measures being taken to reduce impacts to the species during project construction and implementation. A fact sheet conveying this information should be prepared for distribution to the previously referenced people and anyone else who may enter the project site.[471]

This type of thorough education is appropriate for all protected species that are or could occur at the Project site. These materials must be developed and shared with the public and decisionmakers prior to finalizing and certifying the Draft EIR.

Similarly, MM 4.4-12 provides that "wildlife found that might have been affected by exposure to CO_2 shall immediately cause a shutdown of all injection operations." This measure is important and should therefore be incorporated into the Worker Environmental Awareness Program, along with other information about exactly *how* to identify wildlife suffering symptoms of CO_2 exposure.

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[470] See, e.g., *Defend the Bay v. City of Irvine* (2004) 119 Cal.App.4th 1261, 1275; *Preserve Wild Santee, supra,* 210 Cal.App.4th at 281; CEQA Guidelines, § 15126.4(a)(1)(B).

[471] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.

h. Cumulative Impacts and Mitigations

The Draft EIR concludes that "the cumulative impacts of the project when combined with other known and unknown projects, would be significant and unavoidable" for biological resources.[472] The Draft EIR then offers no additional mitigation measures beyond the ones proposed to address direct impacts.[473]

The Draft EIR opts not to independently consider and evaluate potential cumulative impacts to biological resources because of the *Final Environmental Impact Report - Revisions to the Kern County Zoning Ordinance - 2015(C) Focused on Oil and Gas Local Permitting*, referred to in the EIR as the Oil and Gas EIR.[474] The relationship to this Draft EIR is somewhat opaque. The County uses the Oil and Gas EIR "as a source of information regarding cumulative impacts," but supposedly "does not rely" on it "for purposes of tiered review under CEQA."[475] By way of further explanation, the Oil and Gas EIR's information "provide [sic] evidence for the record of the analysis of cumulative impacts" for activities included in the Project, meaning it offers "facts and evidence for the record" on the oil field's biological resources.[476]

We agree that CEQA Guidelines section 15152 guides whether the County can tier to a previous analysis, but the County's supposed use but non-reliance on the Oil and Gas EIR is unconvincing. Per the Guidelines, "tiering" is defined as "using the analysis of general matters contained in a broader EIR" with later EIRs, incorporating by reference the general discussions from the broader EIR, and concentrating the later EIR solely on the issues specific to the later project.[477] This definition of tiering describes how the County is using the Oil and Gas EIR for this Project—meaning, the County is tiering to the challenged EIR, even if it claims not to be.

The County should not be tiering to the Oil and Gas EIR given its status in litigation. The Oil and Gas EIR "is subject to a pending court challenge."[478] This alone should prohibit the County from using the challenged EIR as a source of information. The Draft EIR, however, attempts to carve out the cumulative impacts section of the Oil and Gas EIR to use here because that section is not directly challenged in the lawsuit.[479] Such a tightrope walk is unsupported. In the court challenge, the direct impacts (such as to air, water, and biological resources) are at issue; if the court orders a remedy on those direct impacts, the cumulative impacts analysis would also have to change.[480] This casts the entire analysis of impacts (direct and cumulative) of the EIR into doubt, and the current Draft EIR should instead conduct its own cumulative impacts analysis rather than attempt to rely on a disputed and stale one.

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[472] Draft EIR, Vol. 1 at 4.4-66.
[473] Draft EIR, Vol. 1 at 4.4-66.
[474] Draft EIR, Vol. 1 at 4.4-65.
[475] Draft EIR, Vol. 1 at 4.4-65 (citing CEQA Guidelines, § 15152).
[476] Draft EIR, Vol. 1 at 4.4-65
[477] CEQA Guidelines, § 15152(a).
[478] Draft EIR, Vol. 1 at 4.4.-64.
[479] Draft EIR, Vol. 1 at 4.4.-64.
[480] CEQA Guidelines, § 15130(a)(1) (defining cumulative impact as "the combination of the project evaluated in the EIR together with other projects causing related impacts").

6. The Draft EIR's reliance on a prior conservation easement deed for Endangered Species Act coverage is improper.

It is unclear to what extent Kern County proposes to rely on previously issued plans for Endangered Species Act coverage for the Project, but reliance on existing coverage through take permits is improper. As the Draft EIR recognizes, unauthorized take of species is unlawful, and the County must have an ITP to cover any species take.[481] Yet the Draft EIR claims that California Resources Corporation has an ITP from 2012, pointing to Appendix C.2. The Draft EIR also references an "Elk Hills Habitat Conservation Plan" but does not provide the plan anywhere in the appendices.[482]

The Draft EIR's discussion of ITP coverage is problematic for several reasons. First, the document provided in Appendix C.2 is not an ITP or Habitat Conservation Plan—it is a conservation easement deed for conservation areas that largely do not overlap with the Project site.[483] The document mentions only a small number of the potentially impacted protected species.[484] And the document mentions "certain impacts of oil and gas production facilities and activities at the Elk Hills oil field," which would not encompass the CO_2 capture, compression, transportation and injection activities of this Project.[485] Although the Center for Biological Diversity is aware that a previous oil field operator prepared a Habitat Conservation Plan in 2009 as part of an ITP application necessary to extend a prior permit beyond 2014 and authorize incidental take of species associated with continued oil and gas production activities,[486] there is no publicly available information indicating that plan was finalized.[487]

The Center for Biological Diversity requested from Kern County an ITP noted in other Elk Hills oil field drilling approval documents.[488] The Center received a document in response, ITP number 2081-2014-019-04, issued to California Resources Corporation Elk Hills, LLC. We are including it with our comment submission since this permit must be part of the administrative record.

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[481] Draft EIR, Vol. 1 at 4.4-23 (take requires an ITP issued under section 2081 or a finding that an ITP issued under the federal Endangered Species Act is consistent with state requirements); *id.* at 4.4-25 (section 10 of the federal Endangered Species Act allows a permit applicant to obtain an ITP through submission of a habitat conservation plan); see also MM 4.4-2 (stating that there may be no incidental take of any protected species without a permit or approved conservation plan).

[482] Draft EIR, Vol. 1 at 4.4-36.

[483] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area at 1721 *et seq.*; Draft EIR, Vol. 2, App'x C.3: Conservation Easement Deed – Elk Hills Conservation Area Map at 1741 *et seq.*

[484] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area; Draft EIR, Vol. 1 at 4.4-36.

[485] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area.

[486] 71 Fed. Reg. 6883.

[487] See 78 Fed. Reg. 39836.

[488] Letter from Center for Biological Diversity to Kern County Planning & Natural Resources Department, *Elk Hills Oilfield Incidental Take Permit* (Jan. 16, 2024); CalGEM, *Notice of Determination, NOD-OG California Resources 072022-201-1* (Aug. 25, 2022).

Second, the ITP does not sufficiently include the CTV I Project as a Covered Activity. The ITP explains that the activities covered involve "continued oil and gas related activities and the exploration and development of new wells necessary to enhance recovery and processing of oil and gas reserves."[489] The CTV I Project, in contrast, proposes to capture CO_2 from existing oil field operations, but also "is dependent on the sources permitted for injection into the storage, the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[490] As noted earlier in this comment letter, additional sources of CO_2 could include DAC, hydrogen, and waste to energy facilities. Moreover, CO_2 compressors, pipelines, injection wells, and other infrastructure are fundamentally different from oil and gas counterparts.

Third, and relatedly, the existing ITP covers only four species—the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and Tipton kangaroo rat—not the full range of species that could suffer take from the CTV I Project.[491] Even the CDFW—the state's authoritative agency on this issue—reiterated throughout its comment during the Scoping Phase that the existing ITP is insufficient to cover the Project's impacts on protected species.[492] The CDFW issued its opinion based not only on species that the ITP fails to cover, but the deficiency of the existing ITP to address impacts to the four covered species.[493]

It should also be noted that while the current ITP covers incidental take of the Tipton Kangaroo Rat resulting from oil and gas production, the Draft EIR arbitrarily excludes this species from surveys and consideration of mitigation measures.[494] CRC must therefore obtain a new ITP to cover *all* activities that could result in take of protected species flagged as occurring or potentially occurring in the Project Area. Obtaining ITP(s) covering CTV I Project activities and other species must occur before any construction begins to avoid unlawful take. The County must therefore revise MM 4.4-2, which provides only that if CRC "elects in the future to pursue any disturbance . . . that requires additional take authorization," the Project would obtain a new ITP. [495] The Draft EIR must then be revised to analyze and account for the new ITP.

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[489] CDFW, ITP No. 2081-2014-019-04, Elk Hills Oil and Gas Field at 2–3 (hereinafter, "ITP Permit 2081"); see also *id.* at 6–10 (listing covered activities and not including CCS).
[490] Draft EIR, Vol. 1 at 4.8-24.
[491] ITP Permit 2081 at 11 ("These species and only these species are the 'Covered Species' for the purposes of this ITP.").
[492] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 146–65; see also section VI.G, *supra* (noting instances in which the ITP does not cover protected species for the activities proposed).
[493] See, e.g., Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154 (noting that the Project warrants consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities and for this species, the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").
[494] See Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1701; see also section VI.G, *supra* (discussing exclusion of the Tipton kangaroo rat in the Draft EIR).
[495] Draft EIR, Vol. 1 at 4.4-64 (emphasis added).

H. The Draft EIR Fails to Analyze and Mitigate Cumulatively Considerable Impacts.

Under CEQA, an EIR must discuss significant "cumulative impacts."[496] Cumulative impacts are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts."[497] A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable future projects with impacts that might compound or interrelate with those of the project at hand.[498] Such analysis is necessary because "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[499] As is the case for all impact categories, a lead agency's threshold findings of significance with regard to cumulative impacts must "be supported by substantial evidence"; and, where found, cumulatively considerable impacts must be adequately mitigated.[500]

"[M]ere awareness of proposed expansion plans or other proposed development does not necessarily require the inclusion of those proposed projects in the EIR. Rather, these proposed projects must become 'probable future projects.' (CEQA Guidelines, § 15130(b)(1)(A).)"[501] "'[P]robable future projects' can be interpreted as reasonably probable future projects . . . [P]rojects that are undergoing environmental review are reasonably probable future projects. [Citation.] We conclude that any future project where the applicant has devoted significant time and financial resources to prepare for any regulatory review should be considered as probable future projects for the purposes of cumulative impact."[502]

An adequate cumulative impacts analysis and discussion requires a thorough assessment of the incremental significance of the CTV I Project's impacts over time, and in consideration of "other projects causing related impacts."[503] The Draft EIR concludes that the CTV I Project will cause potentially significant impacts for a number of impact areas, including, but not limited to, air quality, biological resources, energy, geology and soils, and GHG. For some impact areas, including air quality, biological resources, and GHG, the Draft EIR concludes the impact will be significant and unavoidable.[504] However, the Draft EIR fails to conduct an appropriate cumulative impacts analysis and support its conclusion with evidence, because it fails to consider the full range of projects that are required in a cumulative impact analysis.

The most crucial aspect of cumulative impact analysis of a carbon sequestration project is the project's sources of CO_2. An analysis of these sources is necessary not only to understand the impact of their operation together with the CTV I Project, but also in order to give the public a

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[496] CEQA Guidelines, § 15130(a).
[497] CEQA Guidelines, § 15355(b).
[498] Pub. Resources Code, § 21083(b)(2); CEQA Guidelines, § 15065(a)(3).
[499] *Communities for a Better Environment, supra*, 103 Cal.App.4th at 114.
[500] See CEQA Guidelines, § 15064.7(b).
[501] *Gray, supra,* 167 Cal. App. 4th 1099 at 1127–28.
[502] *Id.* at 1127–28.
[503] CEQA Guidelines, § 15130(a)(1).
[504] Draft EIR, Vol. 1 at 5-3 to 5-5.

picture of whether the CTV I will facilitate and incentivize new GHG emissions, rather than reducing existing ones, and whether it will extend the life of existing fossil fuel CO_2-emitting industries. The cumulative analysis fails to include any meaningful discussion of the Project's CO_2 sources.

As described above, the project description section of the Draft EIR lists under "Cumulative Projects" several projects in the County, and provides nothing more than the name, location, type, acreage, and status of these projects.[505] In doing so, the Draft EIR ignores projects that are clearly "probable future projects" and must be analyzed in a proper cumulative impacts analysis. These projects include, at a minimum:

1. Lone Cypress Blue Hydrogen plant

The Draft EIR describes this project as a "Blue Hydrogen project" located at Elk Hills and Skyline Road and classifies the project status as "EIR in Process". It does not include any other information or analysis of its potential cumulative impacts.

Yet documents show that the project's application was deemed complete by Kern County in September 2023,[506] and a draft Notice of Preparation was already prepared for it in December 2023;[507] thus, and as the Draft EIR concedes, this project is already undergoing environmental review.

A Carbon Dioxide Management Agreement (CDMA) for the Lone Cypress Project was entered into by CRC's Carbon TerraVault JV Holdco on December 2022.[508] Moreover, CTV has announced that it is a direct partner in that project, noting in a media release that "the CTV JV has the right to take a majority equity stake in the project, as well as to provide sequestration services for all subsequent Lone Cypress hydrogen projects in California"[509] These facts, together with the fact the project is co-located in the Elk Hills oil field as the CTV I Project, make the Lone Cypress Project a clear "probable future project" that must be analyzed in the cumulative impacts analysis.

2. Golden State Hydrogen plant

The Golden State Hydrogen project, some 60 miles north of the CTV I Project, was approved on January 30, 2024, when the Tulare County Board of Supervisors issued a Notice of Exemption.[510] As discussed above, the plant operating statement contemplates sending its

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[505] Draft EIR, Vol. 1 at 3-43 (Table 3-8).
[506] PLN23-00800 Project Meeting, Email from Jamal Ferguson, Kern County, to Greg Brooks, *supra.*
[507] Notice of Preparation/Initial study, Elk Hills Blue Hydrogen by Lone Cypress Energy Services, LLC (Dec. 2023).
[508] CRC, *Lone Cypress CDMA*, https://www.crc.com/carbon-terravault/projects/lone-cypress-cdma/default.aspx (last accessed Feb. 28, 2024).
[509] CRC, *California Resources Corporation Announces Carbon Dioxide Management Agreement For CTV's First Permanent Carbon Storage Project* (Dec. 7, 2022), https://www.crc.com/news/news-details/2022/California-Resources-Corporation-Announces-Carbon-Dioxide-Management-Agreement-For-CTVs-First-Permanent-Carbon-Storage-Project/.
[510] Notice of Exemption No.., CEQ 23-013 - Golden State Hydrogen Plant Pixley, *supra.*

liquified CO_2 for sequestration at the CTV I Project.[511] The Draft EIR fails to even mention this project, and as discussed above, except for an obscure mention of truck travel in the project description section, fails to discuss or analyze any impact of trucking CO_2 into the Project.

This project is clearly a "probable future project," as it is now beyond the environmental review stage. Because this project was approved using a CEQA exemption, it did not go through any meaningful environmental analysis, which makes a proper cumulative impact analysis even more crucial.

3. Projects with a CDMA for carbon sequestration at CTV I

As discussed above, the CTV I Project is dependent on CO_2-sending industries. Therefore, the most significant aspect of cumulative analysis for the Project is the facilities that will send their CO_2 for sequestration. According to CRC's website, a number of Carbon Dioxide Management Agreements (CDMAs) were already entered into with multiple corporations. All the projects that have entered into a CDMA should be included in the cumulative impact analysis.

These projects include, at a minimum: a new renewable dimethyl ether (rDME) production facility by InEnTec, Inc. (CDMA from May 2023), a renewable gasoline plant by Verde Clean Fuels (CDMA from July 2023), and a waste-to-energy production facility by NLC Energy (CDMA from November 2023). All these projects are planned to be co-located at Elk Hills.[512] Moreover, and importantly, several of these projects contemplate CRC, CTV, or affiliated companies possessing an "equity stake" in the CO_2-sending facilities.[513] As the Project proponent has noted publicly, these projects "play an important role within Carbon TerraVault's strategy" in developing the Project.[514]

The result of the Draft EIR's failure to properly account for cumulative projects is that the Draft EIR's cumulative analysis is deeply flawed. Once an agency has a set of projected projects, CEQA requires it to include a summary of the environmental impacts expected to be

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[511] Operating Statement – Golden State Hydrogen Plant Project, *supra*, at 9.
[512] CRC, *Carbon TerraVault Vaults*.
[513] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* ("CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake"); CRC, *Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA* (May 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Announces-Two-New-Storage-Only-Carbon-Dioxide-Management-Agreements-and-Submission-of-Another-Class-VI-Permit-to-the-EPA/default.aspx ("CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake").
[514] CRC, *Carbon TerraVault Provides Third Quarter 2023 Update* (Nov. 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Provides-Third-Quarter-2023-Update/default.aspx ("This project highlights the value proposition of our CTV Clean Energy Park and its important role within Carbon TerraVault's strategy," said Francisco Leon, CRC's President and Chief Executive Officer. "We welcome NLCE as a trusted partner in developing and furthering California's decarbonization efforts and supporting Kern county's ambitions to become the leading carbon sequestration area in the state.").

produced by those projects and an analysis of whether the impacts are cumulatively considerable.[515]

The description and analysis of cumulative impacts should reflect their severity and the likelihood of their occurrence.[516] While this analysis does not have to go into the same details as the primary analysis of the pProject's impacts, it still must be reasonable and show a good faith effort to disclose the impact.[517] As described under each impact area section in these comments, the Draft EIR does not provide any meaningful analysis of the cumulative impacts of the projects, and ignores even the projects it lists as cumulative projects in Table 3-8.

The Draft EIR must be revised to include an adequate cumulative impacts analysis that includes all the projects it lists as cumulative projects, and all the probable future projects discussed above.

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For the reasons set forth above, we urge the County to re-do its analysis, prepare and circulate a revised Draft EIR, and, ultimately, reject the CTV I Project.

We reserve the right to identify new issues, provide additional information, and propose additional mitigation measures during the County's ongoing decisionmaking process for the CTV I Project.

If you have any questions about the foregoing comments, you may reach out to any of us directly or contact the Earthjustice contacts listed below, who helped prepare this submission.

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[515] CEQA Guidelines, § 15065(a)(3).
[516] CEQA Guidelines, §15130(b); *City of Long Beach v. Los Angeles Unified Sch. Dist.* (2009) 176 Cal.App.4th 889.
[517] *Citizens for Open Gov't v. City of Lodi* (2012) 205 Cal.App.4th 296, 320.

Respectfully submitted,

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ATTACHMENT A

Comment on the Air Quality and Greenhouse Gas (GHG) Analysis Provided in the Draft Environmental Impact Report (SCH# 2022030180) for the Carbon TerraVault 1 (CTV1) Project in Kern County, California Proposed by California Resources Corporation, December 2023

by

Dr. Ranajit (Ron) Sahu[1]

I provide the following technical comments based on my review of the air quality and GHG analyses provided for the proposed CTV1 project in the DEIR. The lead agency for the EIR is Kern County's Planning and Natural Resources Department (Mr. Keith Alvidrez).

The figure below, taken from the DEIR shows the two dis-jointed parcels (at the surface) where the proposed project will be implemented.

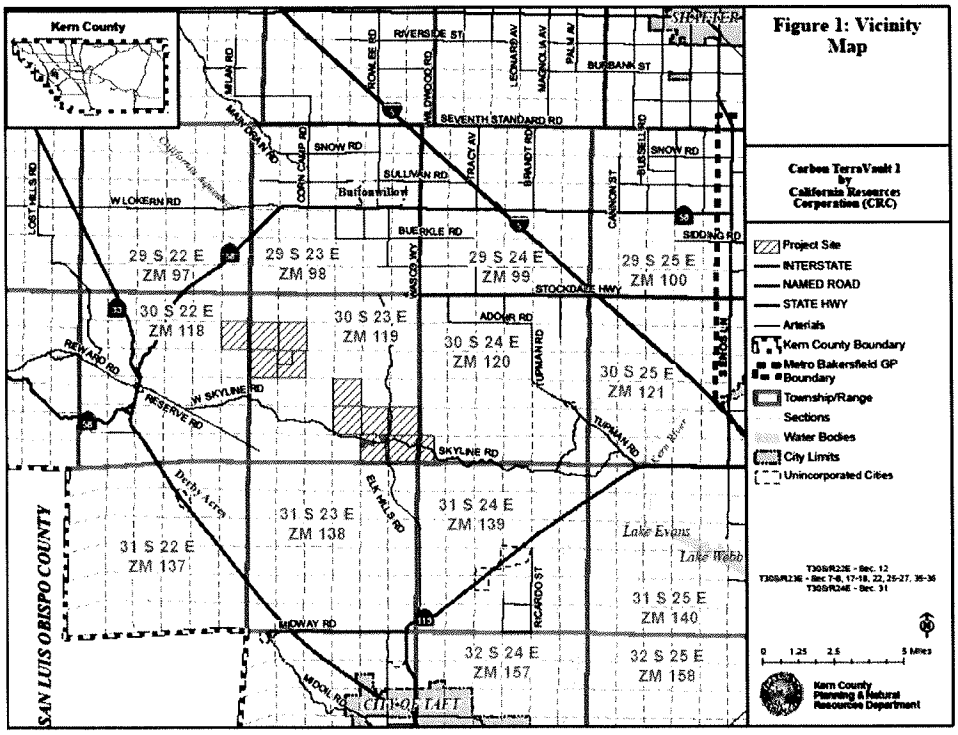

Figure 1: Regional Vicinity Map

[1] Resume provided in Attachment A.

My comments are based on information provided in the body of the DEIR (in Volume 1) and Appendix B (in Volume 2, specifically the report prepared by Trinity Consultants[2]) which contains the supporting information on the air quality and GHG analyses. My comments point out the deficiencies in the analysis, including the lack of support or rationale for critical inputs which should be addressed. Given the lack of publicly available information on the proposed project, I am unable to provide an independent, alternate set of analyses and results.

Comment 0 – Inconsistent Description of the Proposed Project

Page 1-1 (Introduction) and page 3-1 (Project Description) of the DEIR state:

> The Carbon TerraVault I (Kern County) Project (CTV I) proposed by California Resources Corporation (CRC, or project proponent) would request the approval of multiple Conditional Use Permits (CUPs)...for the construction and operation of an approximately 9,130-acre carbon capture and storage (CCS) facility with related capture facilities and pipeline for the initial source and request associated Zone Change Case (ZCC) No. 5, Map 119 and ZCC No. 4, Map 120 from A-1 (Limited Agriculture) to A (Exclusive Agriculture) on approximately 6,160 acres."[3]

Appendix B.1 of the DEIR states that:

> "...[T]he Project will involve a 5,332-acre carbon capture and sequestration field, associated sequestration injection wells and related improvements for storage of Carbon Dioxide (CO_2)."[4]

Yet, later in the same document, it states that:

> "[T]he Carbon TerraVault 1 Carbon Capture and Sequestration Project is consideration of the approval of multiple Conditional Use Permits (CUP) (CUP No. 13, Map no. 118, CUP No. 5, Map 119, CUP No. 3, Map 120) and related changes in zoning designations (ZCC No.5, Map No.118, ZCC No. 5, Map 119, ZCC No. 4, Map 120 for the construction and operation of a 7,385.67 acre carbon capture and storage (CCS) facility, with associated Class VI Underground Injection Control (UIC) wells, 13 miles of facility pipeline for capture from the pre-combustion gas and related infrastructure improvements for the capture, transfer, and storage of CO_2."[5]

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[2] DEIR, Appendix B.1. Air Quality Impact Analysis, May 2023 (revised November 2023), prepared by Trinity Consultants.

[3] DEIR, pages 1-1, 3-1.

[4] DEIR, Appendix B.1, p. 1-1. (emphasis added)

[5] DEIR, Appendix B.1, Section 2.2. (emphasis added)

Please clarify the discrepancies between the three very different acreages noted above.

Comment 1 – Missing Details and Energy/Air Quality Impacts of the Carbon Capture System

The DEIR contains no engineering information about specific design and/or details regarding the operations of the carbon capture (CC) system that is/will be implemented at the Elk Hills power plant or at the existing cryogenic and fractionation natural gas plant (CGP-1) facility (or any other sources of GHG) before those emissions are then managed, ultimately being injected into geologic formations for sequestration.

As an example, while CC systems naturally involve additional equipment such a blowers and ductwork, which incur energy penalties in order to operate, the DEIR does not provide the details supporting the approximately 31 MW per year[6] of energy it estimates that will be needed to operate the CC facilities and associated equipment.

In addition, while the DEIR notes that the energy/power needed to operate the CC facilities would be sourced from the Elk Hills Power Plant, it does not discuss how this additional power generation will change the load factor and other operating characteristics of the power plant. The DEIR, in summary fashion at Appendix B.1, simply states that "...[T]he Elk Hills Power Plant provides about one third of its power to the oilfield for operations and the remainder is distributed to the California power grid via the Pacific Gas and Electric (PG&E) substation in Buttonwillow." It does not discuss how the additional power/energy needed by the proposed CC facilities would be accommodated by the Elk Hills power plant. I note that the DEIR simply assumes that the power plant will continue to operate at an annual (and constant) capacity factor of 93%[7] for every single year of the 30 year duration of the proposed project. The justification for this capacity factor and whether or not it includes the additional energy needed for the CC system is not clear. That should be clarified.

In addition, given that the expected duration of the proposed project is 30+ years, it is presumed that the Elk Hills Power Plant will need to operate for the next three decades to support the project, whether or not the plant would have continued to run for all this additional time into the future without the project. As it stands, the Elk Hills Power Plant is approximately 20 years old already. So, that means the proposed project would require the power plant to operate till it is 50+ years old. Without significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project. The DEIR

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[6] DEIR, p. 4.6-15.

[7] DEIR, Appendix B, tables on pdf pages 310-311.

should address whether or not the proposed project enables the life extension of the Elk Hills power plant and the impacts of any such extension.

Comment 2 – Cursory and Missing Aspects of GHG Leakage

There is little to no detail on the leakage of GHGs, including but not limited to the various types of potential leakage of CO_2 from different aspects of the entire project.

While the DEIR makes a gross assumption that the GHG capture will be 95%,[8] it is not clear if, therefore, the remaining 5% uncaptured GHG is presumed to be an annual leakage level for the duration of the project. If so, what specifically is included in this 5% leakage is not discussed. That should be clarified.

It appears however, that, at best, this uncaptured GHG might include losses during capture of the power plant's exhaust as well as certain fugitive losses in processing the exhaust waste gases containing GHG to and through the amine system, followed by its conveyance to the injection wells. Importantly, three additional potential loss mechanisms and their GHG losses (and associated leakage) do not appear to have been addressed or quantified:

(i) GHG losses associated with ruptures or failures of the additional new pipelines or pipeline components proposed as part of the project. Given the large geographic extent of CTV1, including the gathering and injection infrastructure and given the assumed three decades of operation, such failures are quite likely;

(ii) GHG losses associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance. Pipeline maintenance typically requires evacuation of pipeline sections in order to safely effect such maintenance. Such evacuation necessitates "blowdown" of the gas contained in the pipeline sections. Unless otherwise gathered or captured – which is not discussed in the DEIR – these events can result in emissions of waste gases, containing GHG and other pollutants to the atmosphere; and

(iii) GHG losses from the geologic formation itself due to the injected GHG/CO_2.[9] While the DEIR generally admits that there could be potentially significant leakage[10], the DEIR does not provide any details including the probabilities of such leakage, the circumstances

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[8] Curiously, in Section 4.11 of Appendix B.1, this 95% capture is at the amine units. Why that is the case is not clear. The DEIR should clarify.

[9] DEIR, Appendix B.1, Section 2.2 notes that annually 1.5 million metric tons of CO_2 will be injected, with an overall total project injection of 48 million metric tons. This is roughly a 32 year time period.

[10] For example, DEIR at p. 4.8-26.

under which such leakage may occur, or any quantification of the leakage.

The DEIR does include a few monitoring wells but the logic of their placement (including depths) in the various locations and how just the small number of proposed monitoring wells will provide enough assurance that GHG once injected will not migrated from the intended injected formation, is not provided and is not supported by evidence. This un-sequestered GHG migration may not just be towards the surface (i.e., vertically upwards) but also laterally and even downwards from the formation, eventually manifesting themselves as leakage to the surface. While the timing of this subsurface leakage mechanisms may not occur just during the presumed thirty or so year project period (and its GHG accounting of the benefits of sequestration), that does not mean that leakage after (or long after) the thirty or so year time period should simply be assumed to be zero, with little to no support and little to no verification.

* * * * *

The remainder of my comments address specifics about the air quality and GHG analyses presented in the DEIR. For air quality, I focus mainly on the discussion provided in Chapter 4.3 (specifically Sections 4.3.4 and 4.3.5) and Appendix B (specifically Appendix B.1 – the Trinity Consultants report, from which much of the analysis in the body of the DEIR is drawn from), including certain mitigation measured proposed in the DEIR. For GHG, I have reviewed the analysis presented in Section 4.8 of the DEIR and also in Appendix B. I have also reviewed Appendix F in Volume 2 relating to a site-specific risk assessment.

Comment 3 – Air Quality Emissions Estimates

It is crucial that an air quality analysis fully support the assumptions underlying its emissions estimates, as those assumptions and resulting emissions estimates ultimately affect the DEIR's assessment of project impacts and feasible mitigation.

This is true for all types of air pollutants (i.e., criteria pollutants, air toxics or hazardous air pollutants, and GHG) and from all potential emissions generating sources and activities of the proposed project, including both construction and operational phases.

While it is customary in conducting EIR-type air quality analyses to rely on "standard" models to develop emission estimates as has been done in this DEIR,[11] those models typically only have emission factors (i.e., mass of emissions of pollutant X from a source Y – like piece of fuel-burning

[11] DEIR, Section 4.3.4.

equipment, for example). That such standard models have been used in the present instance is confirmed by the DEIR:

> "[T]he construction and operational emissions were estimated from several emissions models and associated spreadsheet calculations, depending on the source type and data availability. The primary emissions models used included CARB's on-road vehicle emission factor model (EMFAC) version 2021 and the California Emissions Estimator Model (CalEEMod) version 2021.1.13." In addition, the DEIR states that "[T]he capture facilities (new amine unit valve) fugitive emissions have been quantified using the California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities..."[12]

The user of the model or the analyst has to input the corresponding activity factor (i.e., how many and what types of equipment, of what sizes, hours of usage, etc.) in order to run the model and obtain estimates of the mass of emissions (i.e., pounds or tons) from those activities over the desired time period (hours, days, weeks, year, etc.).

An accurate analysis and robust evaluation of impacts is especially important here given that the proposed project will be located in an area that is already non-attainment for several criteria pollutants including: ozone (Federal and State); PM_{10} (State); and $PM_{2.5}$ (Federal and State).[13] I should note also that, for $PM_{2.5}$, the EPA has now proposed to make the primary (i.e., health based) annual National Ambient Air Quality Standard (NAAQS) more stringent from its current level of 12 ug/m^3 to a range between 9 – 10 ug/m^3, reflecting the current science on adverse health impacts of this zero-threshold air pollutant.[14] The adoption of the stricter standard means that the air quality in the area is even more unhealthy than understood previously and even further from attaining the health-based NAAQS than acknowledged in the DEIR.

Comment 3.1 – Emission Factors and Errors

I should note for the record that just because the "standard" models incorporate emission factors for various pollutants and for various types of equipment and activities, that does not mean that those emission factors do, in fact, accurately or conservatively represent the emissions of the respective pollutants from specific equipment and specific activities that are part of the project.

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[12] *Id.*

[13] DEIR, Table 4.3-2.

[14] https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot

First, there are issues of representativeness of the emission factors, especially as they apply to not just new equipment but also to older equipment and the inevitable deterioration of their emissions (including deterioration of any air pollution controls) over time. This specifically applies to the emission factors that are included as part of the "standard" models used to develop emission estimates as noted prior.

Second, there are always issues of precision and error in emission factors (and activity factors, which I discuss later) and the resultant emissions estimates. The emissions estimates in the DEIR in many instances provide values to many significant digits (i.e., implying greater – and false – precision than warranted), thereby misleading the reader as to the accuracy of the air quality emissions estimated. The DEIR contains no estimates of the errors in any of the calculations. In fact, a proper analysis should provide some guidance of the error (or the range) of the emissions as opposed to misleadingly precise estimates for the reader. The DEIR fails completely on this score. To meaningfully inform the public and decision makers, the DEIR should quantify and disclose uncertainties in the emissions estimates.

Comment 3.2 – "Existing" Air Quality Information is Dated And May Not Be Representative

Section 3.2 of Appendix B.1 summarizes "existing" air quality – i.e., ambient monitoring concentrations of several pollutants. Yet, even though the report in Appendix B.1 was revised in November 2023, this "existing" ambient data is only provided for the years 2019 through 2021. Further, the description misleadingly states that these are "the last three years." Clearly that is not the case since no data is provided for 2022. There is also no mention of why 2022 data could not have been reported. That should be fixed. Notably, quality-assured data from 2022 is readily available.[15]

I also note that this "existing" three-year time period of 2019-2021 was substantially impacted by COVID-19 for the years 2020 and 2021. As such, due to changes in economic activities including transportation patterns, and many other factors, it is not assumable, without further discussion, that this impacted three-year period is representative of "existing" air quality. I suggest that a broader time period, say, 5 or even more years, including 2022, be included to describe existing air quality, with comments, as necessary, on any patterns in the data.

Comment 3.3 – None of the Assumptions Made For Estimating Project-Related Emissions Are Supported by Any Justification and/or Rationale

[15] See, https://www.arb.ca.gov/aqmis2/display.php?param=OZONE&units=007&statistic=DAVG&year=2022&mon=12&day=31&county_name=15-Kern&basin=--AIR+BASIN--&latitude=--PART+OF+STATE--&report=7DAY&order=basin%2Ccounty_name%2Cs.name&submit=Retrieve+Data&ptype=aqd&std15=

I will provide examples of these unsupported assumptions in this comment. I also note, that in each instance, there is no verification of any of these assumptions proposed in the DEIR either.

(i) for short-term construction emissions, it is assumed that the construction schedule will be 11 days per well pad, 18 days per well, 2 years for the capture facilities, and 1 year for the pipelines (later noted as 220 days). None of these timelines are supported.

Specifically, Table 4-12 in Appendix B.1 shows the details of the wells to be constructed/repurposed as part of the project. It is excerpted below for easy reference.

Table 4-12. Total Emissions on a Per Well Basis

Well Name	Description	Depth (ft)	Emissions (Tons)
26R Reservoir			
363C-27R	Injector	6290	4.55
353XC-35R (new)	Injector	6390	4.55
373-35R (new)	Injector	7010	5.36
345C-35R (new)	Injector	5690	3.98
341-27R	Plume monitoring	6981	4.55
328-25R	Plume monitoring	5268	3.98
376-36R	Plume monitoring	5832	3.98
355X-26R	Above-zone monitoring	4063	2.35
USDW Monitoring (new)	USDW monitoring	400	1.28
A1/A2 Reservoir			
355-7R	Injector	8387	6.17
357-7R	Injector	8420	6.17
353A-7R	Plume monitoring	8773	6.17
335X-7R	Plume monitoring	8737	6.17
327-7R-RD1	Above-Zone monitoring	3782	2.03
345-7R	A3+ Monitoring	8904	6.17
388X-7R	A3+ Monitoring	8800	6.17
342-17R	A3+ Monitoring	8844	6.17
USDW Monitoring (new)	USDW monitoring	740	1.28
Total			**81.08**

I note that the well depths, excluding the groundwater monitoring wells, in Table 4.12 range from as low as 3782 ft to as high as 8904 feet. Given this wide range of well depths and many other depths noted in Table 4-12, it makes no sense to presume that there will be 18 days required to construct each well. If the intent is to presume that 18 days is the "average" for all wells/various depths noted above, that should be justified. Clearly, the wells in the A1/A2 reservoir will be drilled to deeper depths as compared to the wells in the 26R reservoir. Since they are not expected to be drilled all at once, the construction schedule for the wells should be provided in greater detail, along with supported construction durations.

In addition, it is not clear how the well depths in Table 4-12 were so precisely estimated, right down to the last foot (for example, 6981 feet, 4063 feet, etc.). Please provide the rationale since the depths will affect construction timelines.

(ii) Section 4.2.1 of Appendix B.1 contains a number of mobile source activity assumptions. These include: a 40-mile trip distance; 160 average daily trips (ADTs) for workers during construction; 32 ADTs by 1-ton trucks and 20 ADTs using 5-ton trucks, in addition to 8 water trucks; 16 ADTs by workers and 2 ADTs by vendors during well pad construction; and 12 ADTs by workers and 10 ADTs by vendors during well construction. There is no justification provided for any of these assumptions. Thus, the emission estimation approach is nothing more than an algebraic exercise. As a simple example, it is not clear why there should be a 40-mile trip distance for both workers and vendors. Also, since there is no description of the work that will be done during construction of the well pad and the well, there is no context for understanding if the assumed numbers of workers/vendors, as well as equipment proposed, makes any sense.

These types of assumptions should be supported by actual data that is undoubtedly available to the project proponent since these are not the first well pads nor first wells that are going to be drilled in this area.

(iii) Similarly, there are numerous assumptions about the types, numbers, and operating hours of various construction equipment that will be used in developing the construction emissions. These are inputs to the emissions calculations in the standard models used to develop those estimated. I have excerpted Tables 4-3 through 4-6 from Appendix B.1 below that contain these assumptions.

Table 4-3. Facilities Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Hydro Crane	Cranes	5	1968.75	3.8
ForkLift	Forklifts	7	1968.75	3.8
Excavator	Excavators	1	1968.75	3.8
Backhoe	Tractors/Loaders/Backhoes	4	1968.75	3.8
Air Compressor	Air Compressors	20	246.09	0.5
Crane	Cranes	3	246.09	0.5
Loader	Rubber Tired Loader	3	246.09	0.5
Dozer	Rubber Tired Dozers	1	1968.75	3.8
Dump Truck	Off-Highway Trucks	2	1968.75	3.8
Welding Truck	Welders	8	1968.75	3.8

Table 4-4. Pipeline Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Average Daily Operating Hours
Crane	Cranes	3	5.0
Boom Truck	Other Construction Equipment	3	5.0
Crane	Cranes	3	2.5
Side Boom	Other Construction Equipment	6	5.0
Bending Machine	Other Material Handling Equipment	1	2.5
Air Compressor	Air Compressors	4	5.0
Air Compressor	Air Compressors	1	2.5
Welding Machines	Welders	8	5.0
DitchWitch	Off-Highway Trucks	1	2.5
Vacuum Truck	Other Construction Equipment	2	2.5

Table 4-5. Well Pad Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Grader	Graders	1	16	1.5
Front Loader	Tractors/Loaders/Backhoes	1	40	3.6
Excavator	Excavators	1	32	2.9
Water Truck	Other Construction Equipment	1	40	3.6

Table 4-6. Well Drilling Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Forklift	Forklifts	1	72.0	4.0
Drilling Rig Motor	Bore/Drill Rigs	1	275.4	15.3
Drilling Rig Motor	Bore/Drill Rigs	1	322.2	17.9
Drilling Rig Motor	Bore/Drill Rigs	1	216.0	12.0
Small Generator	Generator Sets	1	8.0	0.4
Light Tower	Generator Sets	2	216.0	12.0
Water Truck	Other Construction Equipment	1	144.0	8.0
Vacuum Truck	Other Construction Equipment	1	432.0	24.0

The DEIR/Appendix B.1 should provide justifications for the equipment type, the numbers of each equipment, and the expected operating hours in each instance. It is also clear that the operating hours are provided with a high degree of precision, with no rationale. For example, 3.8 hours of operation per day for several types of equipment (along with the equally precise annual operating hours (246.09, 1968.75), in Table 4-3. What is the basis of such precision? Similar comments also apply to the other tables above.

(iv) Long-term, i.e., operational emissions are discussed in Section 4.2.2 of the Appendix B.1 for fugitive (dust) emissions (Section 4.2.2.1) and mobile sources (Section 4.2.2.2). However, fugitive dust emissions are simply not quantified. Instead it is noted that these are "...not expected to present a substantial source of fugitive dust (PM_{10}) emissions..." What is the basis for this conclusionary assertion, with no supporting data or calculations?

In addition, the DEIR presumes that the main source of PM_{10} emissions would be from vehicular traffic associated with the project.[16] While this is true, PM_{10} also results from soil disturbance associated with land grading, including stockpiling of soils and also from the storage of other erodible construction materials.

Further, the DEIR does not address fugitive $PM_{2.5}$, for which the area is non-attainment at present and likely to be even more so when the NAAQS for $PM_{2.5}$ is revised downward per EPA's current proposed, as noted prior.

(v) As for mobile source exhaust emissions during operations, like in the case of construction, the DEIR/Appendix B.1 makes numerous unsupported assumptions, with the exception of a reference to a traffic study estimating 20 ADTs from workers. However, other assumptions such as: the 40-mile trip distance; the assumption for 10 additional workers; the complete lack of any vendor-related trips or emissions are not justified or

[16] DEIR, p. 4.3-65.

supported at all. The DEIR should provide that support or revise as needed. The DEIR should provide the justification for why no vendor support would be needed as operational support for the various injection and monitoring wells.

(vi) In addition to the fugitive and mobile source emissions during operations, the only stationary source emissions included in the analysis are from fugitives from component leaks from the two new amine units that will be installed are estimated (in Table 4-11 of Appendix B.1) using the previously mentioned Implelentation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities. However, the applicability of these estimates for "petroleum facilities" to the amine units is not clear. Please provide the justification. Also, please clarify what fractions of the components of each type are expected to be "leakers" at different levels of assumed leakage, i.e., 50 ppm, 100 ppm, 250 ppm, 500 ppm, 1000 ppm, 10,000 ppm, etc. And, how these leakers have been included (or not) in the current calculations.

(vii) Previously, I have excerpted Table 4-12 showing the depths of the 18 new wells that will be drilled, for the various purposes shown in that table. In connection with the drilling schedule, I have also provided a comment about the precisions of the well depths noted in Table 4-12. In addition, I have additional comments/questions:

- First, I note that the DEIR provided no justification provided for the well depths for just/only the two above-zone monitoring wells (i.e., one for each reservoir) noted in that table.
- Second, the DEIR provides no justification (geologic or otherwise) for the depths of these two monitoring wells, that are approximately 2000 feet or higher than the reservoirs themselves.
- Third, the DEIR does not state how such a single monitoring well will be placed exactly where some leakage might manifest itself, given the vast area/acreages in each reservoir.
- Finally, the DEIR does not discuss or address potential leakages that may occur from the formation in directions other than vertically, such as initially laterally or even downward from the formations, later finding their way to the surface. The DEIR does not address how these potential leakage paths will be monitored.

In sum, it appears that, at least as far as the monitoring of the injection/sequestration at each reservoir is concerned, there are too few wells. Of course including additional wells, at justified and proper depths, will increase construction (and operational) emissions that have not been properly included in the DEIR.

Comment 4 – Mitigation Measures

As an overall comment, none of the mitigation measures for air quality and GHG have verification or monitoring requirements that would provide even reasonable confidence that: (i) the proposed measures are, in fact, being implemented as promised in the DEIR; and (ii) that even if they are being implemented, their effectiveness is similar to that claimed. This includes, for example, monitoring to quantify GHG leakages via the various pathways and sources previously discussed as well as monitoring to address emissions of criteria and air toxic air pollutants from the facilities that are part of the proposed project.

Comment 4.1 – Emission Reduction Agreements and Their Limitations As Proposed Mitigation

The DEIR states repeatedly that, as mitigation, the proposed project will avail itself of a Development Mitigation Contract (DMC) or Voluntary Emission Reduction Agreement (VERA) to address the project's criteria pollutant emissions of NO_x, reactive organic compounds (ROGs) and particulate matter (PM). The goal is to "fully mitigate the project's air quality impacts such that development of the project could be considered to result in no net increase in the designated criteria pollutant emissions over the criteria pollutant emissions that would otherwise exist without the development of the project, all to be verified by the SJVAPCD." In addition, Section 4.10 of Appendix B.1 also makes a similar claim, justifying the lack of any air quality impact (or modeling).

First, this entire construct does not work if the emissions from the project are not properly estimated and/or verifiably and accurately measured. Without such accurate measurements, the amount of mitigation, to achieve "no net increase" using the DMC or similar mechanism is meaningless. Yet, there is nothing in the DEIR that provides any assurance of actual measurements of even these criteria pollutants from each of the project's activities.

Second, as noted in the DEIR, the DMC does not extend to other pollutants, including additional criteria pollutants such as carbon monoxide (CO) or sulfur dioxide (SO_2).

The DMC also does not extend to any of the air toxic compounds that will be emitted as a result of combustion sources and the amine system used for CO_2 concentration. This is true for such air toxics emissions during construction and operations.

Since none of the mitigations identified contain any verifiable measures of their effectiveness and the emissions estimates are simply not verifiable since no monitoring is required, there is a significant uncertainty as to the actual emissions and their impacts (mitigated or otherwise) of air toxic compounds.

Comment 4.2 – Lack of Verification and Effectiveness of PM_{10} Reduction Measures

These are listed in Mitigation Measure 4.3-2. I will not repeat all/both of them for the sake of brevity. But every single item on these lists is simply a promise, with no recordkeeping or

verification. At a minimum, such record-keeping and verification should be included in as part of an enforceable mitigation monitoring plan for PM_{10} (and $PM_{2.5}$) reduction.

Comment 4.3 – The 4,000-foot Setback in MM 4.3-5 Should Be Expanded, as Needed

A reasonable setback distance from any injection well to sensitive receptors is necessary. The DEIR proposes that the setback be 4,000 feet but provides no explanation for this distance.

However, while MM 4.3-5 addresses the setback from injection wells, it is not clear why similar setback distances are not also proposed for other physical infrastructure like pipelines, from which ruptures can cause CO_2 to also escape and could result in adverse impacts to humans and wildlife. For example, if any pipeline passes through a topographically low area, any CO_2 that might escape can accumulate locally and cause adverse impacts. For these reasons, setbacks should be provided from all physical infrastructure associated with the proposed project, based on a site-specific factors such as the locations of such infrastructure and nearby receptors in order to meet CEQA's requirement to provide all feasible mitigation for significant impacts.

Comment 4.4 – MM 4.3-7 and Additional Details of Fence Line Monitoring

While I agree with the goal of MM 4.3-7 that an Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project – including but not limited to criteria pollutants, CO_2, and H_2S – should be developed and implemented, MM 4.3-7 provides no details of how such fence line monitoring will occur. Even basic details of whether this will consist of periodic sampling at specific locations along the fence line (of, say, a well pad; or near the amine units, etc.) or continuous open-path measurements along the entire perimeter of such locations, is not provided in the DEIR. Without this, and additional detail, the efficacy of MM 4.3-7 is not clear. The DEIR should provide additional details, like, for example: (i) specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters; (ii) requirements for reporting monitoring results to the County and responsible agencies and for public disclosure of monitoring data and/or performance standards to be used to develop reporting and public disclosure requirements; (iii) any threshold levels (by pollutant) that, if detected at the fence line, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation; and (iv) mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

Attachment A
to Technical Comments of Dr. Ranajit (Ron) Sahu:
Qualifications and Experience

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EXPERIENCE SUMMARY

Dr. Sahu has over thirty two years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over thirty years of project management experience and has successfully managed and executed hundreds of projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past three decades include various trade associations as well as individual companies such as steel mills, petroleum refineries, chemical plants, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, land development companies, and various entities in the public sector including EPA, the US Dept. of Justice, several states (including New York, New Jersey, Connecticut, Kansas, Oregon, New Mexico, Pennsylvania, and others), various agencies such as the California DTSC, and various cities and municipalities. Dr. Sahu has executed projects in all 50 US states, numerous local jurisdictions and internationally.

In addition to consulting, for approximately two decades, Dr. Sahu taught numerous courses in several Southern California universities as adjunct faculty, including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management). He also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental and engineering areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.), public sector (such as the US Department of Justice), and public interest group clients with project management, environmental

consulting, project management, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena, CA.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

"Thermodynamics and Heat Transfer," Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-mid-1990s.

Air and Waste Management Association, West Coast Section, 1989-mid-2000s.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, 2000 - 2021.

CEM, State of Nevada (#EM-1699).

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

"From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada," with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).

6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).

7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc.*, 5:04-cv-00034-KSF (Eastern District of Kentucky).

9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc.*, 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant*

Generation Company LLC, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority,* Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.,* Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.,* Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et. al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).

53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association,* Case No. 11-417-MJP (Western District of Washington).

54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency,* Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.,* Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Resppondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*

85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et. al., (Petitioners) v. EPA et. al., Utility Air Regulatory Group (Petitioners) v. EPA et. al., National Mining Association et. al., (Petitioner) v. EPA et. al.,* (Supreme Court of the United States).

87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.

89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;" Declaration (October 2015) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners' Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.

93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.

95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.,* ERAC Case No. 14-256814.

96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.

97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.

100. Declaration (December 2016) relating to EPA's refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180.* (D.C. Circuit Court of Appeals).

101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).

107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant), Case No. 4:16-CV-1544-BYP*, (US District Court for the Northern District of Ohio, Eastern Division).

108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant),* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.

111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.

113. Expert Report (Harm Phase) (January 2018), Rebuttal Expert Report (Harm Phase) (May 2018) and Supplemental Expert Report (Harm Phase) (April 2019) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).

115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

117. Direct Pre-filed Testimony and Affidavit (December 2018) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

118. Expert Report (February 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

119. Declaration (March 2019) on behalf of Earthjustice in the matter of comments on the renewal of the Title V Federal Operating Permit for Valero Houston refinery.

120. Expert Report (March 2019) on behalf of Plaintiffs for Class Certification in the matter of *Resendez et al v Precision Castparts Corporation* in the Circuit Court for the State of Oregon, County of Multnomah, Case No. 16cv16164.

121. Expert Report (June 2019), Affidavit (July 2019) and Rebuttal Expert Report (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

122. Affidavit/Expert Report (August 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

123. Expert Report (October 2019) relating to the appeal of air permit (Plan Approval) on behalf of Appellants in the matter of *Clean Air Council and Environmental Integrity Project (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection and Sunoco Partners Marketing and Terminals L.P.*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-057-L.

124. Expert Report (December 2019), Affidavit (March 2020), Supplemental Expert Report (July 2020), and Declaration (February 2021) on behalf of Earthjustice in the matter of *Objection to the*

Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

125. Affidavit (December 2019) on behalf of Plaintiff-Intervenor (Surfrider Foundation) in the matter of *United States and the State of Indiana (Plaintiffs), Surfrider Foundation (Plaintiff-Intervenor), and City of Chicago (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant),* Civil Action No. 2:18-cv-00127 (US District Court for the Northern District of Indiana, Hammond Division).

126. Declarations (January 2020, February 2020, May 2020, July 2020, and August 2020) and Pre-filed Testimony (April 2021) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

127. Expert Report (April 2020) on behalf of the plaintiff in the matter of Orion Engineered Carbons, GmbH (Plaintiff) vs. Evonik Operations, GmbH (formerly Evonik Degussa GmbH) (Respondent), before the German Arbitration Institute, Case No. DIS-SV-2019-00216.

128. Expert Independent Evaluation Report (June 2020) for *PacifiCorp's Decommissioning Costs Study Reports dated January 15, 2020 and March 13, 2020 relating to the closures of the Hunter, Huntington, Dave Johnston, Jim Bridger, Naughton, Wyodak, Hayden, and Colstrip (Units 3&4) plants*, prepared for the Oregon Public Utility Commission (Oregon PUC).

129. Direct Pre-filed Testimony (July 2020) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

130. Expert Report (August 2020) and Rebuttal Expert Report (September 2020) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

131. Expert Report (July 2020) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

132. Expert Report (August 2020) and Supplemental Expert Report (February 2021) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

133. Expert Report (August 2020) and Supplemental Expert Report (December 2020) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

134. Pre-filed Direct Testimony (October 2020) and Sur-rebuttal Testimony (November 2020) on behalf of petitioners (Ten Persons Group, including citizens, the Town of Braintree, the Town of Hingham, and the City of Quincy) in the matter of Algonquin Gas Transmission LLC, Weymouth MA, No. X266786 Air Quality Plan Approval, before the Commonwealth of Massachusetts, Department of Environmental Protection, the Office of Appeals and Dispute Resolution, OADR Docket Nos. 2019-008, 2019-009, 2019010, 2019-011, 2019-012 and 2019-013.

135. Expert Report (November 2020) on behalf of Protect PT in the matter of *Protect PT v. Commonwealth of Pennsylvania Department of Environmental Protection and Apex Energy (PA) LLC*, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2018-080-R (consolidated with 2019-101-R)(the "Drakulic Appeal").

136. Expert Report (December 2020) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

137. Pre-filed Testimony (January 2021) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

138. Expert Reports (March 2021 and May 2021) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, Central Planning Board, City of Newark, New Jersey.

139. Expert Report (April 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana, New Orleans Division).

140. Affidavit (April 2021) for *Clayton Faerber et.al., (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 20-CV-00328 01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

141. Expert Report (April 2021, June 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

142. Expert Report (April 2021) and Sur-Rebuttal Report (June 2021) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

143. Expert Report (May 2021) for *Clifford Osmer (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)* related to No. 18-CV-12557 (US District Court for the Eastern District of Louisiana).

144. Expert Report (May 2021) and Rebuttal Expert Report (January 2022) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

145. Expert Report (June 2021) and Declarations (May 2021 and June 2021) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division.)

146. Expert Witness Disclosure (June 2021) on behalf of the Plaintiffs in the matter of *Jay Burdick, et. al., (Plaintiffs) v. Tanoga Inc. (d/b/a Taconic) (Defendant)*, Index No. 253835, (State of New York Supreme Court, County of Rensselaer).

147. Expert Report (June 2021) on behalf of Appellants in the matter of *PennEnvironment and Earthworks (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection (Appellee) and MarkWest Liberty Midstream and resource, LLC (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2020-002-R.

148. Expert Report (June 2021) for *Antonia Saavedra-Vargas (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:18-CV-11461 (US District Court for the Eastern District of Louisiana, New Orleans Division).

149. Affidavit (June 2021) for Lourdes Rubi in the matter of *Lourdes Rubi (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)*, related to 12-968 BELO in MDL No. 2179 (US District Court for the Eastern District of Louisiana, New Orleans Division).

150. Expert Report (June 2021) for *Wallace Smith (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:19-CV-12880 (US District Court for the Eastern District of Louisiana, New Orleans Division).

151. Declaration (July 2021) on behalf of Plaintiffs in the matter of *Stephanie Mackey and Nick Migliore, on behalf* of *themselves and all others similarly situated (Plaintiffs) v. Chemtool Inc. and Lubrizol Corporation (Defendants)*, Case No. 2021-L-0000165, State of Illinois, Circuit Court of the 17th Judicial Circuit, Winnebago County.

152. Declaration (July 2021, August 2021) on behalf of Petitioners in the matter of the Petition for a Hearing on the Merits Regarding Air Quality Permit No. 3340-RMD issued to New Mexico Terminal Services, LLC by *Mountain View Neighborhood Association et. al., (Petitioners) v. City of Albuquerque Environmental Health Department*, AQCB Petition No. 2020-1 before the Albuquerque-Bernalillo County Air Quality Control Board.

153. Expert Disclosure (September 2021) and Affidavit (May 2023) on behalf of the Plaintiffs in the matter of *State of New York, Town of Hempstead, Town of Brookhaven, Incorporated Village of Garden City and Long Island Power Authority et. al., (Plaintiffs) v. Covanta Hempstead Company et. al., (Defendants)*, Index No. 7549/2013 before the Supreme Court of the State of New York, County of Nassau.

154. Expert Report (October 2021) for *John A. Battiste (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:21-CV-00118 (US District Court for the Southern District of Alabama, Mobile Division)

155. Declaration/Expert Report (October 2021) for *Charles K. Grasley et. al., (Plaintiffs) v. Chemtool Incorporated (Defendant)*, Case No. 2021-L-0000162 (State of Illinois, In the Circuit Court of the 17th Judicial Circuit, Winnebago County).

156. Declaration (October 2021) and Expert Report (November 2021) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

157. Expert Report (November 2021) and Declaration (September 2022) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

158. Declaration (November 2021) for the *United States of America and the State of Kansas, Department of Health and Environment (Plaintiffs) v. Coffeyville Resources Refining & Marketing, LLC (Defendant)*, Civ. No. 6:04-cv-01064-JAR-KGG (US District Court for the District of Kansas).

159. Expert Report/Affidavit (December 2021) on behalf of the City of Detroit in the matter of Marathon Petroleum Company (Claimant) v. City of Detroit Building Safety Engineering and Environmental Department, BSEED Case No. MCR 2018-2525, DAH Appeal No. 21-SWA-01, before the State of Michigan, City of Detroit Department of Appeals and Hearings.

160. Expert Report (December 2021) for *John Pabst (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 21-CV-00290 (US District Court for the Eastern District of Louisiana).

161. Expert Report (December 2021) for *Audrey Annette Tillery-Perdue individually and as person representative of the estate of Eddie Lewis Perdue (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendant)*, Civil Action No. 5:19-cv-00052-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

162. Expert Report (February 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

163. Expert Report (February 2022) and Rebuttal Expert Report (June 2022, in preparation) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

164. Expert Report (February 2022) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

165. Expert Report (March 2022), Affidavit (June 2022), Supplemental Expert Report (April 2023) in the matter of *Clean Air Council et. al., (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection (Appellee) and Renovo Energy Center (Permittee)* EHB Docket No. 2021-055-R before the Commonwealth of Pennsylvania Environmental Hearing Board.

166. Declaration (March 2022) in the matter of Max Midstream Texas LLC Air Quality Permit No. 162941 for the Seahawk Crude Condensate Terminal in Calhoun County Texas, TCEQ Docket No. 2022-0157-AIR, before the Texas Commission on Environmental Quality.

167. Expert Pre-filed Testimony (April 2022) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

168. Expert Report (April 2022) and Rebuttal Report (August 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

169. Rule 26 Disclosure (May 2022) in the matter of the *Water Works and Sewer Board of the City of Gadsden (*Plaintiff*) v. 3M Company, et. al., (Defendants)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

170. Expert Report (June 2022) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-011939 (Circuit Court of Cook County, Illinois.)

171. Expert Report (June 2022), Rebuttal Reports (August 2022, September 2022) for Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

172. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the 2019 South Africa Integrated Resource Plan in *African Climate Alliance et. al. v. The Minister of Mineral Resources and Energy et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria.

173. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the Limpopo Mine (Lephalale Coal Mines Ltd.) in *Earthlife Africa v. The Minister of Forestry, Fisheries and Environment et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria, Case No. 9149/2022.

174. Pre-filed Testimony (July 2022) and Rebuttal Testimony (September 2020) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

175. Expert Report (September 2022) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain Watershed Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor, *Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

176. Expert Affidavit (October 2022) for *Concerned Citizens of Cook County GA (Petitioner) v. Georgia Department of Natural Resources (Respondent) and Spectrum Energy Georgia, LLC (Respondent Intervenor)* before the Office of State Administrative Hearings, State of Georgia, Docket No: 2303405-OSAH-BNR-AQ-37-Barnes.

177. Expert Rebuttal Report (January 2023), Supplemental Rebuttal Expert Report (March 2023, May 2023, November 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

178. Expert Report (January 2023) and Rebuttal Expert Report (April 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant)*, Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

179. Affidavit (January 2023) for *Richard Dufour (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-cv-00591-HSO-BWR (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

180. Expert Report (January 2023) and Supplemental Expert Report (July 2023) on behalf of Plaintiffs in the matter of *Stephanie* Mackey *et. al., (Plaintiffs) v. Chemtool Inc. et. al., (Defendants) and Holian Insulation Company Inc. (Third-party Defendant)*, Case No.: 3:21-cv-50283, U.S. District Court, Northern District of Ilinois, Western Division.

181. Expert Report (February 2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

182. Expert Report (February 2023) for *Carol Davis (Plaintiff) v. Lockheed Martin Corporation (*Defendant*)*, Case No. 6:22-cv-81-RBD-EJK, U.S. District Court, Middle District of Florida, Orlando Division.

183. Expert Report (February 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

184. Affidavit (March 2023) on behalf of plaintiffs in the matter of the *State of New Mexico, ex rel. Raul Torrez, Attorney General (Plaintiffs) v. Sterigenics US LLC, Sotera Health Holdings, LLC, Sotera Health LLC and Sotera Health Company (Defendants)*, Case No.: D-307-CV-2020-02629, State of New Mexico, Third Judicial District Court, County of Dona Ana

185. Pre-filed Direct Testimony (March 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

186. Declaration (April 2023) in the matter of Sierra Club (Plaintiff) v. Tennessee Valley Authority in the matter of the Johnsonville Aeroderivative Combustion Turbines Project, Case No.: 3:22-cv-1054, U.S>, District Court, Middle District of Tennessee, Nashville Division.

187. Expert Report (May 2023/June 2023), Affidavit (April 2023) and Declaration (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

188. Affidavit (May 2023) for *Lawrence Tucei (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00078-HSO-BWR (US District Court for the Southern District of Mississippi).

189. Expert Report (May 2023/June 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

190. Expert Report (June 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

191. Declaration (June 2023) in support of public commenters relating to the Michigan Department of Environment Great Lakes and Energy (EGLE)'s Annual Network Monitoring Plan 2024.

192. Expert Report (July 2023) and Rebuttal Expert Report (September 2023) relating to Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

193. Pre-filed Direct Testimony (July 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

194. Declaration (August 2023) in support of comments by Environmental Defense Fund in connection with the "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards, published at 88 Fed. Reg. 36,654 (June 5, 2023) ("Final Rule"), Docket ID No. EPA-HQ-OAR-2021-0668.

195. Expert Report (August 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

196. Pre-filed Testimony (September 2023) and Cross Answering Testimony (October 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

197. Expert Report (December 2023) on behalf of plaintiffs in the matter of *PennEnvironment and Sierra Club (Plaintiffs) v. PPG Industries, Inc. (Defendant)*. Case No.: Civil Action Nos. 2:12-cv-00342, 2:12-cv-00527, 2:13-cv-01395, 1:13-cv-01396, 2:14cv-00229 (consolidated). U.S. District Court Western District of Pennsylvania.

C. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

198. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

199. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

200. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

201. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

202. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

203. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

204. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

205. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

206. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

207. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

208. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

209. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

210. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

211. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

212. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

213. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

214. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

215. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

216. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

217. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

218. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.*, 2:05cv0885 (Western District of Pennsylvania).

219. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

220. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

221. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

222. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

223. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

224. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

225. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

226. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

227. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

228. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

229. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

230. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

231. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

232. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

233. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

234. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation*

Company LLC, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

235. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

236. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.,* Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

237. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

238. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

239. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

240. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

241. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

242. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

243. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

244. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

245. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).

246. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

247. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

248. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

249. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

250. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

251. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

252. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

253. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

254. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

255. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

256. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.

257. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

258. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

259. Deposition (June 2018) (harm Phase) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

260. Trial Testimony (July 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

261. Deposition (January 2019) and Trial Testimony (January 2019) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

262. Deposition (February 2019) and Trial Testimony (March 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric

Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

263. Deposition (June 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

264. Deposition (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

265. Deposition (December 2019) on behalf of the Plaintiffs in the matter of David Kovac, individually and on behalf of wrongful death class of Irene Kovac v. BP Corporation North America Inc., Circuit Court of Jackson County, Missouri (Independence), Case No. 1816-CV12417.

266. Deposition (February 2020, virtual) and testimony at Hearing (August 2020, virtual) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

267. Hearing (July 14-15, 2020, virtual) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

268. Hearing (September 2020, virtual) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware* Operating – *NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

269. Deposition (December 2020, March 4-5, 2021, all virtual) and Hearing (April 2021, virtual) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

270. Hearing (September 2020, virtual) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

271. Deposition (December 2020, virtual and Hearing February 2021, virtual) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

272. Deposition (January 2021, virtual) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

273. Deposition (February 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (*Defendants*)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

274. Deposition (April 2021, virtual) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

275. Deposition (June 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division).

276. Deposition (June 2021, virtual) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

277. Testimony (June 2021, virtual) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, (Central Planning Board, City of Newark, New Jersey).

278. Testimony at Hearing (October 2021) on behalf of Evraz Rocky Mountain Steel in the matter of Colorado's Proposed Revisions to Regulation 22, the Greenhouse Gas Emissions and Energy Management for the Manufacturing Sector in Colorado (GEMM Rule), before the Colorado Air Quality Control Commission.

279. Deposition (November 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana).

280. Testimony at Hearing (November 2021) on behalf of *National Parks Conservation Association, et. al.*, in the matter of the Proposed Revisions to Colorado's Regional Haze State Implementation Plan (SIP) and Colorado Regulation 23, before the Colorado Air Quality Control Commission.

281. Deposition (December 2021) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

282. Deposition (December 2021) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

283. Testimony at Hearing (February 2022, virtual) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

284. Deposition (March 2022) and Rebuttal Deposition (July 2022) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois.)

285. Deposition (April 2022, virtual) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

286. Deposition (May 2022, virtual) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (*Defendants*)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

287. Deposition (June 2022 and September 2022, both virtual) for *Teresa* Fornek *(Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

288. Deposition (June 2022, virtual) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

289. Deposition (July 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

290. Trial (August 2022) on behalf of the Plaintiffs in the matter of Modern *Holdings, LLC, et al. (Plaintiffs) v. Phillips (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

291. Trial (August 2022, in person) for *Susan Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

292. Deposition (September 2022, virtual) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

293. Deposition (September 2022) on behalf of Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

294. Deposition (September 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

295. Hearing (October 2022) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

296. Trial (October 2022, in person) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

297. Depositions (March 2023, June 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

298. Depositions (March 2023, April 2023, May 2023) for Quinn Buczek (Plaintiff) v. Sterigenics US, LLC, Sotera Health, LLC, Prologis First US Properties, LP, et. al., (Defendants) before State Court of Gwinnett County, State of Georgia, Case No. Civil Action File No. 20-C-05918-S1.

299. Deposition (May 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant)*, Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

300. Deposition (May 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

301. Testimony at Hearing on behalf of Evraz North America In the Matter of Colorado Air Quality Regulation Proposed Revisions to Regulation Number 3 to establish enhanced Modeling, monitoring and permitting requirements for Stationary sources in disproportionately impacted communities 5 CCR 1001-5, before the Air Quality Control Commission, State of Colorado.

302. Deposition (2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

303. Testimony at Hearing (July 2023) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain* Watershed *Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor, *Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

304. Deposition (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

305. Deposition (August 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

306. Deposition (August 2023) on behalf of petitioners in *Doreen Carey et; al., (Petitioners) v. Fulcrum Centerpoint LLC. (Permittee/Respondent) and Indiana Department of Environmental Management (Respondent)*, Permit Number 089-44042-00660, before the Indiana Office of Environmental Adjudication.

307. Deposition (August 2023) on behalf of the Plaintiff in the *Water Works and Sewer Board of the Town of Centre, Alabama v. 3M Company, et. al.*, Civil Action No.: CV-2017-900049. Circuit Court of Cherokee County, State of Georgia.

308. Deposition (August 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

309. Deposition (September 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

310. Testimony at Hearing for Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

311. Testimony at Hearing (October 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

312. Testimony at Hearing (August 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

313. Testimony at Hearing (September 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

314. Testimony at Hearing (November 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

ATTACHMENT B

Evaluation of Draft Environmental Impact Report on Geological Storage of Carbon Dioxide at the Carbon TerraVault I Facility in Kern County, California

Dominic DiGiulio, Ph.D.

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Center for Applied Environmental Science

February 25, 2024

About the Author: Dr. DiGiulio is a retired geoscientist from the U.S. Environmental Protection Agency's Office of Research and Development. He has conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. He assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide (Tier II Committee). He has served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. His consulting services to non-government organizations have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

Work experience and list of peer-reviewed publications are available at https://www.linkedin.com/in/dominic-digiulio-phd-79835bbb/ or at https://scholar.google.com/scholar?as_sdt=400007&q=Dominic+DiGiulio&hl=en

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Background

A Draft Environmental Impact Report (DEIR) was prepared by Kern County as the Lead Agency under the California Environmental Quality Act (CEQA). In volume 1 of the DEIR, it is stated that Carbon TerraVault 1 LLC (CTV), a wholly owned subsidiary of the California Resources Corporation, proposes to inject supercritical carbon dioxide (CO_2) at two locations (26R and A1-A2 reservoirs) in the Monterey Formation at the Elk Hills Oil Field in Kern County, California (DEIR, 2024a). The source of CO_2 for injection is pre-combustion Elk Hills Oil Field gas, from which CO_2 is captured and processed at the existing cryogenic and fractionation natural gas plant facility and the Elk Hills Power Plant within the Elk Hills Oil Field (DEIR, 2024a). Currently, the Elk Hills Power Plant provides electricity for both oilfield operations and the California wide power system (DEIR, 2024a). The project would consist of six injection wells - four (one converted Class II well, three new) within the 26R reservoir and two converted Class II wells within the A1 – A2 reservoir.

At the 26R reservoir, the Monterey Formation is approximately 6,000 feet deep with oil and gas production from turbidite sands (DEIR, 2024a). Turbidite deposited sands are interbedded with siliceous shale. Sand porosity and permeability averages 25% and 45 millidarcy (mD), respectively (DEIR, 2024b). At the A1 – A2 reservoir, the Monterey Formation is approximately 8,500 feet deep with oil and gas production also from turbidite sands. Turbidite deposited sands are interbedded with and bound above and below by siliceous shale. Sand porosity and permeability averages 16% and 60 mD, respectively (DEIR, 2024b).

The 26R reservoir was discovered in the 1940s while the A1-A2 reservoir was discovered in the 1970s (DEIR, 2024b). In addition to primary extraction, oil and gas wells have been used for enhanced recovery using water and gas injection over the past 40 years (DEIR, 2024b).

The Reef Ridge Shale is present over the southern San Joaquin Basin and serves as the primary confining layer for both the 26R and A1-A2 reservoirs (DEIR, 2024a). The Reef Ridge Shale is dominated by gray to grayish-black silty or sandy shale with rare silty and clay beds. The Reef Ridge Shale is continuous and ranges from 750 to 1,600 feet thick and has a permeability of less than 0.01 mD and 7% porosity (DEIR, 2024b). To date, over 7,500 wells have been drilled to various depths within the Elk Hills Oil Field (DEIR, 2024b). There are numerous well penetrations in the Monterey Formation outside the 26R and A1 – A2 storage areas as illustrated in figures in Volume 2 of the DEIR. The DEIR fails to specify the exact number of well penetrations.

At full operation, the project is designed to inject up to 1.46 million tons of CO_2 per year into the 26R reservoir (up to 26 years) and up to 0.75 million tons per year in the A1-A2 reservoir, for a total capacity of 2.21 million tons per year (DEIR, 2024a). Additionally, 10 existing wells will be converted to monitoring wells, and six existing wells would be converted into seismic monitoring wells (DEIR, 2024a).

Setbacks and Encroachment

Leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2 (Jordan and Benson, 2009, Zhang and Bachu, 2011). There is interest in using depleted oil and gas reservoirs for geological storage of CO_2 due to extensive preexisting geological

characterization and infrastructure but the presence of a large number of well penetrations increases the possibility of leakage (Celia et al., 2005).

From a health and safety perspective, if large-scale leakage were to occur at the surface, asphyxiation and suffocation are of concern. Continued exposure to CO_2 concentrations above 20–30% is associated with suffocation to humans and most air-breathing animals (Damen et al., 2006). Since CO_2 is denser than air, topography and prevailing meteorologic conditions would largely govern risk from a large-scale release with gas buildup being greater in valleys and low-lying areas.

As discussed in Volume 2 of the DEIR (DEIR, 2024b), in 2008 in Mönchengladbach, Germany, over 100 residents suffered from respiratory problems due to a CO_2 release, of which 19 were hospitalized. The incident involved the release of about 15 metric tons of fire suppression CO_2 inside a factory, which leaked out of the building. At the time there was no wind, so the dense CO_2 cloud drifted down hill to the lowest lying region where there was a village about 1,500 feet away (DEIR, 2024b).

Probably the best-known anthropogenic release of CO_2 occurred in February 2020 from a CO_2 pipeline rupture in proximity to Satartia, MS. The rupture followed heavy rains that resulted in a landslide, creating excessive axial strain on a pipeline weld (DEIR, 2024b). Pipeline operators are required to establish atmospheric models to prepare for emergencies. Denbury's model did not contemplate a release that could affect the Village of Satartia (DEIR, 2024b). Local emergency responders were not informed by Denbury of the rupture and the nature of the unique safety risks of the CO_2 pipeline. As a result, responders had to guess the nature of the risk, in part making assumptions based on reports of a "green gas" and "rotten egg smell" and had to contemplate appropriate mitigative actions (DEIR, 2024b). Fortunately, responders decided to quickly isolate the affected area by shutting down local highways and evacuating people in proximity to the release (DEIR, 2024b). Denbury reported that 200 residents surrounding the rupture location were evacuated, and forty-five people were taken to the hospital. No fatalities were reported (PHMSA, 2022).

Following this incident, a large release of CO_2 to the atmosphere occurred later in 2020 in Yazoo County, Mississippi due to a blowdown valve freezing open (DEIR, 2024b). Work was being conducted to reconnect the pipeline that had ruptured near Satartia. An 8-inch valve froze in the open position due to internal dry-ice formation as CO_2 flashed across the valve (DEIR, 2024b). A total of approximately 5,299 metric tons of CO_2 were released over about 24 hours until the pipeline segment pressure had reduced enough to allow the valve to thaw and be closed. A large CO_2 cloud formed, and the nearby highway closed. Air monitoring was conducted in the surrounding area (DEIR, 2024b).

A clearly unacceptable release from a wellbore would be a CO_2 well blowout. A CO_2 well blowout is considered a low probability high consequence incident (Oldenburg and Budnitz, 2016) that could cause an immediate danger to public health in the vicinity of an abandoned well. The Sheep Mountain CO_2 blowout in March 1982 is a well-documented case in the literature (GEM Wiki, 2024). The leakage rate was estimated to be 13,000 metric tons CO_2 per day (GEM Wiki, 2024). 100% CO_2 flow was observed in the well with chunks of dry ice occasionally ejected hundreds of feet into the air. Other examples of CO_2 well blowouts include the Travale geothermal field, Italy in 1972 having a CO_2 release rate of 113 kg/s and the Torre Alfina geothermal field, Italy in 1973 (Lewicki et al., 2007) having a CO_2 leakage release rate of 76 kg/s (Lewicki et al., 2007; Aines et al., 2009).

Another example of CO_2 release via a wellbore is Crystal Geyser in Utah (the largest cold geyser in the world). The geyser was unintentionally created in the 1930s after a prospective oil well was drilled about 2,600-foot-deep into a fault zone above a natural CO_2 reservoir (DEIR, 2024b). Shortly after drilling, the well was improperly abandoned allowing CO_2 to be released through the well (DEIR, 2024b). Crystal Geyser eruptions last from 7 to 98 minutes with a release rate between 2.5 and 6 kg/s. Downwind CO_2 concentrations have been measured during eruptions, averaging about 4,000 parts per million (ppm) (0.4 percent) at 160 feet, and 800 ppm at 330 feet (DEIR, 2024b).

In 2011, an improperly plugged and abandoned well failed at the Tinsley Field, Mississippi during CO_2 enhanced oil recovery (EOR) (DEIR, 2024b). There were incomplete records of abandoned wells at the site (DEIR, 2024b). A 2,000-foot-deep well failed when the reservoir pressure increased on injection of CO_2. The blowout took 37 days to bring under control, sickened one worker and suffocated deer and other animals (DEIR, 2024b). In 2013, an underground CO_2 blowout occurred at the CO_2-EOR Delhi field in Louisiana, when two or more plugged and abandoned wells failed underground (DEIR, 2024b). Methane, CO_2, oil, water, brine and sands migrated to the surface in a sparsely populated, marshy area. The release lasted for more than six weeks and contaminated the air with CO_2 and methane (DEIR, 2024b).

Comment: As evidenced in the Satartia, MS CO_2 pipeline release and other documented incidences of CO_2 release, including those from wellbores, release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions. The closest sensitive receptor to the project site is McKittrick Elementary School, which is 2.5 miles southwest of the facility pipeline and 4.46 miles from injection well 357-7R. The nearest residence is approximately 4.5 miles southeast of the injection line and 4.4 miles from injection well 345-36R. Buttonwillow Recreation and Park District is approximately 7 miles northeast of injection well 355-7R and 6.9 miles from the injection pipeline (DEIR, 2024a). Based on project-specific and site-specific considerations, the County should determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s).

Comment: Another issue of concern is future development encroaching near land used for CO_2 storage. The land area containing wellbores and vicinity of this land area (e.g., within 1 mile) could conceivably not be suitable for public use for hundreds of years. The DEIR does not address whether or how land uses on surrounding properties might change (soon or in the long term) in ways that would increase the dangers posed by the project.

Mineralization of Injected CO_2

CTV states that full mineralization of CO_2 is expected to occur in two to five years (DEIR, 2024a) - a gross misstatement. If this were true, there would be little concern with geological storage of CO_2 at the CTV facility. Research is ongoing in formations having high divalent cation concentrations (iron, calcium, magnesium) (e.g., basalt) where mineralization is much more rapid. As correctly stated in the Class VI permit applications (EPA, 2024), based on previous studies on reactive transport modeling and geochemical reactions during geological storage, the amount of CO_2 predicted to be trapped by mineralization reactions at the TerraVault 1 Project is extremely small over a 100-year post injection time frame. For this reason, CO_2 mineralization was not included as a part of the compositional simulation modeling for Terravault (EPA, 2024).

Computational modeling indicates that CO_2 injected into the Monterey Formation 26R reservoir will be soluble in both water and oil. Due to remaining saturation of oil and water in the depleted reservoir, total dissolved CO_2 in oil and water is estimated to be 20% and 8% of the CO_2 injected respectively (EPA, 2024). Hence, 72% of injected CO_2 is expected to remain in a supercritical state for an extended period of time (e.g., thousands of years). In the A1 - A2 storage area, CTV states that because of low water saturation within the Monterey Formation A1 - A2 storage reservoir results in greater than 98% of the CO_2 injectate remaining supercritical phase, minimizing the quantity of CO_2 dissolving in formation water through time (DEIR, 2024b). The phase (supercritical fluid, dissolved in water or oil) and form (mineralization) of CO_2 is important because storage as a supercritical fluid is the least secure phase of storage while formation of carbonates during mineralization is by far the most secure form of storage.

Comment: Assessment of mineralization of injected CO_2 in Volume 1 of the DEIR is incorrect and contradicts Volume 2 of the DEIR and the Class VI permit applications. Mineralization of CO_2 is not expected to occur to any appreciable degree during storage in the 26R and A1 – A2 storage reservoirs. The DEIR must be updated to reflect an accurate assessment of mineralization and the additional potential impacts of CO_2 storage in a supercritical state. Also, less storage in water and oil than expected would result in a more rapid pressure increase than expected and necessitate updating computational modeling before the mandatory five-year reevaluation period.

Lateral Confinement to Storage Areas

The Elk Hills Oil Field is a large WNW-ESE trending anticlinal structure, approximately 17 miles long and over seven miles wide (DEIR, 2024b). With increasing depth, the structure subdivides into three distinct anticlines, separated at depth by inactive high-angle reverse faults (DEIR, 2024b). The project would be developed in two phases. In Phase 1, three new wells and one modified existing well used for enhanced oil recovery will be used to inject CO_2 into the Monterey Formation in the 26R reservoir portion of 31S anticline (DEIR, 2024a). In Phase 2, two modified wells used for enhanced oil recovery would be used to inject CO_2 into the Monterey Formation in the A1 - A2 reservoir portion of the Northwest Stevens anticline (DEIR, 2024a). CTV states that it plans to maintain the reservoir pressure at or beneath the discovery pressure of the reservoir to ensure that CO_2 does not migrate beyond the edges of the anticline structure (DEIR, 2024a).

Comment: CTV states that the Monterey Formation in the A1-A2 storage reservoir has "*minimal*" connection outside the Area of Review (DEIR, 2024b). The DEIR is vague about what this means for the project. Do anticlinal structures provide full containment or not? The Monterey Formation A1-A2 CO_2 sequestration reservoir is located in the Northwest Stevens anticline. As discussed by Zumberge et al. (2005), the Northwest Stevens anticline and the western 29R structure share some of the same turbidite sand bodies. Sandstone reservoirs on the two structures also share the same oil family. After filling of the Northwest Stevens anticline reservoirs, oil appears to have spilled into and filled the 24Z trap. This same oil family may also have reached the 2B trap on the east nose of the 29R anticline and the 26R reservoir at the west end of the 31S anticline, again moving within turbidite sand bodies from the Northwest Stevens structure. It appears then that there is hydraulic communication between the Monterey Formation inside and outside of the 26R and A1 - A2 storage areas and injection must be carefully managed to avoid migration of injected CO_2 outside of these storage areas (exceedance of spill point). From schematics provided by CTV (DEIR, 2024b), there are a large number of wellbores screened in the Monterey

Formation outside of storage areas. At least some of these wellbores should be converted to monitoring wells to monitor for both pressure perturbation and CO_2 leakage during injection.

Comment: CTV states that confinement of the Reef Ridge Shale has been demonstrated in the 26R reservoir by the injection of 841 billion cubic feet of gas and 114 million barrels of water with no leakage (DEIR, 2024a). CTV states that confinement of the Reef Ridge Shale has been demonstrated in the A1 – A2 reservoir by the injection of 175 billion cubic feet of gas and five million barrels of water with no leakage. Referring to the work by Zumberge et al. (2005), CTV further states that geochemical analysis of reservoirs confirms compartmentalization through several million years and effectiveness of the Reef Ridge Shale to contain the CO_2 injectate (DEIR, 2024b). However, as discussed in the previous comment, this geochemical analysis also confirmed migration of oil between anticlinal traps, which the DEIR does not disclose. More importantly, there is no discussion of how leakage was monitored. It does not appear that CRC used monitoring wells in the Monterey Formation outside the 26R and A1- A2 reservoir areas to evaluate migration of injected fluids beyond anticlinal structures associated with these formations. It also does not appear that CRC monitored oil and gas wells for gas leakage during enhanced oil recovery operations. Hence, until CRC or CTV provides sufficient documentation, the veracity of these claims cannot be independently evaluated. CTV should provide evidence for claims of full confinement during injection. As previously discussed, CTV should convert several existing oil and gas wells screened in the Monterey Formation outside storage reservoirs into additional monitoring wells.

Permanence Criteria and Monitoring Plan

The primary purpose of geological storage of CO_2 is mitigation of climate change. Leakage of CO_2 from a storage formation through wellbores will occur to at least some extent (Celia and Bachu, 2003). Hence, the important question is not whether there will be leakage, but whether the extent of leakage is acceptable (Celia and Bachu, 2003) and how leakage will be monitored and quantitated.

A leakage rate of less than 1% per thousand years is necessary for geological storage of CO_2 to achieve the same climate benefits as renewable energy sources (Shaffer, 2010). In a Special Report on Carbon Dioxide Capture and Storage, the Intergovernmental Panel on Climate Change (IPCC, 2005) stated that for a well selected, designed, operated and appropriately monitored system, the balance of available evidence suggests that it is very likely the fraction of stored CO_2 retained is more than 99% over the first 100 years and it is likely the fraction of stored CO_2 retained is more than 99% over the first 1000 years. Leak rates of 0.01% per year, equivalent to 99% retention of the stored CO2 after 100 years, may be adequate to ensure the effectiveness of CO_2 storage (Hepple and Benson, 2005). As part of an application for Sequestration Site Certification, the California Air Resources Board (CARB) requires a greater than 90% probability of occurrence that 99% of CO_2 will be retained in the storage complex over 100 years post-injection to be eligible to receive Permanence Certification required for operation in California (CARB, 2018). There are no storage effectiveness criteria in the Class VI federal regulations. This is a major regulatory deficiency that now must be resolved on a state-by-state level.

To assess the risk of leakage of CO_2 through wellbores, Callas et al. (2022) used a storage security calculator developed by Alcalde et al. (2018) to estimate the percent of CO_2 leaked for different densities of wells per square kilometer (km) in a well-regulated environment. Callas et al. (2022) determined that a well density greater than 8 wells/km^2 would result in more than 1% cumulative CO_2 leaked in 1,000 years in a well-regulated environment. They state that well densities of 8 wells/km^2 are of concern. They

categorize the density of existing or abandoned wells as >8 wells/km^2, 6–7 wells/km^2, 4–5 wells/km^2, 2–3 wells/km^2, and <1 well/km^2 as worst to best for wellbore leakage concerns. Given the presence of 354 well penetrations through the confining layer and a storage area of 5332 acres (21.58 km^2), a well penetration density of 16.4 wells/km^2 represents a worst-case scenario for permanence for geologic storage of CO_2. The presence of a large number of well penetrations necessitates a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection.

Comment: Information presented in the DEIR and Class VI permit applications does not support a finding that the project will retain 99% of stored CO_2 in excess of 100 years at cessation of injection, as required by the California Air Resources Board. Such a retention finding is not credible because: (1) the large number of wellbores (354) penetrating the Reef Ridge Shale serving as primary pathways for leakage, (2) the high pressure (~4,000 psi) (the driving force for leakage) of storage, (3) storage occurring primarily as a separate phase supercritical fluid resulting in direct contact of supercritical CO_2 with all 354 well penetrations, and (4) the high probability of elevated magnitude seismic activity in the vicinity of the project area capable of inducing levels of peak ground acceleration that would likely induce wellbore damage after plugging.

Comment: In Impact statement 4.8-1 - Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment, the level of significance before mitigation is categorized as potentially significant (DEIR, 2024a). In mitigation measure MM 4.8-1 it is stated that, "*Prior to any injection of CO2 the owner/operator shall submit a monitoring plan that complies with all requirements of the EPA UIC permit issued for the project to demonstrate the retention of CO_2 in the injection/hydrocarbon reservoir zone. The plan shall be submitted to the Kern County Planning and Natural Resources Department concurrent with submittal to the EPA for review. A copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department*" (DEIR, 2024a). The monitoring plan submitted in the Class VI permit applications and attached in Volume 2 of the DEIR does not directly consider leakage from well penetrations – the most likely source of loss of retention of CO_2. Hence, MM 4.8-1 is deficient and should be rejected. It will be necessary to combine continuous areal monitoring of leakage with periodic monitoring of individual well penetrations to ensure retention of CO_2 and to quantify leakage.

Use of 10% per Year Pressure Loss as a Leakage Verification Criterion

CTV states that in the 26R reservoir, starting in 1998, pressure maintenance ceased, and the gas cap reservoir was "blown-down", depleting reservoir pressure. Since blow-down, reservoir gas pressure has remained at 150-300 psig. At the 26R Reservoir, maximum allowable downhole pressure will vary from 3847 to 4294 psig with planned bottomhole injection pressure between 3558 to 4060 psig. The initial discovery pressure was 3,250 psig (DEIR, 2024b).

Comment: CTV states that computational modeling results calibrated with monitoring data (e.g., pressure) will be used to support that the plume has stabilized and that the pressure change is negligible (less than 10 psi per year) and poses no risk for potential vertical migration after cessation of injection (DEIR, 2024b). In the A1 - A2 Storage Area, CTV states that pressure at the injection wells are expected to stabilize within one year after injection ceases and that final pressure will target the initial reservoir pressure at the time of discovery (DEIR, 2024b). Again, CTV states that monitoring data will be reviewed to ensure that the CO_2 plume has stabilized post-injection and that the reservoir pressure change is

negligible (less than 10 psi per year) (DEIR, 2024b). CTV states that pressure stabilization will be used for non-endangerment assessment (DEIR, 2024b). There does not appear to be any corresponding discussion of a 10% per year pressure loss criterion for leakage verification in the Class VI permit applications. A simple back of the envelope calculation indicates that a pressure loss of 10 psi per year results in a decrease in pressure from 3250 psi (initial reservoir and final target pressure) to 2250 psi in 100 years resulting in appreciable CO_2 loss. In reality, the rate of pressure loss will decrease somewhat as pressure decreases in the formation (i.e., reduction in driving force). Nevertheless, this metric of leakage verification is not sufficiently sensitive to be of practical use and should be reexamined if not rejected for both the 26R and A1 - A2 storage areas.

Wellbore Abandonment Evaluation to Support Plugging

DiGiulio et al. (2023) found that approximately 9 of 27 (33%) of plugged oil and gas wells were leaking gas through vent pipes at the surface and 3 of 26 (10%) of plugged wells examined were leaking gas through soil at the surface in western Pennsylvania, clearly demonstrating that oil and gas wells can continue to leak gas after plugging. Kang et al. (2016, 2017) and DiGiulio et al. (2023) found mean emission rates of leakage of methane from plugged wells in western Pennsylvania were 360 and 390 g/d, respectively. However, the computation of the mean emission rate from plugged wells in the dataset from DiGiulio et al. (2023) excluded an outlier, a plugged well leaking at a rate of 83 kg/d. It is important to realize that these rates are from depleted oil and gas fields. Higher emission rates of gas (in this case CO_2) would be expected if reservoirs were repressurized as is the case for geological storage of CO_2 in depleted oil and gas fields such as at the TerraVault I Project. Emission rates from both unplugged and plugged oil and gas wells follow a distribution whereby leakage from a relatively small number of wells accounts for the majority of total leakage. It is plausible that leakage of CO_2 from abandoned wells would follow a similar distribution.

Wellbore integrity failure is not uncommon. Rates of wellbore integrity failure range from 2 to 75% (Davies et al., 2014). Recent analysis of state and provincial databases show that wellbore integrity issues are widespread in oil and gas well populations in Canada and the U.S. and are likely under-reported or not reported at all depending on the jurisdiction (Wisen et al., 2020; Lackey et al., 2021; Ingraffea et al., 2014, 2020; Abboud et al., 2021).

Wellbore integrity failures are not necessarily addressed through well plugging and can persist after the well is "properly" plugged (Bowman et al., 2023; Kang et al., 2021; Wisen et al., 2020). Surface casing vent flow or sustained casing pressure in an oil or gas well may be due to annular gas flow which may not have been properly addressed during plugging. Gas migration and surface casing vent flows require wellbore treatments such as cement squeezes and casing repair (Hachem et al., 2023; Ingraffea et al., 2014; Yousuf et al., 2021). The process of remediating subsurface leakage is typically more complex and expensive than the average plugging procedure (Raimi et al., 2021) but must be addressed prior to plugging. Once plugged, subsurface leakage via the annulus may go unchecked leading to persistent groundwater impacts and emissions to the atmosphere.

As stated in the Class VI permit applications, the permittee shall not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of injection, annulus or formation fluids into underground sources of drinking water (USDWs) or any unauthorized zones. The objective of this permit is to prevent the movement of fluids into or between USDWs or into

any unauthorized zones consistent with the requirements at 40 CFR 146.86(a) (EPA, 2024). Hence, even in the absence of a USDW in the 26R Reservoir, as a result of an aquifer exemption, the permittee cannot allow migration of CO_2 or other fluids (brine, oil) into overlying or underlying formations or to the surface.

Within the Area of Review the owners or operators must identify all potential conduits for fluid movement out of the injection zone, including both geologic features and artificial penetrations (40 CFR 146.84(c)(1)(iii)). The owner or operator must then evaluate artificial penetrations that may penetrate the confining layer(s) of the injection project for the quality of casing and cementing, and in the case of abandoned wells, for the quality of plugging and abandonment, and perform corrective action on any identified artificial penetrations that could serve as a conduit for fluid movement (40 CFR 146.84(c)(2), 146.84(c)(3), and 146.84(d)).

In its guidance document on Area of Review and Corrective Action, EPA emphasizes the need for a robust evaluation of both plugged and unplugged wellbores that penetrate the primary confining layer (EPA, 2013). EPA provides an extensive set of recommendations and guidelines for evaluation of artificial penetrations (EPA, 2013). Evaluation commences with review of available information including drilling logs, well completion and plugging reports, casing and cementing records, records on internal and external mechanical integrity tests, cement bond/variable density logs, information on well deviation, and wellbore diagrams (EPA, 2013). Information should also include testing for sustained casing pressure and surface casing vent flows which are indicators of wellbore integrity failures and increase the potential for gas emissions and groundwater contamination (Ingraffea et al., 2014, 2020; Lackey and Rajaram, 2019; Soares et al., 2021). Leak testing using procedures developed by Kang et al. (2016) could also be utilized to evaluate well integrity.

EPA states that if available records cannot establish wellbore integrity prior to plugging (e.g., corrosion in well casing and competent cement outside casing at critical locations such as at the interface of the injection zone and confining layer) additional testing is required (EPA, 2013). Additional testing could include multi-finger caliper logging, cement evaluation logging, internal and external mechanical integrity testing similar to that conducted on injection wells, and sidewall coring (EPA, 2013).

EPA also states that after all the available records have been reviewed, any wells located within the Area of Review that cannot be proven to have plugs adequate to prevent migration of carbon dioxide or formation fluids out of the injection zone must be evaluated by field tests in order to determine the quality of plugging, as required in the Class VI Rule (40 CFR 146.84(c)(3)) (EPA, 2013).

Comment: In the Class VI permit applications for the 26R Reservoir Area, CTV identified 204 wellbores that penetrate the Reef Ridge Shale. CTV states that three wells will be repurposed as monitoring wells, and one well, 373-35R, will be repurposed as a CO_2 injection well. CRC states that it has identified 157 wellbores that require plugging because the wellbores will not be used for injection or monitoring. Of the remaining 200 wellbores, 35 wellbores have been plugged back for sidetrack and have API-12 status for plugging and abandonment. No wellbores in the 26R Reservoir area have been permanently plugged back to surface. The disposition of the other 8 wellbores is unclear. It is also unclear why all 200 unused wellbores will not be plugged back to the surface prior to injection. In the DEIR, CRC states that 36 wellbores have been plugged back for sidetrack, leaving 164 wellbores that require standard plugging

procedures. Discrepancies in the number of wellbores requiring plugging between the Class VI permit applications and the DEIR need to be resolved.

Comment: In the DEIR, CTV states that 33 wells in the A1-A2 have been identified for abandonment. The DEIR must disclose the disposition of the other 78 unplugged wellbores, and the plan to plug back to the surface those wells that will not be used for injection or monitoring.

Comment: In Attachment B of Volume 2 of the DEIR, CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1 - A2 reservoirs that penetrate the Reef Ridge Shale - the primary confining layer in both storage areas. For the 26R Reservoir area, CTV states that "*Appendix 1*" lists the wells individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements. Despite several references throughout the DEIR, the DEIR fails to include Appendix 1 itself. In addition, there is no mention of preparation of the same type of Appendix for the A1 – A2 Reservoir area. A detailed wellbore-by-wellbore evaluation for both reservoirs will be necessary to assess wellbore integrity issues prior to plugging to plug wells in a manner to minimize leakage to the extent possible.

Comment: Class VI permit applications require "A tabulation of all wells within the area of review which penetrate the injection or confining zone(s). Such data must include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require" (§146.82(a)(4)). In the Class VI permit applications, CTV states that an appendix entitled "*Well Table with Corrective Action Assessment*" lists the wells individually and provides a description of each well's type, construction, date drilled, location, depth, and record of plugging and/or completion. This table also purportedly identifies pre-operational requirements and the corrective action assessment for each wellbore. Despite explicitly being required in the Class VI permit applications, the appendix with tabulation of wells with the Area of Review was not added to EPA's Class VI docket until 2/7/2024. In addition, the provided appendix is still missing critical information and riddled with vague and indefinite terms. For example, in its tabulation, records of plugging and/or completion only consist of dates. Records of plugging and/or completion should at least include wellbore schematics including actual details of plugging and completion. The table also repeatedly evaluates the annular isolation within the upper confining later as "*adequate*" which fails to provide any meaningful criteria or performance standards. Information submitted in this regard by CTV is insufficient and does not appear to be in compliance with §146.82(a)(4).

Moreover, inclusion of what appears to be part of the DEIR's missing Appendix 1 in EPA's Class VI docket does not absolve Kern County from its own obligation to include the full Appendix with the DEIR for public review and comment, and to use it to inform its own analysis of impacts and appropriate mitigation for the CTV 1 project. The failure of the DEIR to include the Appendix means the DEIR must be recirculated with the missing information included. CTV should submit all information associated with wellbores relevant to wellbore integrity (e.g., internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, cement squeeze operations, etc.).

Comment: In the Class VI permit application for the 26R Reservoir, CTV states that it accessed internal databases as well as California Geologic Energy Management Division information to identify and confirm wells within the Area of Review (EPA, 2024). CTV states that the corrective action assessment included the generation and detailed review of wellbore/casing diagrams for each well in the Area of

Review (EPA, 2024). Information used in the review included depths and dimensions of all hole sections, casing strings, cement plugs, and other wellbore equipment that isolates portions of the wellbore or otherwise establishes plugback depth (EPA, 2024). Perforated intervals are described with depth and status of perforations. Top of cement determination supported the review for annular isolation. Depths to relevant geologic features such as formation tops and injection zone were reviewed for both measured and true vertical depths (EPA, 2024). The depth of the confining zone in each of the wells penetrating the Reef Ridge shale was determined through open-hole well logs and utilized the deviation survey to convert measured depth along the borehole to true vertical depth from surface (EPA, 2024). All of this information is missing in the DEIR. This information (wellbore diagrams, cement evaluation logs, internal and external mechanical integrity tests, etc.) should immediately be made available to the public. This information is critical in determining the retention of CO_2 in storage reservoirs. A detailed wellbore-by-wellbore evaluation is necessary to assess wellbore integrity issues prior to plugging in order to plug wells in a manner that minimizes leakage to the extent possible.

Comment: In the DEIR, CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1-A1 reservoirs (DEIR, 2024b). No wellbores were deemed deficient in either reservoir and none require corrective action. This is a 0.0% wellbore barrier failure rate for 354 wellbores, at odds with the published rates of wellbore failure rates ranging from 2-75% in the literature. Since no information (sustained casing pressure, surface casing vent flow, gas migration in soil, internal and external mechanical integrity testing, cement evaluation logs, wellbore diagrams, drilling logs, etc.) was provided, it is impossible to verify the accuracy of this statement, which should be regarded with a degree of skepticism. It does not appear that EPA conducted an independent evaluation of wellbore integrity of well penetrations. It is both inappropriate and negligent to simply accept a statement of no wellbore barrier failure without supporting information. Again, all supporting information (wellbore diagrams, cement evaluation logs, internal and external mechanical integrity tests, etc.) should immediately be made available to the public to enable an independent evaluation of wellbore integrity.

Comment: In the Corrective Action Plan (EPA 2024), CTV states that all wellbores within the Area of Review will, "*if necessary*", be pressure tested prior to abandonment and monitored and/or have a technical demonstration of adequate zonal confinement prior to the commencement of CO_2 injection or based on an agreed upon phased schedule after CO_2 injection commences, "*if conditions allow*". It is unclear as to what conditions would preclude pressure testing. What is a demonstration of adequate zonal confinement? These statements are far too vague to be of any use. Hence, this Corrective Action Plan is unacceptable. Under CEQA, all feasible mitigation is required. The terms of the Corrective Action Plan do not constitute all feasible mitigation. Since all wellbores penetrating the confining layer will be in direct contact with supercritical CO_2 at high pressure, internal (pressure) and external (e.g., temperature, noise, oxygen-activation logging) mechanical integrity tests should logically be conducted on these wellbores prior to plugging and abandonment, similar to regulatory requirements for plugging injection wells.

Comment: In the A1-A2 area, CTV states that it assessed USDW protection using the following criteria: (1) surface or intermediate casing over the USDW; (2) if the well is abandoned, a cement plug across base of USDW; and (3) cement in the annulus in intermediate casing above the surface casing shoe and "*sufficient*" annular cement within the confining Reef Ridge Shale. Since all wellbores will be exposed to supercritical CO_2 for presumably thousands of years at high pressure in both the 26R and A1-A2 reservoirs, it is critical that existing wellbores not being used for injection or monitoring be plugged in a

manner consistent with regulatory requirements for plugging injection wells (4 plugs). As per Class VI regulations, all well penetrations should include a cement plug through the primary confining zone, and/or across the injection zone/confining zone contact, with sufficient integrity to contain separate-phase carbon dioxide and elevated pressures. Cement plugs should also be located across the bottom of any casings and at the base of the lowermost USDW. A surface plug would also typically be required by local well abandonment regulations to ensure that there is no risk of anyone physically falling into the well bore. Materials that are compatible with CO_2 must be used where appropriate (40 CFR 146.84(d)). A wall-to-wall barrier throughout the confining layer is critical to zonal isolation of CO_2. If well casing is not removed prior to plugging, the integrity of annular cement must be verified through the use of external mechanical tests and recent cement evaluation logs.

Comment: As stated in the Class VI applications, the Etchegoin Formation is between the Reef Ridge confining zone and the Upper Tulare Formation, is continuous across the Area of Review, and will dissipate CO_2 injectate that may migrate upward from the injection zone. The Etchegoin will be monitored continuously for pressure and temperature changes at one monitoring well in the 26R Reservoir. The DEIR does not adequately explain why there is only one monitoring well in Etchegoin. What is the minimum magnitude of leakage that would be detected from pressure perturbation from the injection well located at the greatest distance from the monitoring well? The permittee needs to evaluate this to justify the existence of only one monitoring well in the Etchegoin Formation.

Comment: In the Class VI permit applications, CTV states that surface air monitoring, including broad aerial monitoring and targeted monitoring at wells and pipelines, will be conducted using eddy covariance towers (DEIR, 2024b). In regard to leakage to the atmosphere, under 40 CFR Part 98 Subpart RR, an operator must submit a proposed monitoring, reporting, and verification (MRV) plan to EPA within 180 days of receiving a final Class VI permit (§98.448(b)(2)). As part of the MRV plan, the operator must: (1) "identify potential surface leakage pathways for CO_2 in the maximum monitoring area and the likelihood, magnitude, and timing, of surface leakage of CO_2 through these pathways" (§98.448(b)(2)); (2) develop "a strategy for detecting and quantifying any surface leakage of CO_2" (§98.448(b)(3)); and (3) develop "a strategy for establishing the expected baselines for monitoring CO_2 surface leakage" (§98.448(b)(4)). Hence, leakage to the atmosphere will be considered at some point. However, a monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage. MM 4.8-1 needs to include specific monitoring for leakage from plugged and unplugged well penetrations. Methods employed by Kang et al. (2016) can be used for CO_2 monitoring at both plugged and unplugged wells.

Seismic Risk Evaluation

Of particular concern at the TerraVault I project is the effect of natural or induced seismicity on wellbores. After a well is permanently plugged and abandoned, natural or induced seismicity can damage wellbores. For example, hundreds of oil well casings were sheared in the Wilmington oil field in Los Angeles during five or six earthquakes of relatively low seismic moment magnitude (**M** 2 to **M** 4) during a period of maximum subsidence in the 1950s (Dusseault et al., 2001). The seismic moment magnitude is the product of the area of rupture, the average displacement on the fault (a fracture or zone of fracture between two blocks of rock), and the shear modulus, a parameter related to the rigidity of rocks in the fault zone measured on a logarithmic scale (GWPC, 2021). Recently, Pozzobon et al. (2023) documented increased

leakage of gas from plugged oil and gas wells resulting from seismic activity due to injection of produced water into disposal wells and hydraulic fracturing.

Impacts of earthquakes on buildings and pipelines, including those that are buried, have long been an active area of civil engineering research. There are empirical estimates of pipeline damage that relate the number of repairs to peak ground acceleration, peak ground velocity, maximum ground strain, and other factors. There is a need to extend this existing body of research to subsurface wellbore leakage caused by earthquakes (Kang et al., 2019). Hence, seismic monitoring and hazard assessment should be based not only on the magnitude of seismic event but on ground motion.

USEPA's Class VI regulations require permit applicants to provide a determination that seismic activity will not compromise subsurface containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)). The Class VI rule provisions do not address potential damage to buildings and infrastructure (including wellbore cement sheaths of active and abandoned wells) associated with geologic storage of CO_2. However, as part of its permanence requirements for geologic sequestration, the California Air Resources Board (CARB) has developed requirements which include consideration of natural and induced seismicity (CARB, 2018). In the California Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard (CARB, 2018), if an earthquake of $\mathbf{M} \geq 2.7$ is detected within a radius of one mile of CO_2 injection operations, a determination must be made whether the mechanical integrity of any well, facility, or pipeline within this radius has been compromised. This protocol however does not consider a naturally occurring major seismic event at distance from an injection well which could induce ground movement damaging wellbores. In addition, the California Energy Commission has developed guidelines to evaluate the potential for induced seismicity during geological storage of CO_2 (CEC, 2017).

Given uncertainty in potential impact due to natural and induced seismicity during geological storage of CO_2, protocols developed by U.S. Department of Energy's (DOE) Recommended Practices for Managing Induced Seismicity Risk Associated with Geologic Carbon Storage (Templeton et al., 2021, 2023) should be used when permitting a facility for geological storage of CO_2. This integrated and risk-based protocol is a product of the DOE's National Risk Assessment Partnership, a multi-year collaborative research effort of Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, National Energy Technology Laboratory, and Pacific Northwest National Laboratory. This protocol specifically addresses the risk of seismicity at a geologic carbon storage facility and is relevant to CO_2 injection at Carbon TerraVault I. Recommendations by Templeton et al. (2021, 2023) and regulatory requirements and guidelines by EPA and the State of California are used here as the basis of evaluation for the seismicity portion of the permit application.

Review of Applicable Local, State, and Federal Laws and Requirements on Seismicity

Relevant local, state, and federal laws and regulations should be reviewed to determine how induced seismicity, however minor or unlikely, is regulated and its effects prevented or mitigated (Templeton et al., 2021). In California, the Alquist-Priolo Earthquake Fault Zoning Act (1972) and the Seismic Hazards Mapping Act (1990) direct the State Geologist to delineate regulatory "Zones of Required Investigation" to reduce the threat to public health and safety and to minimize the loss of life and property posed by earthquake-triggered ground failures and other hazards. Cities and counties affected by the zones must regulate certain development projects within them, based on the CA CGS Information Warehouse: Regulatory Map Portal (https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/). As

stated in the DEIR, the Carbon TerraVault I project does not appear to be within a Zone of Required Investigation. In the DEIR, Kern County reviewed compliance with other applicable laws and regulations for this project.

Review of Naturally Occurring Seismic Events and Delineation of a Region of Concern

To support a Class VI rule application, an owner/operator is required to submit a narrative description and information on the seismic history of the area, including the presence and depths of seismic sources, and a determination that seismicity will not interfere with containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)).

CARB requires an evaluation of the seismic history of the proposed sequestration site, including the date, magnitude, depth, and location of the epicenter of seismic sources and a determination that the seismicity would not cause a catastrophic loss of containment, either by breaching the integrity of the well or the sequestration formation (CARB 2018).

To evaluate the impact of a major naturally occurring seismic event distant from a site on a site, it is necessary to define a Region of Concern (ROC). The ROC is defined as the area in which a ground motion threshold over the lifetime of a project could be exceeded causing impact to infrastructure (Templeton et al., 2021), which in this case includes wellbores. An assessment or literature search should identify any tectonic events that may have occurred in the region and a map and catalog should be created for seismic events which have occurred within at least 200 km from the reservoir (Templeton et al., 2021).

Previous seismic activity should be characterized within a region of at least 200 km radius around planned injection operations to ensure that wider regional trends are considered in the seismic hazard assessment (Templeton et al., 2021, 2023). This consideration reduces the possibility of overlooking infrequent but possibly large events that could impact the local hazard. Elements of the seismicity characterization should include:

- Catalogs of instrumentally recorded earthquakes from national, state, or regional agencies.
- Historical records of earthquakes and observed fault ruptures, including but not limited to, historical earthquake catalogs, and newspaper and other contemporary records, and published reports of field geological investigations. Historic reports of significant earthquakes can provide important information on time periods that predate instrumental recording. For rare events that occur once every few hundred to thousands of years, this may be the only evidence of seismic activity.
- Fault maps and fault characterizations, including but not limited to, scientific maps and publications.
- Paleoseismic fault displacement data, including but not limited to, published trenching studies.
- Previous induced earthquake activity, including but not limited to, earthquake catalogs and scientific publications investigating possible induced activity. If the targeted region has a history of induced seismicity, this would be a strong indication of a critically stressed crust.

In Volume II of the DEIR, Soils Engineering Inc. conducted a review of naturally occurring seismic events since 1852. Their identified Region of Concern however was limited to 100 km from the Carbon

TerraVault I project. Major faults within this area are illustrated in Figure 1. From 1852 through 2020, southern California has experienced at least 20 major earthquakes with estimated Richter scale magnitudes ranging from 5.9 to 8.0. As Soils Engineering Inc. discuss, the nearest major active faults in the western portion of the CTV Project are the San Andreas Fault located approximately 23.0 to 23.3 km to the southwest, the Kern Front Fault located approximately 39.7 to 39.9 km to the northeast, the Pleito Fault located approximately 48.3 to 48.7 km to the southeast, the White Fault located approximately 48.6 to 48.9 km to the east-southeast, and the Buena Vista Fault (minor active fault) located approximately 15.42 km to the southeast. The nearest major active faults in the eastern portion of the CTV Project are the San Andreas Fault located approximately 23.9 to 24.6 km to the southwest, the Kern Front Fault located approximately 35.5 to 36.8 km to the northeast, the White Fault located approximately 39.2 to 42.5 km to the east-southeast, the Pleito Fault located approximately 40.0 to 42.9 km southeast, and the Buena Vista Fault located approximately 9.41 km to the southeast.

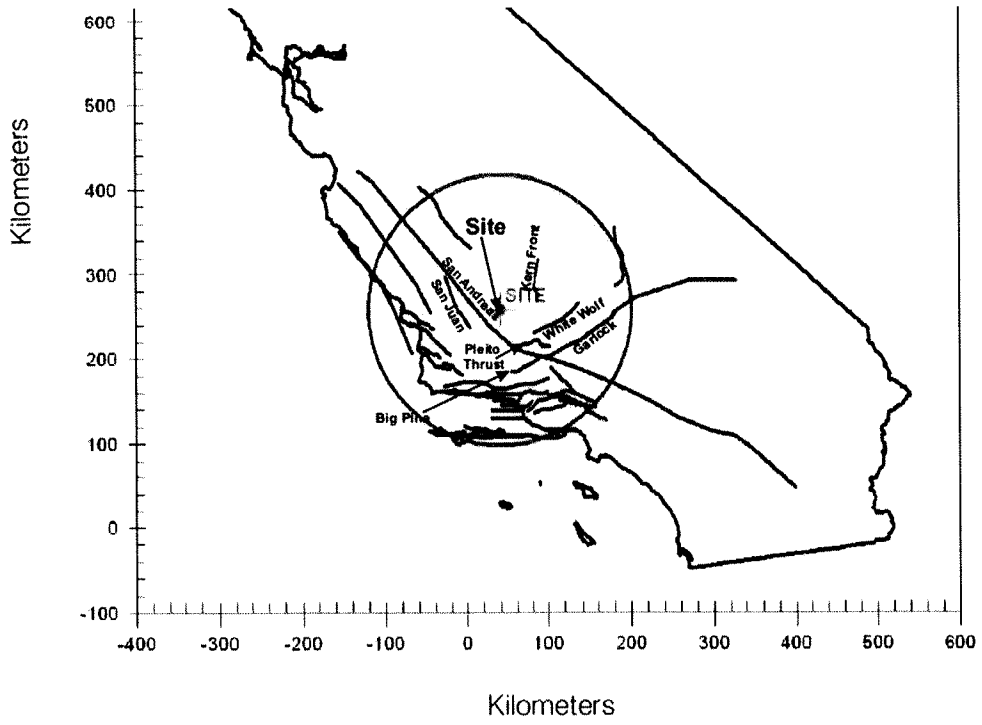

Figure 1. Identification of major faults in the vicinity of the TerraVault 1 Project. Figure from Soils Engineering, Inc. in Vol 2. of DEIR.

Some of these faults have produced earthquakes in excess of seismic moment magnitude **M** 7 (Figure 2). The San Andreas fault is a strike-slip fault (two blocks slide horizontally past each other). The 1857 **M** 7.9 Fort Tejon earthquake along the San Andreas fault, with an epicenter (the surface location directly above the depth or hypocenter where rupture is initiated) in Parkfield, CA (Figure 3) was one of the greatest earthquakes ever recorded in the United States. The San Andreas fault broke the surface continuously for at least 350 km (220 miles), possibly as much as 400 km (250 miles). In Figure 3, the estimated earthquake intensity using the Modified Mercalli (MM) scale (Table 1) is estimated with distance from the epicenter. Intensity is a qualitative measure of the strength of shaking at a specific place

and is characterized in terms of impact of shaking on individuals as well as on objects and structures. It is not a measure of the size of the earthquake.

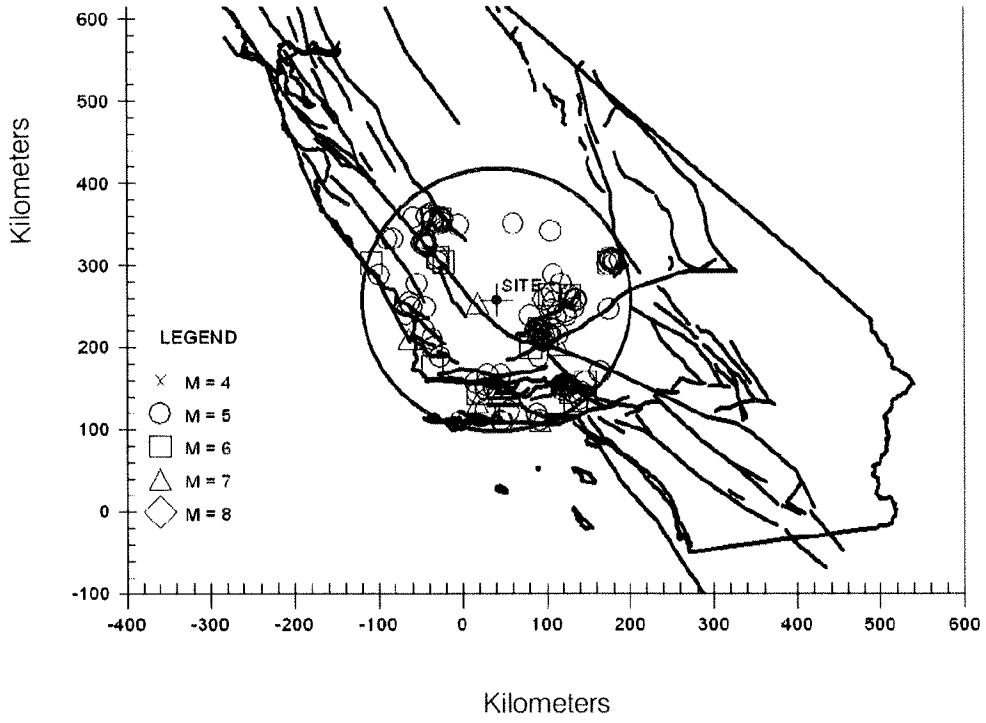

Figure 2. Magnitude of earthquakes along major faults in the vicinity of the CTV project. Figure from Soils Engineering, Inc. in Vol 2. of DEIR.

During the Fort Tejon earthquake, horizontal displacement as much as 9 meters was observed on the Carrizo Plain. As a result of the shaking, the current of the Kern River was turned upstream, and water ran four feet deep over its banks. The waters of Tulare Lake were thrown upon its shores, stranding fish miles from the original lake bed. The waters of the Mokelumne River were thrown upon its banks, reportedly leaving the bed dry in places. The Los Angeles River was reportedly flung out of its bed, too. Some of the artesian wells in Santa Clara Valley ceased to flow, and others increased in output. New springs were formed near Santa Barbara and San Fernando (USGS, 2023).

At the time of the earthquake, California was sparsely populated, especially in the regions of strongest shaking. Were the Fort Tejon shock to happen today, the damage would easily run into billions of dollars, and the loss of life would likely be substantial (USGS, 2023). Strong shaking was reported to have lasted for at least one minute but possibly lasted two or three minutes. The portion of the fault that ruptured in 1857 has settled into a period of dormancy and this has given rise to suggestions that future slip along that zone may be characterized by a very large 1857-type event followed by another period of inactivity (Sieh, 1978).

The Elkhorn Thrust, a thrust fault (reverse fault having a shallow or low angle dip) near the San Andreas fault, may have slipped simultaneously in the 1857 Fort Tejon quake indicating that future movements along the San Andreas fault zone might produce simultaneous rupture on thrust faults causing a "double

earthquake" (Southern California Earthquake Center). Reverse faults (hanging wall moves up and over the foot wall) are common in southern California and other areas experiencing tectonic compression (GWPC, 2021).

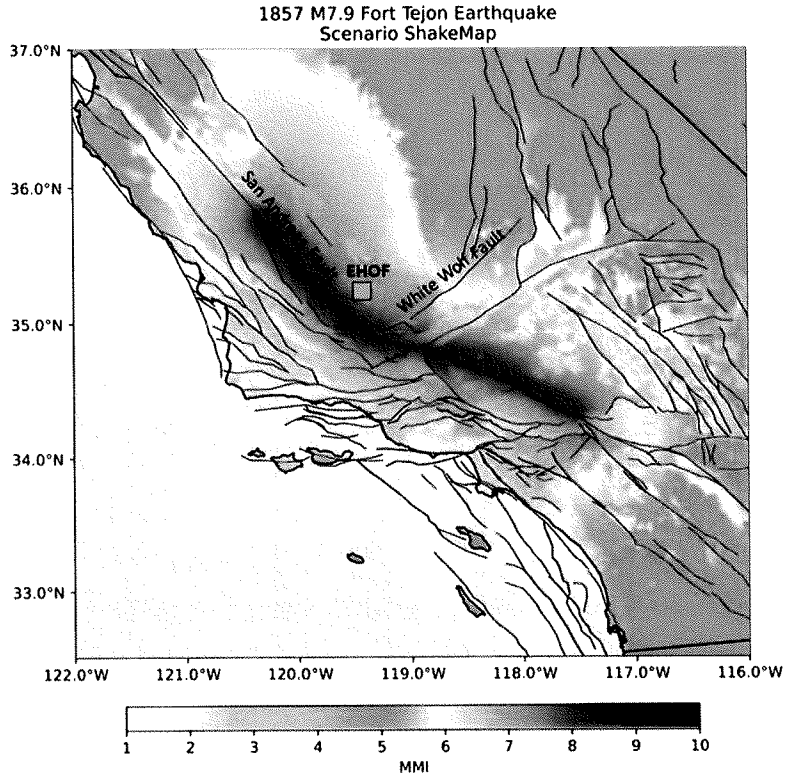

Figure 3. Location of faults in southern California and of the 1857 Tejon earthquake on the San Andreas Fault and estimated Modified Mercalli Intensity. The Epicenter illustrated by dark blue star. Approximate location of Elk Hills Oil Field (EHOF) illustrated by light blue box. San Andreas and White Wolf Faults identified. Figure modified from Southern California Earthquake Data Center.

As discussed by Soils Engineering, Inc. in Volume 2 of the DEIR, an earthquake of **M** 8.0 has been estimated for this segment of the San Andreas Fault having a conditional probability of occurrence of 0.1 (10%) over the 30-year period of 1988 to 2018. Other segments of the San Andreas fault include the Cholame (north) and Mojave (south) segments. Their respective distances from the site and characteristic magnitudes are 58 miles and **M** 7.3 (Cholame) and 78 miles and **M** 7.8 (Mojave). The associated conditional probabilities of occurrence, for the 30-year period of 1988 to 2018 were 0.3 (30%) for both segments.

The White Wolf Fault is a high-angle reverse fault with a small component of left-lateral slip. Movement along this fault was the cause of the **M** 7.5 1952 Bakersfield Earthquake, which most consider to be the third largest historic quake in California, after the 1857 Tejon and 1906 San Francisco quakes. The White Wolf fault is traceable for only about 48 km (34 miles), much less than the fault length typically thought necessary to produce such a major earthquake. The earthquake caused severe damage as far away as Las Vegas. In addition, there were at least 20 aftershocks of **M** 5 or greater associated with the initial **M** 7.5 event (San Joaquin Valley Geology).

Table 1. Modified Mercalli Intensity, peak ground acceleration (PGA), and peak ground velocity (PGV) for the central United States. Source: GWPC (2021).

MMI	Description	PGA (g)	PGV (cm/sec)	Observations (Richter 1958)
I	Not felt	< 0.00007	< 0.003	Not felt except by a few under especially favorable circumstances.
II to III	Weak	0.0008	0.04	Felt by only a few people, often indoors. Hanging objects swing. May not be recognized as an earthquake.
IV	Light	0.01	0.5	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frames creak.
V	Moderate	0.05	3.0	Felt outdoors; direction estimated. Sleepers awakened, liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Strong	0.09	6.5	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken.
VII	Very strong	0.15	14	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices, un-braced parapets, and architectural ornaments. Some cracks in masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII	Severe	0.27	30	Steering of motor cars affected. Damage to masonry; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

Ground motion can cause structural and nonstructural damage to buildings as well as to civil structures, such as dams, bridges, highways, railroads, tunnels, pipelines, tanks, and airport runways. It is commonly accepted that structural damage to modern engineered structures generally happens for earthquakes larger than **M** 5.0 (GWPC, 2021). For example, for the National Seismic Hazard Maps, which are the basis for the building code in the U.S. (International Building Code), the USGS uses a minimum magnitude of **M** 5.0 in the western U.S. and **M** 4.75 in the central and eastern U.S. in their hazard calculations (Petersen et al. 2014). Poorly designed or constructed buildings, such as unreinforced masonry, for example, brick and adobe, and buildings built before modern building codes can be subject to nonstructural damage at magnitudes as low as **M** 4.0 and, in some rare cases, as low as **M** 3.0 (GWPC, 2021). It is unclear what magnitude seismic event would be sufficient to cause damage to wellbores. However, as previously stated, seismic events below **M** 3 or 4 can damage wellbores. Hence, the California Carbon Capture and Sequestration Protocol requiring a determination of integrity of any well, facility, or pipeline when an earthquake of $\mathbf{M} \geq 2.7$ has been detected within a radius of one mile of CO_2 injection operations is reasonable.

Comment: CTV states that during the 1952 Kern County earthquake, there were no reservoir containment issues associated with oil and gas operations at the Elk Hills Oil Field. While the 26R reservoir was discovered in the 1940s, it is stated in Volume 2 of the DEIR that the Monterey Formation reservoir in the

26R anticline was not developed until 1970's. Also, the A1-A2 reservoir was not discovered until the 1970s. Hence, CTV's statement in this regard is misleading and should be removed from the DEIR.

Hazard Evaluation of Natural Seismic Events

Comment: Seismic risk is calculated from four main contributing factors. The first factor is seismic hazard, which is the probability of exceedance of a specified ground motion intensity. The second factor is exposure, which is the infrastructure or population potentially affected by seismicity. The third factor is fragility, which is the susceptibility of each element of exposure to damage from ground motion intensity. The fourth factor is consequence, which is the metric chosen to quantify the risk (e.g., economic impact, loss of CO_2 containment) (Mitchell and Green, 2017). The seismic risk analysis conducted in the DEIR is deficient because it fails to consider all four factors, especially for legacy wells which were not considered at all. In the DEIR, hazard curves were generated, however, legacy wells were not identified as part of exposure to seismicity. Fragility functions were not identified for any infrastructure including legacy wells and the consequences of leakage through legacy wells were not quantified. Hence, a comprehensive seismic risk analysis was not conducted in the DEIR.

Hazard curves can be generated to evaluate a given percent probability of exceedance of a peak ground acceleration or spectral acceleration level over a period of time (e.g., 10% probability of exceedance in 50 years). Peak ground acceleration is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake. It is an index to hazard for short stiff structures. Spectral acceleration is a measure of the maximum force experienced by a mass on top of a rod having a particular natural vibration period. Short buildings (e.g., less than 7 stories) have short natural periods (e.g., 0.2-0.6 sec). Tall buildings have long natural periods (e.g., 0.7 sec or longer) (USGS). Peak ground acceleration appears to be the appropriate metric to evaluate potential to wellbores.

Templeton et al. (2021) state that a site-specific probabilistic seismic hazard analysis should be conducted in accordance with current practice of earthquake hazard estimation to evaluate the baseline hazard from natural tectonic seismicity. Input into the site-specific probabilistic seismic hazard analysis should include the following:

- A database of potentially damaging earthquake sources that may impact the ROC, that experienced activity during the Quaternary Period (past 1.6 million years), including fault-specific sources and areal sources where appropriate. Areal seismic sources are distinct volumes within the Earth's crust that encompass concentrated zones of seismicity,
- Spatial, temporal, and frequency-magnitude distribution models for each seismic source.
- Region appropriate ground motion models for tectonic earthquakes as a function of at least earthquake magnitude and travel path. A ground motion model relates a ground motion parameter such as peak ground acceleration or peak ground velocity to magnitude, distance, and site condition. There are numerous models for tectonically active regions, such as the western U.S. (GWPC, 2021). The models for the western U.S. rely on empirical motion data obtained from instrumental records of earthquakes or numerical modeling in the absence of adequate strong motion data. Empirical models are often developed by performing a statistical regression on a ground motion parameter from the recorded data to find the best fitting model. Current ground motion models do not extend below **M** 3.0 (GWPC, 2021). Common inputs into a ground motion model include magnitude, distance, and site condition. For small earthquakes generally less than

M 4, hypocentral distance is an adequate distance metric. For larger events, a distance metric that accounts for the finite dimensions of the fault rupture area is desirable. For most models, rupture distance (the shortest distance to the fault plane) is used (GWPC, 2021). Site condition inputs also are required to accurately predict ground shaking, particularly at a soil site (GWPC, 2021).

- Information from geological, geophysical, and topographical studies within the ROC should be included to incorporate local site responses.

Templeton et al. (2021) state a seismic hazard report should be prepared by a licensed professional having demonstrated competence in the field of seismic hazard assessment. The seismic hazard report should contain site-specific assessments of the seismic hazard affecting the project and relevant sites within the ROC. The report should identify any known seismic hazards that could adversely affect relevant sites within the ROC in the event of an earthquake. Results from the probabilistic seismic hazard analysis should include multiple hazard curves and hazard maps to report the results from the baseline seismic hazard analysis due to natural seismicity before injection operations commence. Federal and state permitting agencies should then independently review the seismic hazard report to determine the adequacy of the hazard evaluation. The reviews should be conducted by licensed professionals having demonstrated competence in the field of seismic hazard assessment.

Volume 2 of the DEIR contains a report entitled "Preliminary Soil and Geologic Evaluation Terra Vault 1 Carbon Capture Project Elk Hills" completed by Soil Engineering Inc. that contains a probabilistic seismic hazard analysis for the facility. Soils Engineering Inc. used the computer modeling program EQSEARCHWIN version 3.0 (Thomas Blake) to evaluate historical earthquakes in the area of the site over the last 200 years. The largest estimated site accelerations are 0.221g (Section 36) to 0.295g (Section 7/18) from a 7.9 magnitude earthquake on January 9, 1857.

A number of active faults are located within a 50-mile radius of the subject site. Soils Engineering Inc. used the computer modeling program EQFaultwin vers. 3.0 (Thomas Blake) to evaluate the effect that a major earthquake within a 50-mile radius might have on the site. The program computed the maximum peak site ground accelerations resulting from an earthquake. Results of this analysis are presented in Table 2.

This analysis estimates that a maximum peak ground acceleration of up to 0.258g would be felt at the site as a result of a maximum earthquake of magnitude 8.0 on the San Andreas Fault approximately 23 to 24.6 kilometers away. A maximum probable earthquake of magnitude 7.3 on the White Wolf Fault approximately 39.2 to 39.9 kilometers away would create a peak site ground acceleration of up to 0.146g at the site.

Soils Engineering Inc. then utilized USGS's Unified Hazard Tool (USGS, 2024) to generate hazard curves for the site which was re-produced for this report in Figure 4. The USGS program calculates peak ground and spectral acceleration at a site for all the earthquake locations and magnitudes believed possible in the vicinity of the site. Each of these magnitude-location pairs is believed to happen at some average probability per year. Small ground motions are relatively likely, large ground motions are very unlikely. Beginning with the largest ground motions and proceeding to smaller, probabilities are summed to calculate a total probability for a particular period of time (USGS).

Table 2. Identification of faults near the site and associated maximum earthquake magnitude, estimated maximum peak ground acceleration at the site, and associated site intensity. Table from Soils Engineering, Inc. in Vol 2. of DEIR.

FAULT	Approximate Distance (Km)	Maximum Earthquake Magnitude (Mw)	Maximum Peak Ground Acceleration	Estimated Site Intensity (MM)
San Andreas (Other Segments)	**23 to 24.6**	7.4 to **8.0**	0.128 to **0.258**	VIII to **IX**
Kern Front	35.5 to 39.9	6.3	0.085 to 0.093	VII
White Wolf	39.2 to 48.9	7.3	0.123 to 0.146	VIII
Pleito Thrust	40.0 to 48.7	7.0	0.105 to 0.122	VII
San Juan	42.6 to 47.6	7.1	0.093 to 0.101	VII
San Luis Range	72.8 to 76.2	7.2	0.083 to 0.086	VII
Big Pine	64.9 to 73.4	6.9	0.060 to 0.066	VI
Great Valley 14	79.6 to 85.7	6.4	0.050 to 0.052	VI
Garlock (west)	70.3 to 73.6	7.3	0.069 to 0.076	VI to VII

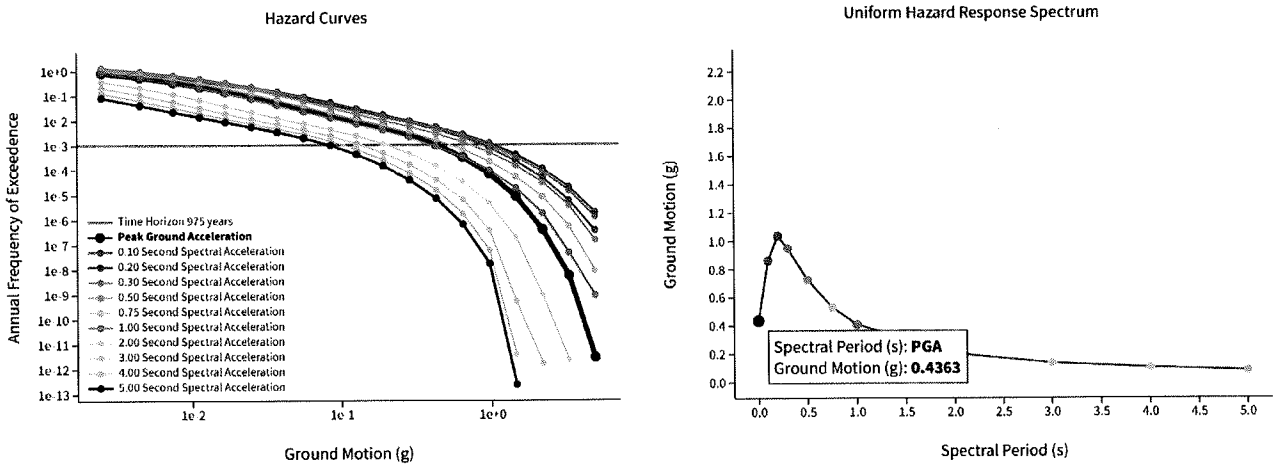

Figure 4. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 5% in 50 years. For an annual frequency of exceedance of 1.025E-03 or return period (inverse of frequency of exceedance) of 975 years, peak ground acceleration = 0.4363g (43.63% of the gravitational constant).

For the project location, a peak ground acceleration rate of 0.4363g was estimated having a 5% probability of exceedance in 50 years with an annual rate of exceedance = 1.025E-03 or a return period of 475 years (DEIR, 2024b). The return period or time horizon is the inverse of the annual rate of

exceedance. Using the USGS "rule of thumb" for calculating return period, this is approximately equivalent to a 9.8% probability of exceedance in 100 years, a 42% probability of exceedance in 500 years, and a 69% probability of exceedance in 900 years. A further examination of the hazard curves (Figure 5) (not included in the DEIR) indicates a peak ground acceleration of 0.3175g having a 10% probability of exceedance in 50 years, 19% probability in 100 years and a 64% probability of exceedance in 400 years. Care was taken in these calculations to ensure that $r^* \leq 1$ where $r^* = r(1+0.5r)$ and r = probability as recommended by USGS (USGS, 2024).

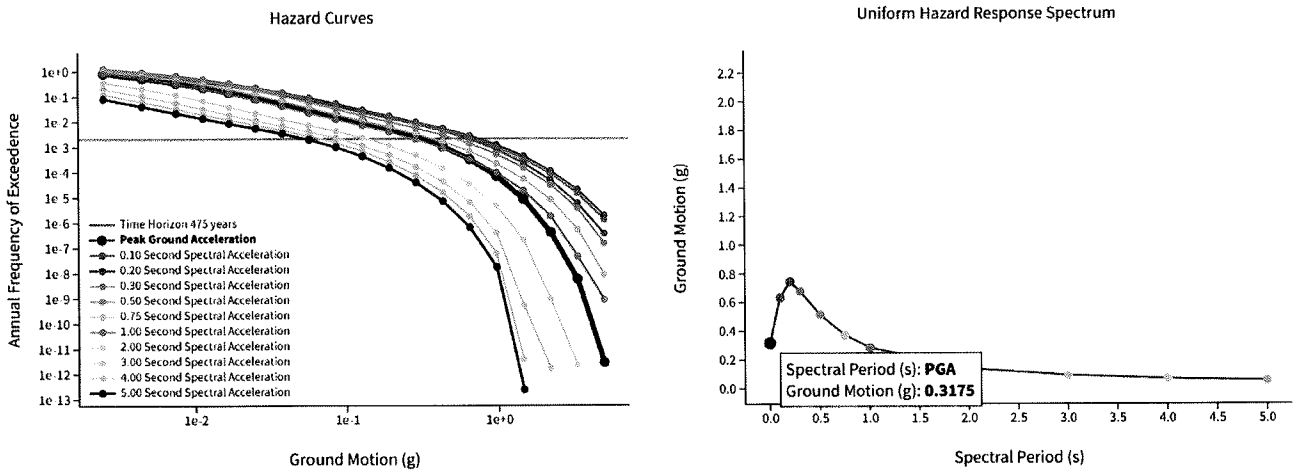

Figure 5. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 10% in 50 years. For an annual frequency of exceedance of 2.105E-03 or return period (inverse of frequency of exceedance) of 475 years, peak ground acceleration = 0.3175g (31.75% of the gravitational constant).

Comment: In Volume 1 of the DEIR, in Impact 4.7-1, it is stated, *"an earthquake may disturb surface and/or subsurface facilities, possibly resulting in loss, injury, or death. Impacts from seismic hazards are considered potentially significant without mitigation and MM 4.7-1 would be required to reduce these potential impacts to a less-than-significant level for this individual project impacts."* Mitigation measure 4.7-1 consists of preparing *"a comprehensive seismic activity monitoring plan that includes, but is not limited to, connection to the Statewide seismic monitoring program of California Seismic Network (CISN)...The final plan shall be approved by the California Air Resources Board and include all requirements of State law including but not limited to: Appropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; Identification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures. All requirements for seismic monitoring adopted by the California Air Resources Board – Carbon Capture, Removal, Utilization and Storage Program shall be implemented."*

While a seismic monitoring plan would be able to detect an earthquake, a seismic monitoring program would not reduce damage to surface and subsurface facilities (e.g., wellbores). Unlike induced seismicity as a result of injection of CO_2, monitoring of natural seismicity is not mitigation. Cement used outside of well casing is a brittle material susceptible to damage from ground motion. Hence, a seismic monitoring program would not mitigate damage from a natural major earthquake within 100 km of the Carbon TerraVault I project to a less-than-significant level. In the presence of moderate seismic activity at the

project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores. The Level of Significance for Impact 4.7-1 should be changed from Less than Significant to Significant and Unavoidable.

Comment: In Volume 2 of the DEIR, Soils Engineering Inc. states, *"Project proponent will design structures in accordance with state and county code requirements for seismic ground shaking and geotechnical and geohazard constraints. Designs shall comply with seismic, soil response at the site, and structural dynamic characteristics contained in the Kern County Code of Building Regulations and the California Building Code and State of California design standards Chapter 16 and 18. These design standards are required by law for all new structures in Kern County and were established to reduce the potential impact to structures from strong seismic shaking to a less than significant level."*

These regulations do not address wellbore integrity, however. It is not clear whether wellbores can withstand a peak ground acceleration of 0.258g, let alone peak ground accelerations of 0.3175g or 0.4363g. A peak ground acceleration of 0.27 g is associated with a Modified Mercalli Intensity of VIII with observations including: steering of motor cars affected; damage to masonry and some masonry walls; twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks; frame houses moved on foundations if not bolted down; loose panel walls thrown out; changes in flow or temperature of springs and wells; and cracks in wet ground and on steep slopes. Hence, this mitigation measure is not appropriate, at least for wellbores like those that would be impacted at Elk Hills. Also, Templeton et al. (2021) state that an evaluation of the anticipated losses as a function of ground motion intensity can be achieved either directly by using vulnerability functions or indirectly through the use of fragility functions. Vulnerability functions directly relate ground motion intensity to anticipated losses. Fragility functions relate ground motion intensity to the probability of damage and are often expressed as either loss ratio curves, damage probability matrices, or fragility curves (Templeton et al., 2021). There does not appear to be vulnerability and fragility functions associated with oil and gas wellbores. However, based on a Modified Mercalli Intensity of at least VIII, wellbore damage would reasonably be expected from a major seismic event within 100 km of the Carbon TerraVault I project. The Level of Significance for Impact 4.7-2 should be changed from Less than Significant to Significant and Unavoidable. In the presence of moderate seismic activity at the project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores.

Comment: CARB requires that an operator use appropriate tools to characterize potential risks of adverse impacts on the environment, health, or safety, by combining the assessment of the probability of occurrence and the magnitude of the adverse impacts of identified project risk scenarios. Risk scenarios identified as part of this assessment must be classified high risk, medium risk, or low risk, according to the combination of probability of occurrence during a 100-year period and the severity of potential consequences (Table 3). Given an approximately 10% and 20% probability of a of a major seismic event inducing a peak ground acceleration of 0.44 g and 0.32 g, respectively, at the TerraVault I Project area, it is difficult to understand how CTV categorized risk as low to medium (Table 4). Risk in assigned scenarios should be classified as high. At a minimum, this high risk classification should mandate robust evaluation and monitoring of wellbore integrity.

Table 3. CARB Risk scenario classification.

	Insubstantial[2]	Substantial[2]	Catastrophic[2]
> 5%[1]	Medium risk	High risk	High risk
1-5%[1]	Low risk	Medium risk	High risk
< 1%[1]	Low risk	Medium risk	Medium risk

1 Probability of occurrence over 100 years
2 Severity of potential consequences

Table 4. Risk Assessment Results from Volume 2 of DEIR

Scenario	Consequence	Probability	Risk
Injection or Monitoring Well Failure	Insubstantial	<1%	Low
Equipment failure	Insubstantial	<1%	Low
Natural Disaster	Insubstantial to Catastrophic	<1%	Low/ Medium
Fluid Leakage to Shallow Groundwater	Insubstantial	<1%	Low
CO_2 leakage to Atmosphere	Insubstantial to Catastrophic	<1%	Low/ Medium
Induced Seismic Event	Insubstantial	<1%	Low
Well Operations (drilling/workover)	Insubstantial to Catastrophic	<1%	Low/ Medium

Additional Hazard from Induced Seismicity

Induced seismicity is of concern for faults that are optimally oriented, critically stressed, and of sufficient size to cause damage sufficient to induce leakage of sequestered CO_2. Leakage of CO_2 could occur through a damaged confining layer, from activation of faults penetrating a confining layer, or through wellbore damage.

Induced seismicity considerations in the Class VI regulations are largely limited to CO_2 migration through faults penetrating the confining layer. EPA (2013) states that use of seismic hazard maps to demonstrate the reasonable expectation that no induced seismic events would occur during the course of a CCS project may fulfill the requirements at 40 CFR 146.82(a)(3)(v). However, if such maps indicate a substantial likelihood of seismic activity, other required geologic information, such as geomechanical data, depth to confining zones, and fault stability analysis may be needed to demonstrate that seismic activity will not compromise subsurface containment (EPA, 2013) An owner/operator is required to determine the "location, orientation, and properties of known or suspected faults and fractures that may transect the confining zone(s) in the Area of Review, along with a determination that they will not interfere with containment" (40 CFR 146.82(a)(3)(ii)). The owner/operator is also required to demonstrate the presence of a "confining zone(s) free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced fluids" (40 CFR 146.83(a)(2)).

It is stated in the Class VI permit applications that in 2019 three-dimensional (3D) seismic survey data was re-processed to allow a more focused structural image around tight folds and faults (EPA, 2024). Offsetting the 31S anticline are high-angle reverse faults that are oriented NW-SE. It is stated that these inactive faults penetrate the lowest portions of the Monterey Formation but not the lower Reef Ridge Shale above the Monterey Formation in the 26R reservoir. It is also stated the 26R reservoir is continuous across the Area of Review and the sands pinch-out up-dip and on the channel edges. As such, the 26R reservoir has minimal connection outside the Area of Review creating a reservoir with no connection to regional saline aquifers (EPA, 2024). The emphasis of EPA regulations are on upward migration of brine and CO_2 as opposed to downward propagation of pressure. The concern with faults in the Monterey Formation may be uncertainty associated with potential propagation of pressure below the storage formation, such as has occurred during disposal of produced water in Class II disposal wells and during hydraulic fracturing.

Increased subsurface fluid injection activity has led to increased seismicity at some sites, including near oil and gas wastewater (produced water) disposal sites, hydraulic fracturing sites, and engineered geothermal systems (Ellsworth, 2013; Keranen and Weingarten, 2018; Templeton et al., 2020). Induced seismicity has raised concerns about the scalability of geologic storage of CO_2 considering the seismic hazard and risk associated with far-reaching subsurface pressurization and adjacent basement rocks (Zoback and Gorelick, 2012; White and Foxall, 2016). Even in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of **M** 4 (Templeton et al., 2023).

Seismogenic response to fluid injection may vary strongly from site to site and between different injection intervals (Templeton et al., 2023). Weingarten et al. (2015) and Schultz et al. (2018) show that the potential for inducing earthquakes in wastewater disposal and hydraulic fracturing, respectively, correlates positively with the total injected fluid volume and the rate of injection. However, the causative mechanisms of induced seismicity and geomechanical conditions at injection sites are diverse and involve many poorly constrained or unknown parameters. Significant uncertainties on the likelihood of inducing seismicity can persist even after careful characterization. It is not fully understood why some operations can cause significant induced seismicity while others do not (Templeton et al., 2021).

Before 2011, the **M** 4.8 event in 1967 near Denver, Colorado, was the largest event widely accepted in the scientific community as having been induced by fluid injection. The Rocky Mountain Arsenal earthquakes demonstrated how the diffusion of pore pressure within an ancient fault system can initiate earthquakes many kilometers from the injection point, delayed by months or even years after injection ceased (Hermann et al. 1981). The **M** 5.7 event in November 2011 in central Oklahoma is now the largest known induced seismic event (Kerenan et al., 2013). This earthquake damaged homes and unreinforced masonry buildings in the epicentral area and was felt as far as 1000 km away in Chicago, Illinois.

Seismicity may be induced tens of kilometers away from large-scale injection. The occurrence of seismicity farther away from injection implies that stress changes much smaller than 1 MPa may be sufficient to trigger seismicity even in naturally quiescent areas. Recent studies indicate that effective stress changes on the order of 100 kPa (14.5 psig) or less can found near earthquake hypocenters (Keranen et al., 2014; Barbour et al., 2017; Norbeck and Rubinstein, 2018; Zhai et al., 2020).

Even faults capable of **M** 5 earthquakes may be previously unknown. In many of the induced seismicity cases, faults that hosted even the largest events > **M** 5 were not known beforehand (Templeton et al.,

2023). Even natural events, such as the 2014 Napa, California earthquake, often occur on blind faults (Brocher et al., 2015). This can be related to the difficulty of imaging faults in basement rocks or the lack of vertical offset in the sedimentary overburden from subvertical strike-slip faults.

The largest injection-induced events have all involved faulting that is considerably deeper than the injection interval (Horton, 2012), suggesting that transmission of increased pressure into the basement elevates the potential for inducing earthquakes. Hence, during geologic storage of CO_2, it is important that pressure perturbation from injection not be transmitted below depths of injection.

Few commercial scale geologic CO_2 storage sites exist that can be used as prototypes to study induced seismic response. The Cogdell CO_2 enhanced oil recovery project has been associated with felt earthquakes. The seismicity in the Cogdell project has been attributed to the very high injection rates and the presence of faults in the reservoir (Gan and Frohlich 2013). At the Illinois basin–Decatur project and the associated Illinois Industrial Carbon Capture and Sequestration Sources project, as of 2022, 2.8 million metric tons of CO_2 have been injected into the Mt. Simon saline sandstone reservoir with detection of nearly 20,000 seismic events with **M** up to 1.2, although none have been felt at the surface (Williams-Stroud et al., 2020). As a result of seismic activity, injection was moved to a shallower zone within the Mt. Simon sandstone resulting in fewer seismic events (Williams-Stroud et al., 2020).

Dvory and Zoback (2021) state that since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

One study of particular relevance to the Carbon TerraVault I project is a potentially injection-induced earthquake swarm in 2005 associated with the WhiteWolf Fault (Goebel et al., 2016). It was comprised of a **M** 4.5 event on 22 September, followed by two **M** 4.7 and **M** 4.3 events the same day. The White Wolf swarm is suspected to be connected to fluid-injection activity at the Tejon Oil Field based on a statistical assessment of injection and seismicity rate changes (Goebel et al., 2015). Injection wells at the Tejon Oil Field targeted a 25–30 m thin, highly permeable stratigraphic zone within the Monterey formation composed of turbiditic sand lenses with maximum lateral extents of 1 to 2 km (Goebel et al., 2016). Recall that turbiditic sand lenses are targeted for CO_2 storage at the Carbon TerraVault I project.

Based on geological mapping, seismicity, and well-log data, Goebel et al. (2016) identified a seismically active normal fault referred to as "Tejon Fault" in proximity to the Tejon Oil Field which deepened (7.7 km) toward the northwest below the Wheeler Ridge fault before intersecting with the White Wolf Fault 8 km from injection wells (Figure 6). Pressure diffusion was likely influenced by a 11 km high permeability pathway along the seismically active part of the Tejon fault (Goebel et al., 2016). Numerical modeling indicated that for a fault zone permeability above ~300 mD and fault width below ~800 m, a pressure increase of just 0.01 MPa (1.5 psi) was sufficient to induce seismicity on a fault favorably oriented to slip (Goebel et al., 2016) as also observed by Keranen et al. (2014) and Hornbach et al. (2015). Given the discussion here, the primary concern at the Carbon TerraVault I project is pressure transmission below the Monterey Formation, not above it. Investigative studies have demonstrated that pressure propagation can occur over large distances and depths during injection of fluids and that a very small pressure differential

can induce seismicity. Hence, analysis conducted by CTV in the DEIR and Class VI permit applications does not eliminate the potential for inducted seismicity at the Carbon TerraVault I project.

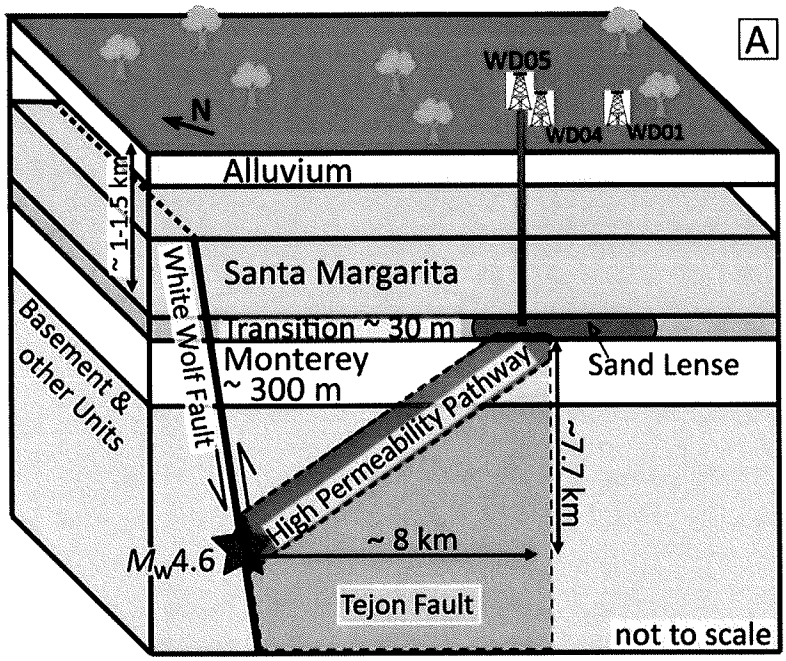

Figure 6. Schematic representation of pressure migration along a high-permeability fault between the Tejon Oil Field and a M 4.6 seismic event along the White Wolf Fault.

Comment: For induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the DEIR adequately consider induced seismicity. Callas et al. (2022) state that lack of a lower confining seal (permeability > 100 nD) (nD = nanodarcy) is a disqualifying threshold for geologic storage of CO_2 because of potential pressure propagation to basement rock capable of producing seismic activity. According to schematics provided in Volume 2 of the DEIR, the Reef Ridge Shale bounds both the upper lower Monterey Formation and has an average permeability of 0.01 mD (mD=millidarcy) or 10,000 nD. As discussed, in the 26R and A1 - A2 Storage Areas, CTV states that final pressure will target the initial reservoir pressure at the time of discovery. Hence, this would decrease but not eliminate the possibility of induced seismicity.

Seismic Monitoring Network Design

The Class VI regulations do not include an explicit requirement for a seismic monitoring plan. However, in its Class VI Implementation manual for UIC Program Directors, EPA states that concerns about seismicity or uncertainties about the seismic history of the site raised during site characterization may necessitate the inclusion of passive seismic monitoring (EPA, 2013).

Seismic data needs to be gathered, analyzed, and archived during the lifetime of a project for geologic storage of CO_2. These data are needed to accurately assess and periodically reassess the natural and

induced seismic hazard and risk associated with the project and to aid in the rapid and effective detection and characterization of the seismicity at the site. This data is especially needed as input into induced seismicity mitigation plan protocols (e.g., traffic light systems). In general, the National Earthquake Information Center (NEIC) and other national or state monitoring systems are not sufficient for monitoring induced seismicity at a facility for geologic storage of CO_2 (Templeton et al., 2021). Routine detection of small events in the immediate vicinity of the injection site is necessary to detect problematic developments as early as possible.

The California Carbon Capture and Storage Review Panel recommended that seismic risks be considered during the operation and monitoring of CO_2 storage projects and stated that specialized seismic monitoring may be warranted (California Institute for Energy and Environment, 2010). The CARB protocol for CO_2 sequestration requires that the operator deploy and maintain a permanent, downhole seismic monitoring system to determine the presence or absence of any induced micro-seismic activity associated with all wells and near any discontinuities, faults, or fractures in the subsurface (CARB, 2018). Templeton et al. (2023) state that to record seismicity within the ROC, it is expected that the footprint of the seismic network would need to extend beyond the ROC. In the 26R Reservoir and A1 - A2 Area of Review areas, CTV will monitor seismicity with a network of surface and shallow borehole seismometers. Specifically, CTV will deploy 6 sensor locations (borehole and near surface) most of which are outside the Area of Review. CTV states that this data will help establish historical natural seismic event depth, magnitude, and frequency in order to distinguish between naturally occurring seismicity and induced seismicity resulting from CO_2 injection.

The Technical Advisory Committee to the California Carbon Capture and Storage Review Panel recommended that monitoring for induced seismicity should begin during the site selection and assessment phase to establish a baseline record of the natural background seismicity in the region encompassed by the project using the state's existing seismometer network augmented by a local network. Templeton et al. (2023) recommend that prior to commencing injection operations, a seismic monitoring network should be operated for at least 6 months but preferably 1 year or longer and be designed to detect and characterize seismicity occurring in the ROC down to at least **M** 1. CTV states in the Class VI permit application that a seismic monitoring network will establish an understanding of baseline seismic activity within the area of the project and that historical seismicity data from the Southern California Seismic Network will be reviewed to assist in establishing the baseline.

Comment: Templeton et al. (2023) state that a local seismic monitoring network should include a combination of high-gain sensors, which can optimally record weak ground motions from small local earthquakes, and low-gain accelerometers, which can optimally record strong ground motions from nearby larger earthquakes. Templeton et al. (2023) also state that each seismic station should measure ground motion in three orthogonal directions (e.g., up-down, north-south, and east-west) to fully capture the movement of the seismic waves as they travel through the earth. CTV states that high-sensitivity 3-component geophones will be utilized for seismic monitoring (DEIR, 2024b). CTV also states that CTV will monitor data from nearby (~5-8mi) existing broadband seismometers and strong motion accelerometers of the Southern California Seismic Network. It is unclear whether the seismic monitoring network is of sufficient robustness. CTV should provide additional information on specification of geophones to be used for seismic monitoring.

Comment: Information on the resolution of the CTV I seismic network is lacking and should be provided in the DEIR and Class VI permit applications. Templeton et al. (2023) state that the network should be able to record and locate seismicity in the ROC with at least a 2-sigma location accuracy of 0.5 km in the horizontal direction and 1.0 km in the vertical direction.

Comment: Templeton et al. (2023) state that seismic monitoring networks should be designed, and stations located such that ground velocities of 600 nm/s can be recorded with a signal-to-noise ratio of at least 6 in the frequency range 5–40 Hz within the ROC. Information on the signal-to-noise ratio in the seismic network is lacking and should be provided in the DEIR and Class VI permit applications.

Comment: Templeton et al. (2023) state that the data should be recorded using at least a 24-bit digital data acquisition system and a global positioning system-based field timing system to achieve the required timing accuracy of at least 1 ms. CTV states that waveform data is to be transmitted near real-time via cellular modem or other wireless means and archived in a database (DEIR, 2024b). Timing accuracy was not specified in the DEIR and the Class VI permit applications.

Seismicity Mitigation Plan

If the project operator obtains evidence that an earthquake has caused a failure of the mechanical integrity of wells, facilities, or pipelines, which may cause potential CO_2 emissions to the atmosphere, the project operator must implement an Emergency Remedial Response Plan (CARB, 2018). The operator should create a site-specific induced seismicity mitigation plan for the DEIR based on a Traffic Light System (TLS) framework (Templeton et al., 2023). Templeton et al. (2023) state that the TLS framework should include at least three response levels, indicating operation as usual (green), heightened awareness and reassessing and modifying as appropriate of injection operations (yellow), and stopping injection (red). In the Class VI permit application, CTV created a five-response level (green, yellow, orange, magenta, red) seismicity mitigation plan.

Comment: CTV established response levels based on the magnitude of a seismic event. For an induced seismic event having **M** > 2.0, in the Class VI permit application, CTV states that it will initiate gradual shutdown of the injection wells if it is determined "*appropriate*". Words like "*appropriate*" are vague and don't provide measurable performance criteria, per CEQA requirements. CTV also states that it will monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure, and identify and implement appropriate remedial actions in consultation with the UIC Program Director (DEIR, 2024b). There is no mention of evaluation of any other wellbores, which is a critical oversight.

The CARB protocol for CO_2 sequestration requires that the operator continuously monitor for indication of an earthquake of **M** 2.7 or greater occurring within a radius of one-mile of injection operations. If an earthquake of **M** 2.7 or greater is identified, CARB, in consultation with the project operator and the California Geological Survey, or local geological survey or equivalent, must conduct an evaluation of the following: (a) whether there is indication of a causal connection between the injection activity and the earthquake; (b) whether there is a pattern of seismic activity in the area that correlates with nearby

injection activity; and (c) whether the mechanical integrity of any well, facility, or pipeline within the radius specified in subsection C.4.3.2.3(b) has been compromised (CARB, 2018). Hence, if induced seismicity having a magnitude of **M** 2.7 or larger occurs, the operator must conduct an evaluation of the integrity of *all* wellbores including those plugged and abandoned.

Comment: The preliminary results of the seismic evaluation must be reported to CARB within 30 days following the earthquake, with a final report submitted within 120 days (CARB, 2018). The report must include, at a minimum: (1) the date, time, and magnitude of the earthquake; (2) the location and distance of the epicenter from the CCS project; (3) the results of the investigation into the link between the injection activity and the earthquake or pattern of seismicity; (4) any emergency and remedial actions taken; (5) a description of any investigations and tests conducted to assess the mechanical integrity of wells and other surface equipment, and a demonstration that the well and equipment were either not damaged by the earthquake or that mechanical integrity was restored prior to the re-initiation of injection; and (6) any identified changes necessary to the CCS project Testing and Monitoring Plan (CARB, 2018). There is no mention of reporting of seismic events to CARB anywhere in the seismicity mitigation plan.

Comment: Templeton et al. (2023) state that the seismicity mitigation plan should provide a clear description of mandatory and optional actions and procedures at each of the response levels. CTV repeatedly used the term *"if appropriate"* for initiation of injection well shutdown. The term appropriate is not defined and hence is ambiguous. Words like "*appropriate*" are vague and don't provide measurable performance criteria, per CEQA requirements. It is unclear precisely under what conditions initiation of shutdown would commence for yellow, orange and magenta operating states.

Comment: Of perhaps greater concern are naturally occurring seismic events at distance from the facility. In these cases, a seismic mitigation plan specified in terms of peak ground velocity or ground acceleration would be more useful in the DEIR and Class VI permit application.

Conclusions and Recommendations

There is interest in using depleted oil and gas reservoirs, such as the Carbon TerraVault I project for geological storage of CO_2 due to extensive preexisting geological characterization and infrastructure. Also, since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

However, well penetrations are widely recognized as a primary pathway for leakage during geologic storage of CO_2. There are an extraordinarily large number of wellbores (354) penetrating the primary confining layer (Reef Ridge Shale) at the Carbon TerraVault I project. Leakage through wellbores will be facilitated by the high pressure of storage (~4,000 psi) and storage occurring primarily as a separate phase supercritical fluid. All 354 wellbores will eventually be in direct contact with highly pressurized supercritical CO_2 – a highly corrosive medium.

Complicating matters further is the fact that that the Carbon TerraVault I project is located in an area of high natural seismicity. The probability of a natural seismic event capable of causing wellbore damage in the project area is quite high (~20% within 100 years). Given the large number of well penetrations, high

pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. The success or failure of geologic storage of CO_2 at the Carbon TerraVault I project will largely depend on minimizing leakage from well penetrations.

The importance of properly evaluating wellbores prior to plugging to determine the need for corrective action and evaluating wellbores that have been plugged sometime in the past cannot be stressed enough. Unfortunately, only a table identifying well penetrations was provided in the Class VI permit applications. No identification of well penetrations was provided in the Draft Environmental Impact Report. CTV claims that no wellbores require corrective action – a claim that must be viewed with considerable skepticism since wellbore integrity failure rates published from oil and gas sites in the literature range from 2 to 75%.

In one column of the table provided in the Class VI permit applications, annular isolation of wellbores within the upper confining later is subjectively described as "*adequate.*" No proof of adequacy of any wellbore beyond those used for injection was provided in the DEIR or Class VI permit applications. CTV should immediately submit all supporting information (drilling logs, well completion and plugging reports, casing and cementing records, records on internal and external mechanical integrity testing, cement bond/variable density logs, and wellbore diagrams) to the public record. Also, EPA should conduct an evaluation of each well penetration – something that the agency should have done but does not appear to have done so. Simply accepting CTV's claim of adequacy is unacceptable.

In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, neither the DEIR nor the Class VI permit applications should be approved.

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Attachment A
to Technical Comments of Dominic DiGiulio, PhD:
Qualifications and Experience

Dominic DiGiulio

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Background

I am a retired geoscientist from the U.S. Environmental Protection Agency. I have conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. I assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide. I have served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. My consulting services have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

Education

B.S., Environmental Engineering, Temple University, Philadelphia, PA (1982)
M.S., Environmental Science, Drexel University, Philadelphia, PA (1988)
Ph.D., Soil, Water, and Environmental Science, University of Arizona, Tucson, AZ (2000)

Employment

Independent Consultant: Feb 2023 - present

Research Affiliate: University of Colorado, Boulder, CO: October 2020 - present. I conduct research on the impact of abandoned wells on air, surface water, and groundwater quality.

Senior Research Scientist: PSE Healthy Energy, Oakland, CA: Jan 2017 – Feb 2023. My research focused on evaluating the impact of oil and gas development on water resources and air quality. In addition to publishing findings of my research in peer-reviewed journals and reports, I provided testimony on oil and gas development rule-making, served as an expert witness in litigation against oil and gas corporations, and have testified before Congress on the impact of oil and gas development on water resources.

Research Associate: Stanford University, Stanford, CA: Apr 2014 – May 2019. I conducted research on the impact of oil and gas development to groundwater.

Environmental Engineer: U.S. Environmental Protection Agency, Office of Research and Development, Ada, OK: Sep 1988 – Mar 2014 (retired). Duties included providing regulatory oversight assistance to

EPA remedial project managers and conducting research related to subsurface gas flow and vapor transport. Research included: (1) Development of methods to improve the effectiveness of soil vapor extraction, bioventing, and air sparging subsurface remediation systems including lead authorship of EPA's primary technical resource document in these areas; (2) Co-development of analytical solutions and associated codes for estimation of gas permeability and gas flow in soil; (3) Development of analytical solutions to simulate combined solute and vapor transport in soil including lead authorship of the model *VFLUX;* (4) Development of field methods to improve active soil-gas sampling especially pertaining to leak and purge testing; (5) Development of forensic techniques (use of hydrocarbon degradation products and radon) and assistance in development of EPA guidance to evaluate vapor intrusion (migration of organic compounds from ground water to indoor air); (6) Development of ground water and soil gas monitoring strategies including assistance in development of EPA's Class VI rule on geologic sequestration of carbon dioxide; (7) Development of methods to evaluate impact to Underground Sources of Drinking Water (USDWs) under the Safe Drinking Water Act and stray gas migration due to hydraulic fracturing. Research activities included conducting seminars, workshops, and short courses to States.

Environmental Engineer (Remedial Project Manager: U.S. Environmental Protection Agency, Region III, Philadelphia, PA: Jun 1980 – Dec. 1981 and Sep 1982 – Jan 1988. Duties included: conducting investigations (e.g., remedial investigations, risk assessments, feasibility studies, sample collection) under the Comprehensive Environmental Response and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA), federal contractor oversight, preparation of consent orders and initiation of enforcement actions.

Military Service: U.S. Marine Corps: Active duty 1975-1978, Camp Pendleton, CA, Honorable Discharge in 1981.

Scientific Awards

5 EPA Bronze Medals: (1) Development of EPA Guidance Document on Soil Vacuum Extraction, (2) Technical Support to EPA's Program and Regional offices on Subsurface Gas Flow and Vapor Transport, (3) Development of EPA Guidance on Vapor Intrusion, (4) Research on Vapor Intrusion, (5) Development of Class VI Rule on Geologic Sequestration of Carbon Dioxide

3 EPA Honor Awards: (1) Development of a National Risk Management Research Laboratory Strategic Research Plan, (2) Development of a Protocol to Assess Vapor Intrusion; (3) Technical support at Leaking Underground Storage Tank Sites

3 EPA Scientific and Technological Achievement Awards: (1) Innovative Design of Soil Vacuum Extraction Systems, (2) Development of Analytical Model to Simulate Transient Flux of Volatile Organic Compounds in Soil to Ground Water and the Atmosphere, (3) Simulation of Geochemical Impacts to Ground Water from Leakage of Carbon Dioxide

Peer-Reviewed Journal Publications, Reports, and Book Chapters

Tisherman, R.; Rossi, R.J.; Shonkoff, S.B.C., DiGiulio, D.C. **2023**. Groundwater Uranium Contamination from Produced Water Disposal to Unlined Ponds in the San Joaquin Valley. *Science of the Total Environment*, Vol. 904, 15 December 2023, 166937

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Hill L.L., Czolowski E.D., DiGiulio D.C, Shonkoff S.B.C. **2019**. Temporal and spatial trends of conventional and unconventional oil and gas waste management in Pennsylvania, 1991–2017. *Science of the Total Environment* 674, 623-636.

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Ruybal C.J.; Wilkin R.T.; Rue K.D., McCray J.E., DiGiulio, D.C. **2018**. A New Equilibrator Design for Rapid Detection of Methane in Groundwater during Purging. *Environmental Engineering Science* 35(9)

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Rossi, R.J.; DiGiulio, D.C. **2023**. Documenting Known Abandoned Wells in Proximity to Potential Carbon Storage Formations in Louisiana.

DiGiulio, D.C. **2023**. Evaluation of Stray Natural Gas in the Amber Norrid Domestic Water Well Near Abandoned Oil Wells in Hanover Township, Washington County, Pennsylvania. September 3, 2023

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ATTACHMENT C

Accufacts Inc.
"Clear Knowledge in the Over Information Age"

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Redmond, WA 98052
Ph (425) 802-1200
kuprewicz@comcast.net

February 26, 2024

Attn: Earthjustice
Michelle Ghafar
50 California Street, Suite 500
San Francisco, CA 94111

Re: Observations concerning Kern County's Draft Environmental Impact Report ("DEIR") on the TerraVault I Carbon Capture and Storage Project ("Project").

A. Summary of DEIR.

The above referenced DEIR makes many statements that are confusing or misleading, lacking critical information to allow decision makers, including the public, to make an informed evaluation and decision about the proposed Project from this document. It appears that many of these statements relate to safety jurisdiction of various agencies, which based on my extensive experience, are confusing, if not misleading. It appears that the Project is getting ahead of badly needed safety regulatory efforts, either at the state or federal level before prudent safety regulations can be developed and implemented. Section 3 below identifies eight areas where the DEIR needs to be supplemented with important details before this Project is allowed to proceed. Lack of such detail has served to be a recurring problem across the U.S. as states and local governments wrestle with serious gaps in pipeline safety regulations for CO_2 pipelines as a result of an onslaught of multibillion dollar proposals incentivized by recent federal tax credits. A 2022 paper identifies at least eight serious deficiencies in current federal minimum pipeline safety regulations concerning liquid CO_2 pipelines summarized as follows:[1]

1. The definition of carbon dioxide needs to be updated.
2. Scientifically based regulation on impact areas for CO_2 pipeline ruptures needs to be promulgated.
3. Regulatory reference to industry recommended practices should be avoided.
4. Fracture propagation protection on CO_2 pipelines needs to be codified.
5. The use of odorant in CO_2 pipelines should be mandated.
6. Pipeline operations and maintenance manuals should require specific coordination with local emergency response personnel.
7. Maximum contaminant impurities for CO_2 pipelines should be specified.
8. Regulations for conversion of existing pipelines to CO_2 service should be developed.

[1] Richard B. Kuprewicz, President of Accufacts Inc., prepared for the Pipeline Safety Trust, "Accufacts' Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.," March 23, 2022, pp. 12 &13.

B. The TerraVault 1 Carbon Capture and Storage Project DEIR - a simple synopsis.

The TerraVault 1 Project proposes to capture CO_2 from the existing Elk Hills oil field, produced by separating a portion of the pre-combustion field gas production into "high-purity" CO_2 streams at two existing or relocated cryogenic and fractionation natural gas plant facilities identified as "CGP-1." The term high purity is not defined in the DEIR, but is a critical parameter given that existing federal minimum pipeline safety jurisdiction currently establishes a CO_2 purity of more than 90% in a poorly worded definition of carbon dioxide.[2]

The high-purity CO_2 streams will then be transported from the two CGP-1 processing/treating locations by "Facility Pipelines" which will be newly constructed pipelines.[3] The DEIR also uses the term Injection Pipelines. The definition of both Facility Pipelines and Injection Pipelines needs to be clarified as well as their transition boundaries as these terms have specific meaning in the industry and affect regulatory safety jurisdictions, if any, of various federal and state agencies that might become involved.

The DEIR indicates that new pipelines of up to 16-inches in diameter, approximately 5.61 miles long for phase 1, and approximately 7.59 miles long for phase 2, will transport CO_2 to six injection wells at two sequestration reservoir sites within the site plan (to 26R Monterey Formation Reservoir at an approximate depth of 6,000 feet for phase 1's four injection well sites, and to A1-A2 Monterey Formation Reservoir, approximately 8,500 feet deep for phase 2's two injector well sites).[4]

C. Critically important and needed pipeline information is missing in the DEIR.

Important pipeline information is missing in the DEIR that will not permit decisionmakers to make an informed decision about this Project. For example, some of the many major shortcomings in the DEIR related to pipeline issues are:

1. The purity of the claimed "high-purity" CO_2 stream has not been provided.

The CO_2 purity sets a simple bar as to whether the Pipeline and Hazardous Materials Safety Administration, or PHMSA, the federal agency chartered with transportation pipeline safety regulations, or for that matter the California Office of the State Fire Marshal, or OSFM, the state agency chartered with intrastate liquid transportation pipeline safety oversight in California, has any pipeline safety jurisdiction under current transportation pipeline safety regulations. The DEIR needs to provide the minimum purity of the CO_2 stream for reinjection and how this minimum will be controlled/maintained and assured. If the CO_2 purity is not above 90 %, the pipeline facilities are not regulated as transportation pipelines under current federal pipeline safety regulations.

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[2] 49CFR§195.2 Definitions - *Carbon Dioxide*.
[3] DEIR, Volume 1, pp. 3-18 & 3-19.
[4] DEIR, Volume 1, pp. 3-21 & 3-22.

Since the CO_2 will be produced from the oil/gas field, the DEIR also needs to present how possible impurities in the CO_2 stream will be limited and controlled. This is especially important for water as water in CO_2 pipelines is not tolerated well in carbon steel pipeline systems. Water in such CO_2 systems can experience extremely unpredictable and high corrosion rates that can quickly result in pipeline rupture failure.

2. **The DEIR discussion of Facility Pipelines and Injection Pipelines is not clear.**

Facility Pipelines and Injection Pipelines usually have special meaning/distinction within the industry and whether any pipeline safety agency has any jurisdiction. The DEIR is very confusing on this important issue, labeling for example Injection Pipelines under the heading Facility Pipelines in the figures' legends.[5] PHMSA, or for that matter the OSFM, may not have any jurisdiction on this Project or parts of this Project.

3. **The DEIR indicates that the Facility Pipelines will operate at pressures roughly 1,700 to 2,100 psig for "dense phase" transport.[6]**

Psig, or pounds per square inch gauge, is a pressure measurement used in the industry. The pressure range for this system, while higher than conventional liquid transportation pipelines, is not unusual for dense phase CO_2 pipelines. Dense phase is a term used to mean either liquid **or** supercritical CO_2 phase for a liquid pipeline, and is not defined in either Federal or California pipeline safety regulations.[7] What phase a specific CO_2 liquid pipeline segment is in (liquid or supercritical) at the time of a pipeline rupture can have a significant impact on rupture release dynamics, the tonnage of pipeline inventory that will be vented even after mainline valves are closed, and associated attempts to model possible rupture impact zones and attempts at establishing realistic safety buffer zones.

4. **The DEIR does not provide important pipeline parameters.**

At this stage of the Project, the pipeline operator should be able to provide the pipeline specifics such as: pipe grade, thickness, diameter, and maximum operating pressure, or MOP, a term defined in federal pipeline safety regulation having a specific meaning related to pipeline safety. As previously mentioned, the DEIR should also clearly delineate the general pipeline route, possible pipeline safety jurisdictional boundaries, and approximate location of main equipment such as pump/compressor stations. The lack of such basic information makes it difficult to determine a simple process flow scheme for the Project. This lack of such basic information also prevents decisionmakers from assessing impacts and to develop feasible mitigations for the Project. Not only does the DEIR lack such critical basic pipeline information, what information is supplied is also confusing. It appears the Project is being rushed and

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[5] DEIR, Volume 1, p. 3-20, Figures 3-8 and 3-9, Location of Phase 1 Wells: 373-35R, 353X-35R, 345-36R, and 363-27R, and Location of the Phase 2 Wells: 357-7R and 355-7R, respectively.

[6] DEIR, Volume 1, p. 3-16.

[7] 49CFR§195 and California Code, Chapter 5.5. The Elder California Pipeline Safety Act of 1981.

missing basic information to permit independent evaluation and verification of the Project.

5. **The location of compressor equipment is not well defined.**

The DEIR states "Two new CO_2 compressor packages are proposed for installation at the facility. Compressors would be of the reciprocating type and driven by electric motors."[8] The general location and specific phase of the CO_2 feeding into such equipment is very important to the safe operation of the system and, more importantly, the compressors. One way to blow up a reciprocating compressor is to inadvertently introduce liquid into the compressor. I cannot determine from the limited and confusing information provided in the DEIR whether the location of the proposed compressors will be safely placed within the system to assure liquid CO_2 cannot be inadvertently introduced into the compressors.

6. **The placement of mainline valves along the pipelines are not defined.**

The DEIR states: "New valves would be installed based on regulatory and owner requirements."[9] As should become obvious from reading this report, such important valve determinations have not been clearly defined, so this DEIR citation is meaningless. Also, the DEIR does not identify whether mainline valves will be manually operated or remotely operated. Manually operated valves can take considerable time to reach and then close (especially for larger diameter pipelines such as a 16-inch mainline valve) increasing the tonnage of CO_2 released upon pipeline rupture.

As a point of reference, a 16-inch diameter CO_2 pipeline, depending on whether the CO_2 inventory is in a supercritical or liquid phase and its associated density, will release approximately 110 to 200 tons per mile of CO_2 upon a pipeline rupture once pipeline mainlines have been closed. What makes transportation pipelines unique, especially for CO_2, is the amount of tonnage undergoing phase change from cooling, that can be de-inventoried from a ruptured pipeline, releasing tons of CO_2 between mainline valves once such valves have been closed. The lack of timely closure of valves was a significant contributing factor for the Satartia, MS rupture CO_2 release as discussed later in this report.

7. **The CO_2 temperature along the pipelines is not provided.**

An important variable in the DEIR, approximate CO_2 temperature along the pipelines, dictates the CO_2, whether liquid or supercritical phase (which can change) along the pipelines as temperature changes at the expected pipeline operating pressure. This important temperature parameter is not mentioned nor discussed anywhere in the DEIR. What phase a segment of a pipeline is transporting CO_2 in can have serious significance on issues such as safety jurisdiction, design/operation, and pipeline rupture

[8] DEIR, Volume 1, p. 3-17.
[9] DEIR, Volume 1, p. 3-18.

release dynamics and safety buffer zones. For example, current federal minimum pipeline safety regulations do not regulate pipelines operating in liquid CO_2 phase. I have previously mentioned the importance of assuring that reciprocating compressors do not inadvertently receive liquid. Without understanding the initial phase CO_2 will most likely be in in a specific pipeline segment, attempts to establish safe buffer or impact zones are meaningless. Two temperature extreme boundary cases for CO_2 are usually necessary; a high temperature season and a low temperature season to assist in defining the range of CO_2 phases (liquid or supercritical), and associated release modeling/pipeline buffer safety margins for the operation.

8. The DEIR misses the importance of CO_2 phase.

The DEIR also misses the important differences associated with varying phases of CO_2 in a liquid pipeline operation that are not properly addressed in current pipeline safety regulations, leaving such pipelines basically unregulated in many critically important areas. While the DEIR attempts to address certain environmental impacts related to the Project, the real issue relates to pipeline safety and the possible impact to public safety. The DEIR is incomplete in this important area and needs to be supplemented with this missing information before this Project can move forward.

While not mentioned in the DEIR, at the expected pressures and temperatures of the proposed Project's pipelines, I would anticipate the Project's pipelines to be operated in either liquid CO_2 or supercritical CO_2 phases, with the phases changing somewhat with time depending on the temperature of the buried pipelines. Whether a pipeline segment is liquid or supercritical phase at the time of rupture affects the expected phase change occurring at the rupture site, the rate of release, the tonnage that will be released between closed valves, and expected buffer impact zones.

D. The California OSFM is limited in what pipeline safety regulations it can enforce for intrastate liquid carbon dioxide transportation pipelines.

Despite the best of recent intentions to enact improvements in carbon dioxide pipeline safety regulations within California, the California Legislature has failed to pass meaningful improvements in pipeline safety regulations as it applies to intrastate carbon dioxide pipelines. Without such new legislation, the California OSFM can only implement and enforce pipeline safety regulations for intrastate CO_2 liquid pipelines within the state as codified in federal minimum pipeline safety regulations (49CFR§195) intended for liquid transportation pipelines. Based on my extensive experience in California liquid pipeline operation and many pipeline investigations within the state, it is my understanding that the OSFM can only enforce federal pipeline safety regulations for CO_2 liquid pipelines codified in current federal regulations.

Federal regulations for carbon dioxide pipelines are currently woefully inadequate as discussed in more detail in my recently referenced March 23, 2022 CO_2 public paper. In addition, announcements by PHMSA to move forward with carbon dioxide safety regulations may miss many of the safety issues and concerns related to carbon dioxide liquid pipelines

which can take some time to properly address, given the highly unusual restrictive regulatory process imposed on PHMSA.[10]

E. The DEIR attempts to minimize the impact of the Satartia rupture on the public.

Some additional information might be helpful to add to the February 22, 2020 Satartia, MS 24-inch pipeline rupture discussion in the DEIR.[11] Depending on the density one assumes in the pipeline, the rupture released 3,000 to 5,000 tons of carbon dioxide after the mainline valves were eventually closed on the 24-inch pipeline, which took considerable time to isolate the ruptured segment. The CO_2 plume went beyond the Town of Satartia, crossing the Yazoo River, extending well over a mile from the pipeline release site which was basically downhill from the rupture releasing heavier than air CO_2. The DEIR fails to mention that the Town of Satartia was not identified as a high consequence area in the pipeline operator's integrity management program and the air dispersion model was unfit for the 24-inch pipeline. The high rain situations and steep terrain should not come as a surprise in this challenging location, and the wording in the DEIR appears to try to downplay that the rupture threat was a unique situation in that area of Mississippi. PHMSA's corrective action order requiring review of geohazard potential along the pipeline should dispel any illusion that breakaway landslide was an unusual threat. Despite the release of a PHMSA Advisory following the Satartia rupture, PHMSA knows that there have been pipeline regulations in effect for many decades that place the responsibility on the pipeline operator to monitor their pipeline right-of-way for signs of possible abnormal loading such as massive landslide potential (what is known in the industry as a breakaway landslide threat) that can easily result in pipeline rupture.[12]

F. Well Blowout prevention and Aliso Canyon similarities.

While not a specific pipeline associated matter, I have an ethical responsibility to note that the DEIR does not address the possibility of a CO_2 injection well blowout on any of the six proposed CO_2 injection wells. In late 2015, California was associated with an underground natural gas storage well blowout, the Aliso Canyon failure, that released well over 100,000 tons of natural gas which is normally lighter than air as compared to CO_2 which is heavier than air. The Aliso Canyon failure demonstrated to the public some of the risk of large high pressure underground storage reservoirs. I would advise that the Project incorporate some form of well blowout prevention design to prevent release of massive quantities of heavier than air CO_2 from the underground reservoirs should an injection well experience a blowout. The safety design should incorporate an approach with prudent independent safeties to assure that the installation will actually work and stop the release of CO_2 from the high-pressure reservoir if a well blowout occurs. Without getting into specific design issues, there are various ways to approach this possible threat, such as incorporating an automatic subservice safety valve as a blowout preventor on each injection well. The tonnage of CO_2 released from a well blowout

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[10] "PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak," May 26, 2022 at PHMSA website: https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures.

[11] DEIR, Volume 1, pp. 4.9-8 & 4.9-9.

[12] PHMSA updated ADB-2022-01, "Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards," June 2, 2022.

can easily exceed, by many orders of magnitude, the tonnage of CO_2 released from a pipeline rupture. As history has often demonstrated, well blowouts can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases.

G. Background/Experience.

Accufacts was asked to review the DEIR for the Project recently released in December 2023.[13] I have over fifty years of experience in the energy industry, including almost 25 years as president of Accufacts Inc. ("Accufacts"). Accufacts provides independent expert consulting services to assist decision makers in making informed decisions concerning pipelines. Pipeline safety expertise is provided in areas including, but not limited to; pipeline failure investigation, risk management, siting, construction, design, operation, maintenance, training, control room management including Supervisory Control and Data Acquisition ("SCADA") approaches, leak/rupture detection, integrity management, emergency response, and pipeline safety regulatory development and compliance. Much of my background is grounded in pipeline incident investigations following numerous pipeline rupture tragedies spanning several decades.

For the past two decades I have been involved as a representative of the public, which carries special obligations to avoid a conflict of interest, in advancing pipeline safety regulations at the federal and various state levels as demonstrated by my CV. For example, I played a significant role representing the public in developing integrity management federal pipeline safety regulations in the early 2000s for both liquid and gas transmission pipelines. These regulatory approaches emulated a safety process approach that I instituted and developed for the City of Bellingham, WA. This process, identified as the Safety Immediate Action Plan, or SIAP, identified steps that the pipeline operator was to complete following the Bellingham rupture tragedy of June 10, 1999, before that pipeline could be permitted to be returned to service.

H. Conclusion.

The DEIR is seriously incomplete and deficient in many areas as discussed above. These deficiencies need to be properly addressed before a DEIR can be deemed complete and sufficient for the Project to move forward. It is my understanding that the County can require that such critical information related to pipeline safety and CO_2 pipelines can be ordered to be provided, or supplemented, before this Project can be allowed to move forward.

Richard B. Kuprewicz, President, Accufacts Inc. *Richard B. Kuprewicz*

[13] Draft Environmental Impact Report – SCH# 2022030180 Volume 1, Chapters 1 through 12, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol_1_Ch_1-12_upd.pdf, and Draft Environmental Impact Report – SCH# 2022030180 Volume 2, Appendices A-K, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol2.pdf, December 2023.

Attachment A
to Technical Comments of Richard Kuprewicz:
Qualifications and Experience

Curriculum Vitae.

Richard B. Kuprewicz

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Profile:

As president of Accufacts Inc., I specialize in gas and liquid pipeline investigation, auditing, risk management, siting, construction, design, operation, maintenance, training, SCADA, leak detection, management review, emergency response, and regulatory development and compliance. I have consulted for various local, state and federal agencies, NGOs, the public, and pipeline industry members on pipeline regulation, operation and design, with particular emphasis on operation in unusually sensitive areas of high population density or environmental sensitivity.

Employment:

Accufacts Inc. **1999 – Present**

Pipeline regulatory advisor, incident investigator, and expert witness on all matters related to gas and liquid pipeline siting, design, operation, maintenance, risk analysis, and management.

Position: President
Duties:
> Full business responsibility
> Technical Expert

Alaska Anvil Inc. **1993 – 1999**

Engineering, procurement, and construction (EPC) oversight for various clients on oil production facilities, refining, and transportation pipeline design/operations in Alaska.

Position: Process Team Leader
Duties:
> Led process engineers group
> Review process designs
> Perform hazard analysis
> HAZOP Team leader
> Assure regulatory compliance in pipeline and process safety management

ARCO Transportation Alaska, Inc. **1991 - 1993**

Oversight of Trans Alaska Pipeline System (TAPS) and other Alaska pipeline assets for Arco after the Exxon Valdez event.

Position: Senior Technical Advisor
Duties:
> Access to all Alaska operations with partial Arco ownership
> Review, analysis of major Alaska pipeline projects

ARCO Transportation Co. **1989 – 1991**

Responsible for strategic planning, design, government interface, and construction of new gas pipeline projects, as well as gas pipeline acquisition/conversions.

Position: Manager Gas Pipeline Projects
Duties:
> Project management
> Oil pipeline conversion to gas transmission
> New distribution pipeline installation
> Full turnkey responsibility for new gas transmission pipeline, including FERC filing

Four Corners Pipeline Co. **1985 – 1989**

Managed operations of crude oil and product pipelines/terminals/berths/tank farms operating in western U.S., including regulatory compliance, emergency and spill response, and telecommunications and SCADA organizations supporting operations.

Position: Vice President and Manager of Operations
Duties:
> Full operational responsibility
> Major ship berth operations
> New acquisitions
> Several thousand miles of common carrier and private pipelines

Arco Product CQC Kiln **1985**

Operations manager of new plant acquisition, including major cogeneration power generation, with full profit center responsibility.

Position: Plant Manager
Duties:
> Team building of new facility that had been failing
> Plant design modifications and troubleshooting
> Setting expense and capital budgets, including key gas supply negotiations
> Modification of steam plant, power generation, and environmental controls

Arco Products Co. **1981 - 1985**

Operated Refined Product Blending, Storage and Handling Tank Farms, as well as Utility and Waste Water Treatment Operations for the third largest refinery on the west coast.

Position: Operations Manager of Process Services
Duties:
> Modernize refinery utilities and storage/blending operations
> Develop hydrocarbon product blends, including RFGs
> Modification of steam plants, power generation, and environmental controls
> Coordinate new major cogeneration installation, 400 MW plus

Arco Products Co. **1977 - 1981**

Coordinated short and long-range operational and capital planning, and major expansion for two west coast refineries.

Position: Manager of Refinery Planning and Evaluation
Duties:
> Establish monthly refinery volumetric plans
> Develop 5-year refinery long range plans
> Perform economic analysis for refinery enhancements
> Issue authorization for capital/expense major expenditures

Arco Products Co. **1973 - 1977**

Operating Supervisor and Process Engineer for various major refinery complexes.

Position: Operations Supervisor/Process Engineer
Duties:
> FCC Complex Supervisor
> Hydrocracker Complex Supervisor
> Process engineer throughout major integrated refinery improving process yield and energy efficiency

Qualifications:

Served for over fifteen years as a member representing the public on the federal Technical Hazardous Liquid Pipeline Safety Standards Committee (THLPSSC), a technical committee established by Congress to advise PHMSA on pipeline safety regulations.
Committee members are appointed by the Secretary of Transportation.

Served seven years, including position as its chairman, on the Washington State Citizens Committee on Pipeline Safety (CCOPS).
Positions are appointed by the governor of the state to advise federal, state, and local governments on regulatory matters related to pipeline safety, routing, construction, operation and maintenance.

Served on Executive subcommittee advising Congress and PHMSA on a report that culminated in new federal rules concerning Distribution Integrity Management Program (DIMP) gas distribution pipeline safety regulations.

As a representative of the public, advised the Office of Pipeline Safety on proposed new liquid and gas transmission pipeline integrity management rulemaking following the pipeline tragedies in Bellingham, Washington (1999) and Carlsbad, New Mexico (2000).

Member of Control Room Management committee assisting PHMSA on development of pipeline safety Control Room Management (CRM) regulations.

Certified and experienced HAZOP Team Leader associated with process safety management and application.

Education:

MBA (1976)	Pepperdine University, Los Angeles, CA
BS Chemical Engineering (1973)	University of California, Davis, CA
BS Chemistry (1973)	University of California, Davis, CA

Publications in the Public Domain:

1. "An Assessment of First Responder Readiness for Pipeline Emergencies in the State of Washington," prepared for the Office of the State Fire Marshall, by Hanson Engineers Inc., Elway Research Inc., and Accufacts Inc., and dated June 26, 2001.

2. "Preventing Pipeline Failures," prepared for the State of Washington Joint Legislative Audit and Review Committee ("JLARC"), by Richard B. Kuprewicz, President of Accufacts Inc., dated December 30, 2002.

3. "Pipelines - National Security and the Public's Right-to-Know," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated May 14, 2003.

4. "Preventing Pipeline Releases," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated July 22, 2003.

5. "Pipeline Integrity and Direct Assessment, A Layman's Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated November 18, 2004.

6. "Public Safety and FERC's LNG Spin, What Citizens Aren't Being Told," jointly authored by Richard B. Kuprewicz, President of Accufacts Inc., Clifford A. Goudey, Outreach Coordinator MIT Sea Grant College Program, and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated May 14, 2005.

7. "A Simple Perspective on Excess Flow Valve Effectiveness in Gas Distribution System Service Lines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated July 18, 2005.

8. "Observations on the Application of Smart Pigging on Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated September 5, 2005.

9. "The Proposed Corrib Onshore System - An Independent Analysis," prepared for the Centre for Public Inquiry by Richard B. Kuprewicz, dated October 24, 2005.

10. "Observations on Sakhalin II Transmission Pipelines," prepared for The Wild Salmon Center by Richard B. Kuprewicz, dated February 24, 2006.

11. "Increasing MAOP on U.S. Gas Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2006. This paper was also published in the June 26 and July 1, 2006 issues of the Oil & Gas Journal and in the December 2006 issue of the UK Global Pipeline Monthly magazines.

12. "An Independent Analysis of the Proposed Brunswick Pipeline Routes in Saint John, New Brunswick," prepared for the Friends of Rockwood Park, by Richard B. Kuprewicz, dated September 16, 2006.

13. "Commentary on the Risk Analysis for the Proposed Emera Brunswick Pipeline Through Saint John, NB," by Richard B. Kuprewicz, dated October 18, 2006.

14. "General Observations On the Myth of a Best International Pipeline Standard," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2007.

15. "Observations on Practical Leak Detection for Transmission Pipelines – An Experienced Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated August 30, 2007.

16. "Recommended Leak Detection Methods for the Keystone Pipeline in the Vicinity of the Fordville Aquifer," prepared for TransCanada Keystone L.P. by Richard B. Kuprewicz, President of Accufacts Inc., dated September 26, 2007.

17. "Increasing MOP on the Proposed Keystone XL 36-Inch Liquid Transmission Pipeline," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated February 6, 2009.

18. "Observations on Unified Command Drift River Fact Sheet No 1: Water Usage Options for the current Mt. Redoubt Volcano threat to the Drift River Oil Terminal," prepared for Cook Inletkeeper by Richard B. Kuprewicz, dated April 3, 2009.

19. "Observations on the Keystone XL Oil Pipeline DEIS," prepared for Plains Justice by Richard B. Kuprewicz, dated April 10, 2010.

20. "PADD III & PADD II Refinery Options for Canadian Bitumen Oil and the Keystone XL Pipeline," prepared for the Natural Resources Defense Council (NRDC), by Richard B. Kuprewicz, dated June 29, 2010.

21. "The State of Natural Gas Pipelines in Fort Worth," prepared for the Fort Worth League of Neighborhoods by Richard B. Kuprewicz, President of Accufacts Inc., and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated October, 2010.

22. "Accufacts' Independent Observations on the Chevron No. 2 Crude Oil Pipeline," prepared for the City of Salt Lake, Utah, by Richard B. Kuprewicz, dated January 30, 2011.

23. "Accufacts' Independent Analysis of New Proposed School Sites and Risks Associated with a Nearby HVL Pipeline," prepared for the Sylvania, Ohio School District, by Richard B. Kuprewicz, dated February 9, 2011.

24. "Accufacts' Report Concerning Issues Related to the 36-inch Natural Gas Pipeline and the Application of Appleview, LLC Premises: 7009 and 7010 River Road, North Bergen, NJ," prepared for the Galaxy Towers Condominium Association Inc., by Richard B. Kuprewicz, dated February 28, 2011.

25. "Prepared Testimony of Richard B. Kuprewicz Evaluating PG&E's Pipeline Safety Enhancement Plan," submitted on behalf of The Utility Reform Network (TURN), by Richard B. Kuprewicz, Accufacts Inc., dated January 31, 2012.

26. "Evaluation of the Valve Automation Component of PG&E's Safety Enhancement Plan," extracted from full testimony submitted on behalf of The Utility Reform Network (TURN), by Richard B.Kuprewicz, Accufacts Inc., dated January 31, 2012, Extracted Report issued February 20, 2012.

27. "Accufacts' Perspective on Enbridge Filing to NEB for Modifications on Line 9 Reversal Phase I Project," prepared for Equiterre Canada, by Richard B. Kuprewicz, Accufacts Inc., dated April 23, 2012.

28. "Accufacts' Evaluation of Tennessee Gas Pipeline 300 Line Expansion Projects in PA & NJ," prepared for the Delaware RiverKeeper Network, by Richard B. Kuprewicz, Accufacts Inc., dated June 27, 2012.

29. "Impact of an ONEOK NGL Pipeline Release in At-Risk Landslide and/or Sinkhole Karst Areas of Crook County, Wyoming," prepared for landowners, by Richard B. Kuprewicz, Accufacts Inc., and submitted to Crook County Commissioners, dated July 16, 2012.

30. "Impact of Processing Dilbit on the Proposed NPDES Permit for the BP Cherry Point Washington Refinery," prepared for the Puget Soundkeeper Alliance, by Richard B. Kuprewicz, Accufacts Inc., dated July 31, 2012.

31. "Analysis of SWG's Proposed Accelerated EVPP and P70VSP Replacement Plans, Public Utilities Commission of Nevada Docket Nos. 12-02019 and 12-04005," prepared for the State of Nevada Bureau of Consumer Protection, by Richard B. Kuprewicz, Accufacts Inc., dated August 17, 2012.

32. "Accufacts Inc. Most Probable Cause Findings of Three Oil Spills in Nigeria," prepared for Bohler Advocaten, by Richard B. Kuprewicz, Accufacts Inc., dated September 3, 2012.

33. "Observations on Proposed 12-inch NGL ONEOK Pipeline Route in Crook County Sensitive or Unstable Land Areas," prepared by Richard B. Kuprewicz, Accufacts Inc., dated September 13, 2012.

34. "Findings from Analysis of CEII Confidential Data Supplied to Accufacts Concerning the Millennium Pipeline Company L.L.C. Minisink Compressor Project Application to FERC, Docket No. CP11-515-000," prepared by Richard B. Kuprewicz, Accufacts Inc., for Minisink Residents for Environmental Preservation and Safety (MREPS), dated November 25, 2012.

35. "Supplemental Observations from Analysis of CEII Confidential Data Supplied to Accufacts Concerning Tennessee Gas Pipeline's Northeast Upgrade Project," prepared by Richard B. Kuprewicz, Accufacts Inc., for Delaware RiverKeeper Network, dated December 19, 2012.

36. "Report on Pipeline Safety for Enbridge's Line 9B Application to NEB," prepared by Richard B. Kuprewicz, Accufacts Inc., for Equiterre, dated August 5, 2013.

37. "Accufacts' Evaluation of Oil Spill Joint Investigation Visit Field Reporting Process for the Niger Delta Region of Nigeria," prepared by Richard B. Kuprewicz for Amnesty International, September 30, 2013.

38. "Accufacts' Expert Report on ExxonMobil Pipeline Company Silvertip Pipeline Rupture of July 1, 2011 into the Yellowstone River at the Laurel Crossing," prepared by Richard B. Kuprewicz, November 25, 2013.

39. "Accufacts Inc. Evaluation of Transco's 42-inch Skillman Loop submissions to FERC concerning the Princeton Ridge, NJ segment," prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated June 26, 2014, and submitted to FERC Docket No. CP13-551.

40. Accufacts report "DTI Myersville Compressor Station and Dominion Cove Point Project Interlinks," prepared by Richard B. Kuprewicz for Earthjustice, dated August 13, 2014, and submitted to FERC Docket No. CP13-113-000.

41. "Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco's Leidy Southeast Expansion Project," prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated September 3, 2014, and submitted to FERC Docket No. CP13-551.

42. Accufacts' "Evaluation of Actual Velocity Critical Issues Related to Transco's Leidy Expansion Project," prepared by Richard B. Kuprewicz for Delaware Riverkeeper Network, dated September 8, 2014, and submitted to FERC Docket No. CP13-551.

43. "Accufacts' Report to Portland Water District on the Portland – Montreal Pipeline," with Appendix, prepared by Richard B. Kuprewicz for the Portland, ME Water District, dated July 28, 1014.

44. "Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco's Leidy Southeast Expansion Project," prepared by Richard B. Kuprewicz and submitted to FERC Docket No. CP13-551.

45. Review of Algonquin Gas Transmission LLC's Algonquin Incremental Market ("AIM Project"), Impacting the Town of Cortlandt, NY, FERC Docket No. CP14-96-0000, Increasing System Capacity from 2.6 Billion Cubic Feet (Bcf/d) to 2.93 Bcf/d," prepared by Richard B. Kuprewicz, and dated Nov. 3, 2014.

46. Accufacts' Key Observations dated January 6, 2015 on Spectra's Recent Responses to FERC Staff's Data Request on the Algonquin Gas Transmission Proposal (aka "AIM Project"), FERC Docket No. CP 14-96-000) related to Accufacts' Nov. 3, 2014 Report and prepared by Richard B. Kuprewicz.

47. Accufacts' Report on Mariner East Project Affecting West Goshen Township, dated March 6, 2015, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

48. Accufacts' Report on Atmos Energy Corporation ("Atmos") filing on the Proposed System Integrity Projects ("SIP") to the Mississippi Public Service Commission ("MPSC") under Docket No. 15-UN-049 ("Docket"), prepared by Richard B. Kuprewicz, dated June 12, 2015.

49. Accufacts' Report to the Shwx'owhamel First Nations and the Peters Band ("First Nations") on the Trans Mountain Expansion Project ("TMEP") filing to the Canadian NEB, prepared by Richard B. Kuprewicz, dated April 24, 2015.

50. Accufacts Report Concerning Review of Siting of Transco New Compressor and Metering Station, and Possible New Jersey Intrastate Transmission Pipeline Within the Township of Chesterfield, NJ ("Township"), to the Township of Chesterfield, NJ, dated February 18, 2016.

51. Accufacts Report, "Accufacts Expert Analysis of Humberplex Developments Inc. v. TransCanada Pipelines Limited and Enbridge Gas Distribution Inc.; Application under Section 112 of the National Energy Board Act, R.S.C. 1985, c. N-7," dated April 26, 2016, filed with the Canadian Nation Energy Board (NEB).

52. Accufacts Report, " A Review, Analysis and Comments on Engineering Critical Assessments as proposed in

PHMSA's Proposed Rule on Safety of Gas Transmission and Gathering Pipelines," prepared for Pipeline Safety Trust by Richard B. Kuprewicz, dated May 16, 2016.

53. Accufacts' Report on Atmos Energy Corporation ("Atmos") filing to the Mississippi Public Utilities Staff, "Accufacts Review of Atmos Spending Proposal 2017 – 2021 (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 15, 2016.

54. Accufacts Report, "Accufacts Review of the U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) for the Dakota Access Pipeline ("DAPL")," prepared for Earthjustice by Richard B. Kuprewicz, dated October 28, 2016.

55. Accufacts' Report on Mariner East 2 Expansion Project Affecting West Goshen Township, dated January 6, 2017, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

56. Accufacts Review of Puget Sound Energy's Energize Eastside Transmission project along Olympic Pipe Line's two petroleum pipelines crossing the City of Newcastle, for the City of Newcastle, WA, June 20, 2017.

57. Accufacts Review of the Draft Environmental Impact Statement for the Line 3 Pipeline Project Prepared for the Minnesota Department of Commerce, July 9, 2017, filed on behalf of Friends of the Headwaters, to Minnesota State Department of Commerce for Docket Nos. CN-14-916 & PPL-15-137.

58. Testimony of Richard B. Kuprewicz, president of Accufacts Inc., in the matter West Goshen Township and Concerned Citizens of West Goshen Township v. Sunoco Pipelines, L.P. before the Pennsylvania Public Utilities Commission, Docket No. C-2017-2589346, on July 18, 2017, on Behalf of West Goshen Township and Concerned Citizens of West Goshen Township.

59. Direct Testimony of Richard B. Kuprewicz, president of Accufacts Inc., on Behalf of Friends of the Headwaters regarding Enbridge Energy, Limited Partnership proposal to replace and reroute an existing Line 3 to the Minnesota Office of Administrative Hearings for the Minnesota Public Utilities Commission (MPUC PL-9/CN-14-916 and MPUC PL-9/PPL-15-137), September 11, 2017 and October 23, 2017.

60. Direct Testimony of Richard B. Kuprewicz On Behalf of The District of Columbia Government, before the Public Service Commission of the District of Columbia, in the matter of the merger of AltaGas Ltd. and WGL Holdings, Inc., Formal Case No. 1142, September 29, 2017.

61. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2018 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated December 4, 2017.

62. Report to Hugh A. Donaghue, Esquire, Concord Township Solicitor, "Accufacts Comments on Adelphia Project Application to FERC (Docket No. CP18-46-000) as it might impact Concord Township," dated May 30, 2018.

63. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2019 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 20, 2018.

64. Report to West Goshen Township Manager, PA, "Accufacts report on the repurposing of an existing 12-inch Sunoco pipeline segment to interconnect with the Mariner East 2 and Mariner East 2X crossing West Goshen Township," dated November 8, 2018.

65. Report to West Whiteland Township Manager, PA, "Accufacts Observations on Possible Pennsylvania State Pipeline Safety Regulations," prepared by Richard B. Kuprewicz, dated March 22, 2019.

66. Accufacts Public Comments on the Proposed Joint Settlement, BI&E v. Sunoco Pipeline L.P. ("SPLP"), Docket No. C-2018-3006534 ("Proposed Settlement"), submitted on August 15, 2019 to the Pennsylvania Public Utility Commission on the behalf of West Goshen Township as an intervener.

67. Report to West Whiteland Township Manager, Ms. Mimi Gleason, "Accufacts Perspective on Two Questions from West Whiteland's Board of Supervisors on Proposed Changes to ME 2 and ME 2X Construction/Operational Activities within West Whiteland," dated September 5, 2019."

68. Report to West Goshen Township Manager, Mr. Casey LaLonde, "Accufacts Report on the episode on the evening of 8-5-19 at the Mariner East Boot Road Pump Station ("Event"), Boot Road, West Goshen Township, PA," dated September 16, 2019.

69. Provided direct testimony before the Arizona Corporation Commission, In the Matter of the Application of Southwest Gas Corporation for the Establishment of Just and Reasonable Rates and Charges Designed to Realize a Reasonable Rate of Return on Fair Value of the Properties of Southwest Gas Corporation Devoted to its Arizona Operations (Docket No. G-01551A-19-0055), testified on behalf of Utilities Division Arizona Corporation Commission, February 19, 2020.

70. Report to West Goshen Township Manager, Mr. Casey LaLonde, "Accufacts Report on the Mariner East 2X Pipeline Affecting West Goshen Township," dated July 23, 2020.

71. Assisted the Commonwealth of Massachusetts, Office of the Attorney General in developing pipeline safety processes to be incorporated into the settlement agreement related to Columbia Gas' sale of Assets to Eversource following the Merrimack Valley, Massachusetts overpressure event of September 13, 2018.

72. Report to Natural Resources Defense Council, Inc., "Accufacts' Observations on the Use of Keystone XL Pipeline Pipe Exhibiting External Coating Deterioration Issues from Long Term Storage Exposure to the Elements," October 1, 2020.

73. Report to Pennsylvania Public Utilities Commission ("PAPUC"), "Accufacts Comments on Proposed Pennsylvania Intrastate Liquid Pipeline Safety Regulations," dated October 29, 2021, prepared for West Whiteland Township Board of Supervisors, West Whiteland Township, PA. Filed to PAPUC public web docket November 5, 2021 by West Whiteland Township under Reference Docket Number L-2019-3010267. Addresses suggested improvements in proposed pipeline safety rules for PA intrastate liquid transmission pipelines.

74. Submitted written testimony of Richard B. Kuprewicz on Behalf of Bay Mills Indian Community to ALJ Dennis Mack, dated December 14, 2021, in the matter of the Application of Enbridge Energy, Limited Partnership for Authority to Replace and Relocate the Segment of Line 5 Crossing the Straits of Mackinac into a Tunnel Beneath the Straits of Mackinac, before the State of Michigan Public Service Commission, U-20763.

75. Public presentation to New York State Indian Point Nuclear Facility Decommissioning Oversight Board on Holtec removal activities in proximity to Enbridge three Natural Gas Transmission Pipelines, March 17, 2022.

76. Report to Pipeline Safety Trust and Bold Alliance, "Accufacts' Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.," March 23, 2022.

77. Accufacts Inc., Public Presentation For the National Academies of Science Engineering Medicine and The Transportation Research Board, "To Committee on Criteria for Installing Automatic and Remote-Controlled Shutoff Valves on Existing Gas and Hazardous Liquid Transmission Pipelines," 4/27/22.

78. Accufacts Inc, "6/13/22 Webinar to Illinois Emergency Responders, Healthcare Providers, & Local Officials on Responses to CO_2 Transmission Pipeline Releases," 6/13/22.

79. Accufacts Report for Pipeline Safety Trust, "Safety of Hydrogen Transportation by Gas Pipelines," 11/28/22.

80. Completed a series of testimonies related to Enbridge's Line 5 proposal to replace 2 – 20-inch diameter existing submerged pipelines currently lying across the bottom of the Straits of Mackinac with a 30-inch diameter grade X-70 pipeline, proposed to be installed in a 21-foot diameter concrete tunnel to be installed across the approximate 4 mile span of the Straits of Mackinac. Testified on Behalf of the Bay Mill Indian Community before the State of Michigan Public Service Commission, Docket U-20763, in opposition to this very poorly designed proposal/installation allowing for movement of the pipeline on rollers within the tunnel. Final testimony to the docket submitted May 19, 2023. This is the only pipeline proposal I am aware of in the world that would place a crude oil and liquid propane pipeline, especially a 30-inch diameter pipeline, within a tunnel.

81. Issued to Ms. Niroop Srivatsa, City Manager, "Accufacts Report for the City of Lafayette on the Status of the Tree Assessment Process with PG&E," indicating most of the trees identified for removal by PG&E risk management

approach have nothing to do with gas pipeline safety, June 15, 2023.

82. Issued Direct Testimony to Illinois Commerce Commission ("ICC") on the Navigator Heartland Greenway LLC Application for a Carbon Dioxide Transportation and Sequestration pipeline, under Docket 23-0161, on behalf of Citizens Against Heartland Pipeline ("CAHGP"), McDonough County, Christian County and Hancock County (the "Counties") (jointly, "Citizen and County Intervenors" of "CCI"), raising serious questions as to PHMSA's recent assertions of pipeline safety jurisdiction, and underscoring the ICC's authority for pipeline siting jurisdiction of said pipeline proposal in the State of Illinois, filed June15, 2023.

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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Central Region
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Fresno, California 93710
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

March 1, 2024

Keith Alvidrez, Planner II
Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, California 93301

Subject: Carbon TerraVault 1 Project (Project)
Draft Environmental Impact Report (DEIR)
State Clearinghouse No. 2022030180

Dear Keith Alvidrez:

The California Department of Fish and Wildlife (CDFW) has reviewed a Draft Environmental Impact Report (DEIR) prepared by your agency acting as Lead Agency for the Project pursuant the California Environmental Quality Act (CEQA) and CEQA Guidelines.[1]

Thank you for the opportunity to provide further comments and recommendations regarding those activities involved in the Project that may affect California fish and wildlife. Likewise, CDFW appreciates the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under the Fish and Game Code. It should be noted that CDFW originally provided comments through early consultation, in a letter dated, April 6, 2022, regarding this proposed Project.

CDFW ROLE

CDFW is California's **Trustee Agency** for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (*Id.*, § 1802). Similarly, for purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

[1] CEQA is codified in the California Public Resources Code in section 21000 et seq. The "CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

CDFW is also submitting comments as a **Responsible Agency** under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381). CDFW expects that it may need to exercise regulatory authority as provided by the Fish and Game Code. As proposed, for example, the Project may be subject to CDFW's lake and streambed alteration regulatory authority (Fish & G. Code, § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required.

As a responsible agency, CDFW is responsible for providing, as available, biological expertise during public agency environmental review efforts (e.g., CEQA), focusing specifically on project activities that have the potential to adversely affect fish and wildlife resources. CDFW provides recommendations to identify potential impacts and possible measures to avoid or reduce those impacts.

Fully Protected Species: CDFW has jurisdiction over fully protected species of birds, mammals, amphibians and reptiles, and fish, pursuant to Fish and Game Code sections 3511, 4700, 5050, and 5515. Take of any fully protected species is prohibited except where specifically authorized in Fish and Game Code; CDFW cannot authorize their incidental take for this Project.

Bird Protection: CDFW has jurisdiction over actions with potential to result in the disturbance or destruction of active nest sites or the unauthorized take of birds. Fish and Game Code sections that protect birds, their eggs and nests include, §§ 3503 (regarding unlawful take, possession or needless destruction of the nest or eggs of any bird), 3503.5 (regarding the take, possession or destruction of any birds-of-prey or their nests or eggs), and 3513 (regarding unlawful take of any migratory nongame bird).

Other Special Status Species: Species of plants and animals need not be officially listed as Endangered, Rare, or Threatened on any State or federal list pursuant to CESA and/or the federal Endangered Species Act (ESA) to be considered Endangered, Rare, or Threatened under CEQA. If a species can be shown to meet the criteria specified in the CEQA Guidelines (California Code of Regs tit. 14, Chapter 3, § 15380), it should be fully considered in the environmental analysis for the Project.

PROJECT DESCRIPTION SUMMARY

Proponent: California Resources Corporation (CRC)

Objective: The Project proposes to construct a carbon capture and storage (CCS) facility for permanent underground storage of up to 48 million tons of CO_2 in two reservoir formations on approximately 9,130 surface acres in the Elk Hills Oilfield in unincorporated Kern County and the related initial source for the capture of CO_2.

The initial source of CO_2 is the pre-combustion oilfield gas from infield locations, including uses associated with the existing Elk Hills Power Plant. Maximum injection per year from future sources would be up to 2, 210,000 tons per year divided between the two formations (R-26 and A1-A-2). The Project consists of: 1) underground pore space, approved by the Environmental Protection Agency (EPA) as the "area of review" where CO_2 will become permanently mineralized into rock; 2) the CCS Surface Land Area over the underground storage area where limited uses will be permitted; 3) approval of six (6) EPA Class VI UIC wells; 4) conversion and creation of wells for CO_2 leak monitoring and seismic activity; 5) approximately 13 miles of facility and injection underground pipeline for capture of pre-combustion gas; and 6) the related infrastructure improvements for the capture, transfer, and permanent storage of CO_2.

Location: The Project is within the administrative boundary of the Elk Hills oilfield (9,130 surface acres) which is owned and operated by CRC in unincorporated Kern County. The proposed Project area is located on the west side of Elk Hills Road and north side of Skyline Road, within the Elk Hills Oil Field, approximately 26 miles from the City of Bakersfield, approximately 8.5 miles from the City of Taft, and approximately 4 miles from the unincorporated community of Buttonwillow, also being located within sections 7, 8, 9, 10, 13, 15, 16, 17, 18, and 26 of Township 30 South, Range 23 East, Mount Diablo Base and Meridian (MDBM), County of Kern, State of California.

Timeframe: Unspecified

COMMENTS AND RECOMMENDATIONS

CDFW offers the comments and recommendations below to assist the Lead Agency in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct, and indirect impacts on fish and wildlife (biological) resources.

In the April 6, 2002, early consultation comment letter CDFW submitted in response to the Notice of Preparation, CDFW identified that the Project Area is known to support high densities of several special-status animal species including the State and federally endangered and State fully protected blunt-nosed leopard lizard (*Gambelia sila*); the State and federally endangered giant kangaroo rat (*Dipodomys ingens*); the State threatened and federally endangered San Joaquin kit fox (*Vulpes macrotis mutica*); the State threatened Swainson's hawk (*Buteo swainsoni*) and San Joaquin (also known as Nelson's) antelope squirrel (*Ammospermophilus nelsoni*); the State species of special concern American badger (*Taxidea taxus*), short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), burrowing owl (*Athene cunicularia*), and California glossy snake (*Arizona elegans occidentalis*). The Project Area is also in the range of several special-status plant species including but not limited to the State and federally endangered and California rare plant rank (CRPR) 1B.1 California jewelflower (*Caulanthus californicus*). Since preparation of the April 6, 2022, early consultation comment letter, two species have become candidates for listing under CESA and remain candidates as of the date

of this letter. These species include Temblor legless lizard (*Anniella alexanderae*) and Crotch's bumble bee (*Bombus crotchii*).

There is an abundance of information about the extensive rare biological resources present throughout the Elk Hills Oil Field (EHOF), due to its history as the Naval Petroleum Reserve 1 (NPR1). NPR1 was sold to Occidental Petroleum as part of the 1996 National Defense Act that directed the Department of Energy (DOE) to sell the oilfield; Occidental Petroleum (OXY) completed the purchase in 1998. In addition to the extensive biological information collected by DOE, a joint Program Environmental Impact Report/Supplemental Environmental Impact Statement was prepared by DOE/Kern County in 1997 to support the transfer. CDFW issued a 1997 CESA Memorandum of Understanding and subsequent amendments, which was then superseded by a 2014 Incidental Take Permit (ITP), which authorized take of State listed species associated with oilfield exploration and operation. CDFW's ITP was supported by the Kern County Oil and Gas Environmental Impact Report. CDFW's 2014 ITP permitting effort was supported by extensive biological survey information and related modeling provided by OXY. CDFW requests that the EIR fully identify potential impacts to biological resources, including the above-mentioned species by evaluating the extensive existing biological information collected over decades within the EHOF. Specific examples follow. For all of the species referenced above, CDFW can provide some of this information if needed, as we relied heavily upon it for our more recent permitting efforts. In addition to comments in the April 6, 2022, early consultation letter, CDFW recommends that the following modifications and/or edits be incorporated into the final EIR, including proposed avoidance, minimization, and compensatory measures, prior to its adoption by Kern County.

Blunt Nosed Leopard Lizard (BNLL). The Biological Resources section of the DEIR appears to rely primarily on reconnaissance level surveys conducted for the DEIR and ignores the substantial body of biological information collected within the EHOF. For example, the DEIR blunt-nosed leopard lizard (BNLL) analysis states, "*The blunt-nosed leopard lizard was not observed during reconnaissance surveys. However, the BSA is within the known range for the species, suitable habitat is present, and there is a recent CNDDB record of the species within one mile of the BSA.*" This is wholly misleading given the extensive distribution of BNLL known to occur within the EHOF, as supported by decades of surveys and research on this species both during the NPR1 designation as well as after being acquired by OXY, with annual surveys conducted by OXY/CRC since 1998; there is no other area within the range of BNLL as extensively studied for BNLL as the EHOF. BNLL densities are extremely dense in portions of the EHOF, particularly in the vicinity of the North flank and the Elk Hills Conservation Area. BNLL densities at EHOF likely exceed those observed anywhere else in the species range. We recommend that the DEIR discloses OXY's BNLL Kernal probability densities, ongoing monitoring routes and associated detections, and historical observations to better inform the CEQA impact analysis, as well as to inform the likelihood for Project related impacts to this Fully Protected species to be avoided as required by Fish and Game Code.

San Joaquin antelope squirrel (SJAS). The DEIR indicates that multiple detections of SJAS were during reconnaissance level surveys, but no reference was made to the substantial body of SJAS detection data that exists for EHOF. SJAS are considered fairly widespread throughout the EHOF, though estimates of population size have not been published. OXY's information previously provided to CDFW indicates that the total number of observations has fluctuated with a low of 29 in 2000, and a high of 179 in 2003. During seismic surveys conducted on and adjacent to the EHOF between 1998 and 2001, the locations of SJAS were collected and mapped using GPS (n = 1,298). CDFW recommends that the DEIR discloses OXY/CRC's ongoing SJAS monitoring and associated detections, and historical observations to better inform the CEQA impact analysis.

Giant Kangaroo Rat (GKR). The DEIR indicates that "G*iant kangaroo rat was not observed during reconnaissance surveys. However, the BSA is within the known range of the species, suitable habitat is present.*" Like the species mentioned above, there is also extensive giant kangaroo rat (GKR) survey data within EHOF. OXY/CRC has a compilation of historical observations of GKR occurrences from the late 1970's through 2003, and monitored GKR consistently from 1994 through 2002 and allow for comparisons within this time period. For year 2003 forward, the survey effort was effectively doubled so data from subsequent years will allow for comparisons back to 2003. The EHOF sections surveyed for GKR presence are located in the non-High Production Area on the perimeters of the EHOF, in the existing EHOF Conservation Area, as well as adjacent areas off of EHOF within the 2-mile buffer along the Northeast Flank, Northwest Flank and Southwest Flank of EHOF. These GKR survey areas overlap substantively with the proposed Project boundaries; CDFW recommends that the DEIR discloses OXY/CRC's ongoing GKR monitoring and associated detections, and historical observations to better inform the CEQA impact analysis.

San Joaquin kit fox (SJKF). The DEIR states that "*No San Joaquin kit fox were observed during reconnaissance surveys. However, potentially suitable dens, some including diagnostic sign such as scat and track, were observed throughout the BSA. San Joaquin kit fox den in a variety of areas, such as ROWs and vacant lands, and they may be attracted to the BSA because of the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance.*" Like the species mentioned above, there has been extensive SJKF surveys and research conducted at the EHOF; much of the original contemporary published research on SJKF was conducted at NPR-1. OXY/CRC has a compilation of historical observations of SJKF occurrences within the EHOF from the late 1970's through 2003; these data were collected from many different survey efforts. Methods of monitoring for kit fox on the EHOF changed substantially between the time periods of 1981-1995 and 1998-2011. Between 1981 and 1995, SJKF were systematically trapped and radio collared (Cypher et al. 2000). Monitoring of population trends from 1998 to present has consisted of spotlighting and scent stations. As described above under GKR occurrence on EHOF, the areas surveyed for SJKF presence are also located in the non-High Production Areas on the perimeters of the EHOF, in the existing EHOF

Conservation Area, as well as adjacent areas off of EHOF within the 2-mile buffer; these SJKF survey areas overlap substantially with the proposed Project footprint. EHOF SJKF data includes an observed low of one (1) kit fox in 1998 with a high of 173 in 2004. This species experiences large natural fluctuations in population densities throughout their ranges. Earlier (before 1998) monitoring efforts on EHOF allowed for the calculation of density and population estimates. Total population estimates reached a high in 1994 of 363 (density estimate of 4.35 per sq mi or 1.68 per sq km) and a low in 1991 of 46 (density estimate of 0.55 per sq mi (0.21 per sq km). This time period was characterized with fairly dramatic decreases and increases, and kit fox numbers have been observed to fluctuate in other areas (Cypher et al. 2000). CDFW recommends that the DEIR discloses OXY/CRC's SJKF monitoring and associated detections, and historical observations to better inform the CEQA impact analysis.

Temblor legless lizard

The DEIR indicates in Table 4.4-4 Special Status Animal Species with Potential to Occur on Site that Temblor legless lizard (TLL) could potentially be affected by the Project. The DEIR also indicates that to reduce to less than significant the Project-related impacts to the species, the Project proponent will: determine the presence of the species by conducting "protocol surveys" at and near the Project Area, and employ a biological monitor to conduct pre-disturbance surveys within 30 days of commencing ground-disturbing activities (MM 4.4-1); maintain a 30-foot protective buffer from dens and/or active burrows which harbor the species (MM 4.4-3); implement a Worker Environmental Awareness Program for on-site workers (MM 4.4-11); and implement MM 4.4-13 which includes a list of Project-related prohibitions and limits designed to minimize take of the species.

If pre-Project CDFW-approved surveys conducted by qualified individuals reveal the presence of TLL at the Project Area, avoidance may not be possible and Incidental Take Authorization should be sought from CDFW. Individual TLLs are difficult to detect, even if they are present, and are not typically found within dens and/or burrows, therefore, the proposed "protocol surveys" of the Project Area, and proposed avoidance buffers from active dens and/or burrows may not constitute avoidance of the candidate species.

Habitat loss resulting from land conversion to agricultural, urban, and industrial development is the primary threat to TLL. The species is known to occur within and in the vicinity of the Project Area. The Project may have the potential to significantly impact local TLL populations.

Recommended Mitigation Measure 1: TLL Surveys

CDFW recommends the Lead Agency require the Project proponent conduct surveys of the Project Area implementing a CDFW-approved methodology to determine the presence of TLL at and near the Project Area

Recommended Mitigation Measure 2: TLL Avoidance

CDFW recommends the Lead Agency require the Project proponent consult with, and provide an avoidance plan for approval by, CDFW in the event the surveys reveal the presence of TLL at and/or near the Project Area.

Recommended Mitigation Measure 3: TLL Take Authorization
In the event complete avoidance of TLL is not feasible, CDFW recommends the Lead Agency require the Project applicant obtain incidental take authorization from CDFW prior to commencing ground disturbing activities.

Crotch's Bumble Bee

The DEIR indicates in Table 4.4-4 Special Status Animal Species with Potential to Occur on Site that Crotch's bumble bee (CBB) could potentially be affected by the Project. The Lead Agency indicates that to reduce to less than significant the Project-related impacts to the species, the Project proponent will: determine the presence of the species by conducting protocol surveys at and near the Project Area, and employ a biological monitor to conduct pre-disturbance surveys within 30 days of commencing ground-disturbing activities (MM 4.4-1); implement a Worker Environmental Awareness Program for on-site workers (MM 4.4-11); and implement MM 4.4-13 which includes a list of Project-related prohibitions and limits designed to minimize take of the species. CDFW does not concur that the Mitigation Measures are sufficient to mitigate impacts, to ensure the Project Area is surveyed sufficiently to determine presence or absence and adequately mitigate for the species, CDFW recommends the following:

Recommended Mitigation Measure 4: CCB Surveys

CDFW recommends that a qualified biologist conduct focused surveys for CBB and their requisite habitat features during the blooming period immediately prior to Project construction, following the methodology outlined in the Survey Considerations for California Endangered Species Act Candidate Bumble Bee Species (CDFW 2023).

Recommended Mitigation Measure 5: CBB Avoidance Buffer

If surveys cannot be completed, CDFW recommends that all small mammal burrows and thatched/bunch grasses be avoided by a minimum of 50 feet to avoid take and potentially significant impacts. If ground-disturbing activities will occur during the overwintering period (October through February), consultation with CDFW is warranted to discuss how to implement Project activities and avoid take. Any detection of CBB prior to or during Project construction warrants consultation with CDFW to discuss how to avoid take.

Recommended Mitigation Measure 6: CBB Take Authorization

If CBB is identified during surveys or at any time during Project construction, consultation with CDFW is warranted to determine if the Project can avoid take. If take cannot be avoided, take authorization prior to any ground disturbing activities is warranted. Take authorization would occur through issuance of an ITP by CDFW, pursuant to Fish and Game Code section 2081(b).

EDITORIAL COMMENTS AND/OR SUGGESTIONS

Mitigation Measures : MM 4.4-1 B states, "*As an alternative to individual pre-disturbance surveys for each application, and after consultation with and concurrence by the California Department of Fish and Wildlife and the United States Fish and Wildlife Service, multiple parcels or areas of CCS activities (including lands which may have multiple surface or mineral ownership) may be consolidated for the purpose of more efficiently managing pre-disturbance surveys and determinations regarding the absence of protected species in areas of proposed new ground disturbance activities.*", it is unclear what this statement means for implementation of protocol surveys, please provide additional clarification in the final EIR.

Impacts to Conserved Lands: As a condition of previous CDFW and USFWS permits, OXY placed 7,878 acres of high-quality habitat ("Elk Hills Conservation Area") within the EHOF into permanently conserved status via recordation of a Conservation Easement in favor of CDFW. The Elk Hills Conservation Area is present along the North and South flanks of the EHOF, which is within and adjacent to a portion of the Project. Specifically, the proposed pore space underlies a portion of the Elk Hills Conservation Area. CDFW recommends the final EIR analyze any potential direct or indirect impacts to this conserved land and the associated special status species. Project related impacts to conserved lands may make the project proponent liable for making whole, the loss of mitigation associated with the CDFW and USFWS permits.

The DEIR indicates that Project facilities would be located within the Elk hills Conservation Area. However, while a portion of the Project Pore Space may underly the Elk Hills Conservation area, any Project related surface disturbance is prohibited by the Conservation Easement recorded in favor of CDFW. For example, Project surface infrastructure such as but not limited to pipelines and injection wells must completely avoid the Elk Hills Conservation Area parcels. Further, an appropriate buffer (at least 500 feet) for such surface infrastructure should be observed from the periphery of the Elk Hills Conservation Area boundary to minimize the potential for CO_2 leaks impacting the rare species inhabiting the Elk Hills Conservation Area. CDFW requests that these avoidance measures be made an explicit condition of approval in the Final EIR.

Federally Listed Species: CDFW recommends consulting with USFWS regarding potential impacts to federally listed species including but not limited to BNLL, GKR, SJKF, and California jewelflower. Take under the ESA is more broadly defined than

CESA; take under ESA also includes significant habitat modification or degradation that could result in death or injury to a listed species by interfering with essential behavioral patterns such as breeding, foraging, or nesting. Consultation with the USFWS in order to comply with ESA is advised well in advance of any Project activities.

Lake and Streambed Alteration: Based on the information provided in the DEIR, as well as our familiarity with the EHOF, the Project Area contains multiple streams. The DEIR contemplates that Project activities may be subject to CDFW's regulatory authority pursuant to Fish and Game Code section 1600 et seq. which requires an entity to notify CDFW prior to commencing any activity that may (a) substantially divert or obstruct the natural flow of any river, stream, or lake; (b) substantially change or use any material from the bed, bank, or channel of any river, stream, or lake (including the removal of riparian vegetation): (c) deposit debris, waste or other materials that could pass into any river, stream, or lake. "Any river, stream, or lake" includes those that are ephemeral, intermittent, or episodic, as well as those that are perennial. CDFW is required to comply with CEQA in the issuance of a Lake or Streambed Alteration Agreement; therefore, if the CEQA document approved for the Project does not adequately describe the Project and its impacts to streams, a subsequent CEQA analysis may be necessary for Lake or Streambed Alteration Agreement issuance. For information on notification requirements, please refer to CDFW's website (https://wildlife.ca.gov/Conservation/LSA) or contact CDFW staff in the Central Region Lake and Streambed Alteration Program at (559) 243-4593 or R4LSA@wildlife.ca.gov.

ENVIRONMENTAL DATA

CEQA requires that information developed in environmental impact reports and negative declarations be incorporated into a database, which may be used to make subsequent or supplemental environmental determinations (Pub. Resources Code, § 21003, subd. (e)). Accordingly, please report any special-status species and natural communities detected during Project surveys to the CNDDB. The CNDDB field survey form can be found at the following link: https://www.wildlife.ca.gov/Data/CNDDB/Submitting-Data. The completed form can be mailed electronically to CNDDB at the following email address: CNDDB@wildlife.ca.gov. The types of information reported to CNDDB can be found at the following link: https://www.wildlife.ca.gov/Data/CNDDB/Plants-and-Animals.

FILING FEES

The Project, as proposed, would have an impact on fish and/or wildlife, and assessment of filing fees is necessary. Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW. Payment of the fee is required in order for the underlying project approval to be operative, vested, and final (Cal. Code Regs, tit. 14, § 753.5; Fish & G. Code, § 711.4; Pub. Resources Code, § 21089).

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CONCLUSION

CDFW appreciates the opportunity to comment on the DEIR to assist Kern County in identifying and mitigating Project-related impacts on biological resources.

If you have any questions, please contact Steve Hulbert, Senior Environmental Scientist Specialist, at the address provided on this letterhead, by telephone at (559) 575-6415, or by electronic mail at Steven.Hulbert@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Julie Vance
FA83F09FE08945A...
Julie A. Vance
Regional Manager

Enclosure

REFERENCES

CDFW 2023. Survey considerations for California Endangered Species Act candidate bumble bee species. California Department of Fish and Wildlife, Sacramento, California, USA.

Cypher, B. L., G.D. Warrick, M. R. M. Otten, T. P. O'Farrell, W. H. Berry, D. E. Harris, T.T. Kato, P. M. McCue, J. H. Scrivner, and B. W. Zoellick. 2000. Population dynamics of San Joaquin kit foxes at the Naval Petroleum Reserves in California. Wildlife Monographs 145: 1-43.

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Attachment 1

MITIGATION MONITORING AND REPORTING PROGRAM (MMRP) FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE RECOMMENDED MITIGATION MEASURES

PROJECT: Carbon TerraVault 1
SCH No.: 2022030180

RECOMMENDED MITIGATION MEASURE	STATUS/DATE/INITIALS
Before Disturbing Soil or Vegetation	
Mitigation Measure 1: Temblor Legless Lizard Surveys	
Mitigation Measure 3: Temblor Legless Lizard Take Authorization	
Mitigation Measure 4: Crotch's Bumble Bee Surveys	
Mitigation Measure 6: Crotch's Bumble Bee Take Authorization	
During Construction	
Mitigation Measure 2: Temblor Legless Lizard Avoidance	
Mitigation Measure 5: Crotch's Bumble Bee Avoidance	

From: Colin O"Brien
To: Keith Alvidrez; CTV1EIRComments
Cc: Michelle Ghafar; Nirit Lotan
Subject: Question about the administrative record for Carbon TerraVault I Project
Date: Thursday, February 29, 2024 1:38:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Hi Keith –

I have a hopefully quick question about the administrative record that the County is compiling for the Carbon TerraVault I (CTV I) Project.

As best I can tell, every (or almost every) impact section of the CTV I Draft EIR states something along the lines of the following:

"The analysis in this section is based on the Kern County (County) *Final Environmental Impact Report - Revisions to the Kern County Zoning Ordinance - 2015(C) Focused on Oil and Gas Local Permitting*, certified on November 9, 2015), supplemented by a Supplemental EIR certified on December 11, 2018, a Supplemental Recirculated EIR (SREIR) certified on March 8, 2021, and an Addendum adopted on August 23, 2020 (collectively referred to as the 'Oil and Gas EIR')." (See, e.g., CTV I Draft EIR at p. 4.1-1.)

Given these repeated references, does the County intend to include all the collective components of the "Oil and Gas EIR," including appendices, in the administrative record for the CTV I Project? I presume so, and hopefully you can confirm that is the case. Otherwise, we and others commenting on the CTV 1 Draft EIR might feel compelled to submit the Oil and Gas EIR ourselves, which could lead to a large volume of unnecessary duplication.

Sincere thanks,
Colin

Colin C. O'Brien
Pronouns: he/him/his
Deputy Managing Attorney
California Regional Office
Earthjustice
50 California Street, Suite 500
San Francisco, CA 94111
T: 415.217.2010
F: 415.217.2040
earthjustice.org

EARTHJUSTICE

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March 1, 2024

Kern County Planning Commission
Public services building, 2700 M St #100,
Bakersfield, CA 93301
Subject Line: RE: EPA-R09-OW-2023-0623

To whom it may concern,

Attached are the signatures and comments of **86 individuals** who signed onto the following statement in just four days through the Sierra Club.

> I am writing to give my opposition to the Carbon TerraVault 1 project in the Elk Hills oil fields of Kern County, California, EPA-R09-OW-2023-0623. As the first Carbon Capture and Sequestration (CCS) project in California to undergo environmental impact review, this project will set precedent across the state for future projects and therefore, must meet the highest standards.
>
> This Draft EIR shows inadequacies around health and safety mitigation of:
> - National Ambient Air Quality Standards (NAAQS) for particulate matter (PM2.5),
> - Impacts to sensitive receptors like schools and neighborhoods,
> - Risks leaks from uncapped oil wells, could source carbon from blue hydrogen projects,
> - Extend the life of oil and gas production plant by decades
>
> I urge you to reject this project and invest in real clean energy solutions that advance California's air, climate, public health, and environmental justice goals, and to protect the already overburdened frontline communities from further harm to their health and environment.

41 of these signers, you might also notice, added their own additional personal comments. If there are any questions about this statement or our positions on this matter do not hesitate to contact us.

Sincerely,

Mercedes Macias
Senior Field Organizer
Sierra Club
mercedes.macias@sierraclub.org

1. Ann Gallon
Bakersfield, CA 93314
After watching the Hydrogen Energy California (HECA) project in Kern County never get off the the ground with its attempt to sell the fossil fuel industry on carbon capture and sequestration, I see this iteration as just another boondoggle?or foot dragging by that industry.
I was on a science-based webinar out of Pasadena last year featuring an expert on hydrology and asked him what he thought of ccs: His one word response was, "BOONDOGGLE"

2. vishnu reddy
Bakersfield, CA 93311
As a resident of kern county this issue is important to me and I and my fellow residents and Sierra club members will be keenly aware of the way local regulators and politicians vote on this issue.

3. Gary Lasky

Carbon Capture and Storage will *never* work to mitigate our U.S. and global emissions of GHGs. It is a sham, and the oil and gas industry knows it, to keep up profits at the expense of a habitable planet. SAY NO TO THE TERRAVAULT 1 PROJECT!
Gary Lasky
Legal Co-Chair
Sierra Club Tehipite Chapter
Fresno, CA
559-790-3495

4. Silvia Rocha
Azusa, CA 91702
Do the right thing now.

5. Josue Acosta
La Quinta, CA 92253
Don?t trust these mfkers

6. Debra Cruet-Good
Rancho Santa Fe, CA 92067
Drilling for oil damages the environmental health for all living beings, but especially the natural and indigenous animals that have no means of safety in their living environment!

7. Rhonda Casper
Los Angeles, CA 90068
For the health of environment and the community, I urge you to say NO to this proposed project.

8. Paula Torres
Pico Rivera, CA 90660
Greetings, Upon this important subject as it impacts ones health. My family, my neighbors and myself have lived by the oil wells rigs for decades in which has impacted our health for the worse even shortening our very lives.
FYI we've been dealing with Asthma,COPD and Cancer all which were contributed by this oil and gas collection process. Now our children and grandchildren nieces and nephews are being impacted by it for the worse
They now are having heart and lung issues alongside more of my neighbors are also dealing with cancer.
Please take heed on this matter and help with this since it's impacting everyone's health, the environment plus the pets, wildlife and plants within their production sites

9. cameron wasserman
petaluma, CA 94952
I am a forester with the united states forest service. Protect the environment.

10. David Marrett
Wildomar, CA 92595

I am a retired university professor, outdoor educator and high school science teacher who is extremely concerned about the condition of the world we are passing on to future generations. I have thousands of former students, two sons and (so far) two grandsons. And of course younger friends, their families, nephews, nieces, cousins and so on.
But it is the people in the global south, few of whom I know, who will pay the lion?s share of misery from Climate Chaos. The bulk of the ClimateCrises is due to one cause: fossil fuel extraction, combustion and transformation into petrochemicals including plastics. We need to accelerate a just transition to clean energy.

11. Barry Barnett
Santa Rosa, CA 95409
I completely agree with the text of this petition. We need to stop drilling, and releasing methane into the atmosphere, and not try to fool us by saying that you will completely help your toxic pollution with another drilling project.

12. Kristine Severson
San Francisco, CA 94115
I feel very strongly about the issue and don?t like the precedent it could set if we allow this.

13. Caty Wagner
North Hills, CA 91343
I had to move out of the San Joaquin Valley because the air quality was so awful. My heart breaks for everyone who can?t afford to do it. This is absolutely exploitation of lower income communities.

14. Aurora Garcia
Kensington, CA 94708
I have grandchildren. Climate change is real and it's bad. Keep the oil in the ground.

15. Penelope Lepome
Ridgecrest, CA 93555
I live in Kern County and I am very anxious about climate change. A Carbon Fee and dividend program would be better than CCS.

16. Lori Pesante
Bakersfield, CA 93311
I live right where all these oil wells are still operating here in Bakersfield/ Kern and I?ve seen the manipulative practices these oil companies engage in. It is INSANE to grant them ANY ability to engage in projects of this magnitude located in our most disinvested Farmworker communities, let alone for a project that is IN NO WAY a climate solution and will in fact exacerbate our problems for many years to come. Please DENY THE CRC/ CTV ccs application!

17. Leslie Brevidoro
Northridge, CA 91325
It?s almost too late but we still have to try harder. That includes all the corporations and wealthy companies etc. Especially the ones most directly involved in contributing to our demise.
CHANGE THINGS NOW!!
Too late is just too late.

18. Matthew Smith
Manhattan Beach, CA 90266
It?s NOT the right answer

19. Sophia Chumley
San Francisco, CA 94110
Just No on this. The pandemic revealed that communities affected by fossil fuel production suffer deadly consequences

when their already compromised respiratory health is affected more by a virus . We can control air quality and protect our people. We can?t approve new fossil fuel projects . When the epa refuses to stand up for people, people lose any faith in their government. Do your job please! Protect Californians , all California s not just those fortunate enough to live far from oil fields. It is up to each of you that work there to use your power to save lives .

20. Judith Trimble
Los Angeles, CA 90008
Let?s make human beings? safety, health and well being our number one priority, not money and greed. Our children and future generations require healthy air quality and living spaces in order to thrive. Bottom line - STOP DESTROYING OUR FUTURE(ie our next generation and planet)! It?s time to stop being reckless and negligent. Now is the time to prove you can be responsible, accountable and caring adults. Set an good example for the next generation.

21. Joe Bruyn
Chatsworth, CA 91311
lots be safe out there because life on it i think could be the end

22. Marlene Juette
Folsom, CA 95630
My family has been in Sacramento Valley since I was 3! We must stop the continual pollution that is making it worse and worse and worse to live here. It is essential that we create a clean environment. We have too much damage already caused by oil and gas. It is time to reject gas and oil and pave the way to renewable energy.

23. Melissa Littlefield
Winchester, CA 92596
My life is dedicated to helping kids with disabilities. We need to keep the world safe for them to breathe!

24. Cheryl Figueroa
La Mesa, CA 91942
Oil is death ??

25. Carol Davydova
Sacramento, CA 95822
Our government needs to defund subsidies to fossil energy and plan renewables as our energy path forward.

26. Kendra Burns
Bakersfield, CA 93306
Please safeguard our community's health.

27. Sheryl Williams
Williams, CA 95987
Please.?. Help to preserve our Planet and ? the Life on Her...?

28. LaDonna Adam
Benicia, CA 94510
The environment is so much more important than making rich people even richer. Save ourselves!

29. Ben Savill
Tustin, CA 92782
There are too many examples of greenwashing by Big Oil to cover up their lies, misinformation, pollution, environmental harms, health & safety breaches, and violations of numerous laws. Big Oil cannot be trusted to do the right thing.

30. Prudence Sweeney
Carlsbad, CA 92008
There has been too much harm to the environment already! Please think about the health of the communities already

established around the area you want to drill in.

31. Captain Richard Gillette
OAKHURST, CA 93644
This is a disaster - the future of our lives depends on you doing the tight thing! If you have children or grandchildren PROTECT THEIR FUTURE!!!!

32. Tabitha Morgan
Marysville, CA 95901
This issue is important to me because I believe it is time for Big Oil industries to allocate their industrious skills, talents, and power to finding sustainable ways of transitioning from oil to renewable and cleaner sources of fuels and materials. Communities, society, and ultimately the globe, is at the mercy of Big Oil. The delicate balance of gases in our natural atmosphere allow us to sustain our lives. At the very least, new construction should be crafted in regions that are 161km or more away from communities with residential areas, schools, merchant shops, shopping centers, schools, religious centers, government centers, and any facility frequented by local community members. We have too much information now, regarding the impact these types of infrastructures have on our communities, to continue doing the same processes that have led us all to this point. It is paramount to shift the strategies from extraction of fossil fuels to more modern and ingenious methods.

33. Suzette Myers
Oceanside, CA 92057
This project is a terrible idea for our environment, and the future of Californians.

34. Laurie Hidy
Wofford Heights, CA 93285
This project is dangerous and will only result in further endangering the lives of residents, gchildren, livestock and wildlife including the rivers and lakes here. As a resident of Kern County and find that the data for this project,not surprisingly, has caused alarm bells to go off on numerous levels. Stop this project immediately in order to take a closer look at alternatives to fossil fuels.

35. Annie Walton-Teter
Santa Monica, CA 90405
We ALL need to be saving our home planet and its biodiversity.

36. Lauren Bier
Rancho Santa Fe, CA 92067
We cannot continue to prolong fossil fuel extraction, prioritizing profits at the expense of a healthy future. I have lived outside of extraction communities in both Pennsylvania and California?s Central Valley. We need to stop greenwashing and start transitioning in a way that helps people stay employed without sacrificing health.

37. Betsy Eudey
Twain Harte, CA 95383
We have far too many other safe, eco-friendly, and financially-viable options that make it ridiculous to engage in more drilling for oil and gas. And even if it costs a lot of money up front, the investment is worth the reward, as we can't undo all of the damage to the environment that drilling will cause.

38. Julia Mensing
San Carlos, CA 94070
We must get away from our dependence on fossil fuels and convert to renewable, sources that are environmentally safe for

the planet. Thank you for your consideration.

39. Cannon Hanson
Brea, CA 92821
We need to transition from fossil fuels and reduce the consumerist mentality corporations have forced on Americans

40. Nishanga Bliss
Berkeley, CA 94702
We need to transition to clean energy fast & can?t rely on unproven tech fixes.

41. Alvin Waters
Granada Hills, CA 91344

42. Anna Cesar
1041, CA 90027

43. Briana Kohnen
Tehachapi, CA 93561

44. Carina Chadwick
Santa Clarita, CA 91390

45. CARL LUHRING
Vista, CA 92081

46. Cindy Stein
Newbury Park, CA 91320

47. Debra Robinson
San Bernardino, CA 92404

48. Denise Marble
Huntington Beach, CA 92646

49. Derek McDow
Nevada City, CA 95959

50. Isaac Wollman
San Luis Obispo, CA 93401

51. Isabela Bahadorzadeh
Bakersfield, CA 93311

52. Jacqueline Stratton
Trinidad, CA 95570

53. James Michael 'Mike' Henderson
San Luis Obispo, CA 93405

54. Janis Tilton
San Ramon, CA 94582

55. Jeanette Gonzalez Ramos
Bakersfield, CA 93307

56. Jocelyn Iverson
Visalia, CA 93291

57. Jose Perez
Bakersfield, CA 93305

58. Judy Matusz
Bakersfield, CA 93308

59. Julia Nila
Chino, CA 91710

60. Kevin Eisenstaedt
SF, CA 94102

61. Kiana Chandruang
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INTEROFFICE MEMORANDUM

To: Keith Alvidrez, Planner II
From: Dayana Torres, EHS
Subject: ZCC 5, MAP 119, ZCC 4, MAP 120, CUP 13, MAP 118, CUP 14, MAP 118, CUP 5, MAP 119, CUP 6, MAP 119, CUP 3, MAP 120, CUP 2, MAP 138

Date: March 25, 2024

The Kern County Environmental Health Division has reviewed the above referenced project. This Division has the local regulatory authority to enforce state regulations and local codes as they relate to waste discharge, water supply requirements, and other items that may affect the health and safety of the public or that may be detrimental to the environment.

The Environmental Health Division requests that the following conditions be place on the subject project:

1. The applicant shall submit a business plan to the Hazardous Materials Division for review and approval within 30 days of operation for hazardous materials stored or generated on-site.

Via Email

March 1, 2024

Kern County Planning and Natural Resources Department
Attn: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100
Bakersfield, CA 93301
CTV1EIRComments@kerncounty.com
Alvidrezk@kerncounty.com

Re: Comments on the Draft Environmental Impact Report for Carbon TerraVault I

Dear Mr. Alvidrez:

On behalf of Center for Biological Diversity, Center on Race, Poverty & the Environment, Central California Environmental Justice Network, Central Valley Air Quality Coalition, and Sierra Club, we are writing to submit the following comments regarding the Draft Environmental Impact Report (the Draft EIR) for the Carbon TerraVault I Project (the CTV I Project) for carbon capture and storage (CCS) in the Elk Hills oil field. These comments are offered to ensure that Kern County (the County) complies with the California Environmental Quality Act (CEQA)[1] and CEQA Guidelines[2] in its consideration of the CTV I Project.

In addition, we submit technical expert analyses prepared by Ron Sahu, PhD, QEP, CEM (Attachment A); Dominic DiGiulio, PhD (Attachment B); and Richard Kuprewicz (Attachment C). We refer the County to these reports, both here and throughout these comments, for further discussion of the Draft EIR's inadequacies.

As an initial matter, we urge the County to redress key deficiencies in the Draft EIR that inhibit public comment and participation. In particular, the Draft EIR fails to provide an "Appendix 1" that is repeatedly referenced throughout the document and relied upon for key information about existing oil and gas wellbores and planned monitoring wells at the Project site.[3] The County must recirculate the Draft EIR, include the missing Appendix 1, and provide a

[1] Pub. Resources Code, § 21000 *et seq*.
[2] Cal. Code Regs., tit. 14, § 15000 *et seq*. (CEQA Guidelines).
[3] See, e.g., Draft EIR, Vol. 1 at 4.7-1 (noting "Geology and Soils" analysis in section 4.7 is based on U.S. Environmental Protection Agency's (EPA's) Class VI Underground Injection Control (UIC) Permit Application for CTV I); Draft EIR, Vol. 2, App'x E.2: EPA Class VI UIC Permit Application Narratives for the Elk Hills 26R Storage Project and the A1A2 Storage Project at 2240 ("Appendix 1 provides a complete list of all API-12 wellbores within the [area of review]. As required by 40 CFR 146.84(c)(2), the well table in Appendix 1 describes each well's type, construction, date drilled, location, measured depth, true vertical depth, completion record relative to the A1-A2 injection zone, record of plugging, requirement for corrective action, if necessary. CTV also identifies well work to be completed during the pre-operational testing phase.").

minimum 45-day comment period to give the public sufficient time to review and comment on the CTV I Project as required by CEQA.[4]

Beyond the obvious error of failing to include Appendix 1, the Draft EIR is generally missing critical details about the CTV I Project and vague throughout, making it impossible to sufficiently analyze the range of impacts due to the Project and to adopt adequate mitigation measures. The Draft EIR therefore fails in its basic purpose of being an informational document "to provide public agencies and the public in general with detailed information about the effect that a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project."[5]

These errors are particularly inappropriate because this Project will be the first in California to deploy CCS in order to facilitate continued fossil fuel extraction and combustion, which is an application of this technology that threatens to seriously derail progress toward state and federal climate commitments.[6] Indeed, not only will the CTV I Project extend the life of the decades-old Elk Hills oil field and the existing gas plant and power plant supporting the field, the Project will also justify the build-out of multiple new polluting facilities as future CO_2 sources, including a blue hydrogen plant, a renewable dimethyl ether production facility, a gasoline plant, and a waste-to-energy production facility.[7] Rather than doubling down on counterproductive and risky projects that will allow the Elk Hills field to continue operating for years longer than necessary, and further lock in the County's dependence on the fossil fuel industry, the County should be investing in the transition to renewable clean energy solutions.

In the past, initial projections of specific CCS proposals have frequently overestimated the level of capture that those projects ended up achieving in practice.[8] The Draft EIR neither grapples with this possibility in the context of CTV I nor demonstrates how it plans to avoid the pitfalls that hindered earlier projects. And by allowing fossil fuel facilities to keep operating, CTV I will ultimately serve to exacerbate pollution and ongoing harms to the County's frontline communities.[9] The process of capturing, transporting, injecting, and storing CO_2 also poses serious public health and safety threats, including from toxic releases and catastrophic accidents

[4] CEQA Guidelines, § 15105(a).
[5] See Pub. Resources Code, § 21061.
[6] See Inst. for Energy Economics & Fin. Analysis (IEEFA), *The Carbon Capture Crux* (Sept. 2022) at 73–74, https://ieefa.org/sites/default/files/2022-09/The%20Carbon%20Capture%20Crux.pdf.
[7] Cal. Resources Corp. (CRC), *Carbon TerraVault Vaults*, https://www.crc.com/carbon-terravault/vaults/default.aspx (last accessed Feb. 23, 2024).
[8] See, e.g., IEEFA, *The Carbon Capture Crux*; IEEFA, *Carbon Capture and Storage*, https://ieefa.org/ccs#:~:text=Yet%20an%20IEEFA%20review%20of,low%20carbon%2C%20not%20a%20solution (last updated Dec. 5, 2023).
[9] See Jacobson, M.Z., *The Health and Climate Impacts of Carbon Capture and Direct Air Capture*, Energy Environ. Sci. 12 (2019), 3567–74, https://doi.org/10.1039/C9EE02709B; Concerned Health Professionals of N.Y. & Physicians for Social Responsibility, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure* (Apr. 2022) at 80–81, https://www.psr.org/wp-content/uploads/2022/04/compendium-8.pdf.

that endanger the homes, schools, and other sensitive locations near Elk Hills.[10] The Draft EIR fails to demonstrate how the CTV I Project will minimize these harms, nor does it indicate that the Project's alleged benefits are justified in light of them.

These harms will disproportionately fall on people of color and lower income residents who have long been overburdened by the same oil and gas operations and polluting industries that CTV I now threatens to prolong.[11] The Elk Hills oil field neighbors environmental justice communities in Buttonwillow, Taft, and Tupman that cannot afford the air, climate, energy, water, health and safety, geologic, biological, and other impacts from the CTV I Project.[12]

After carefully reviewing the Draft EIR, we have concluded that it fails in numerous respects to comply with CEQA. As explained below, the Draft EIR violates CEQA because it fails to: (1) properly define the project description and the scope of the CTV I Project's foreseeable impacts; (2) properly consider reasonably foreseeable projects; (3) adequately analyze and mitigate growth-inducing impacts; (4) employ appropriate Project objectives; (5) properly consider alternatives to the Project; and (6) adequately analyze and mitigate numerous foreseeable environmental impacts and cumulative impacts. As the first environmental impact report prepared for a CCS project in California, the Draft EIR falls far short of establishing appropriate standards and safeguards should these projects move forward in the future.

For these and the additional reasons expressed below, we strongly urge the County to reject the Draft EIR as an informational document, and to prepare and circulate a revised Draft EIR that complies with CEQA.

We include a table of contents on the next page to facilitate review.

[10] See DiGiulio Report at 3–5; Zegart, *The Gassing of Satartia*, Huffington Post (Aug. 26, 2021), https://www.huffpost.com/entry/gassing-satartia-mississippi-co2-pipeline_n_60ddea9fe4b0ddef8b0ddc8f.

[11] See Lam, Y. et al., *Briefing: Analysis of Proposed Carbon Capture Projects in the US Power Sector and Co-Location with Environmental Justice Communities* (Sept. 2023) at 4, https://static1.squarespace.com/static/5d14dab43967cc000179f3d2/t/64f9df23792cce775bf32100/1694097188142/Map_Proposed+CCS+Projects+-+Two+Pager_CURRENT.pdf (showing 94.3% of planned CCS projects in the U.S. power sector are located within 3 miles of an environmental justice community, including CTV I).

[12] Numerous studies have found a significant association between proximity to oil and gas production and adverse health outcomes in the San Joaquin Valley. See, e.g., Gonzalez, D.J.X. et al., *Oil and Gas Production and Spontaneous Preterm Birth in the San Joaquin Valley, CA* (2020), Environmental Epidemiology, 4(4), https://journals.lww.com/environepidem/Fulltext/2020/08000/Oil_and_gas_production_and_spontaneous_preterm.1.aspx?context=LatestArticles.

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I. THE DRAFT EIR'S ANALYSIS AND MITIGATION ARE BASED ON AN IMPROPER PROJECT DESCRIPTION

CEQA aims to foster greater transparency to ensure that decisionmakers and stakeholders are informed of potentially harmful environmental consequences of proposed projects, receive a clear and robust analysis of those consequences, and are assured that feasible mitigation is implemented. This level of transparency requires a complete understanding of the project and an analysis that encompasses the project's full scope. "Only through an accurate view of the project may outsiders and public decision-makers balance the proposal's benefits against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal . . . and weigh other alternatives in the balance."[13] Here, the County does not achieve the level of transparency required by CEQA because of an inappropriately narrow project description.

Under CEQA, a "project" is defined as the whole of an action that has the potential to cause direct or indirect physical changes to the environment.[14] A project description that omits integral components of the full project may result in an EIR that fails to disclose all the impacts of the project.[15] EIR project descriptions have been rejected as inadequate when, as is the case here, the EIR limited the scope of environmental review by artificially narrowing the project description, thus minimizing the project's impacts and undermining public review.[16]

A proper description and analysis must include "future action" that is "a reasonably foreseeable consequence of the initial project" and would "be significant in that it will likely change the scope or nature of the initial project or its environmental effects."[17] As explained below, the Draft EIR fails to include the whole of the action in its analysis, and to analyze reasonably foreseeable and significant consequences of the CTV I Project.

The Draft EIR's scope is too narrow because it fails to address critical components of the CTV I Project, including the interrelationship between the Project and the development of industries in Kern County that will send CO_2 for sequestration to the Elk Hills oil field, and between the Project and development of CO_2 transportation infrastructure. And the inadequate

[13] *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 192.
[14] CEQA Guidelines, § 15378(a); see *Habitat Watershed Caretakers v. City of Santa Cruz* (2013) Cal.App.4th 1277, 1297.
[15] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829 (project description for sand and gravel mine omitted water pipelines serving project); *City of Santee v. County of San Diego* (1989) 214 Cal.App.3d 1438, 1454 (concluding that complete project description is necessary to ensure that environmental impacts of entire project are considered).
[16] See, e.g., *Rural Landowners Assn. v. City Council* (1983) 143 Cal.App.3d 1013, 1024 (EIR for city general plan amendment and rezoning that failed to describe or analyze the impacts of development that would follow annexation to the city); *County of Inyo, supra*, 71 Cal.App.3d at 193 (EIR for groundwater pumping and water export project that failed to describe or analyze groundwater exports and instead improperly sought to characterize expanding groundwater exports as a separate, ongoing project).
[17] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal* (1988) 47 Cal.3d 376, 396, as modified on denial of reh'g (Jan. 26, 1989).

specification of the project description and scope also renders the Draft EIR informationally inadequate.

The project description states that the Project includes "the construction and operation of an approximately 9,130-acre CCS facility with related capture facilities and pipelines for the initial source."[18] That "initial source," according to the Draft EIR, would be the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility and used at the Elk Hills power plant. The Draft EIR goes on to say that "[n]o additional sources of CO_2 (from outside Elk Hills) or other new development are proposed for the CCS Surface Land Area or injection into the project."[19]

However, the "initial source" that the Draft EIR analyzes is only the first among several sources that are proposed to send CO_2 for storage in the Project. The storage reservoirs have the capacity to store almost 50 million metric tons (MMT) of CO_2 and the Project proponent is seeking to approve *the whole project's storage capacity* in the Draft EIR.[20] The Draft EIR's analysis discloses that at a maximum, the initial source's CO_2 will add up to about 31 MMT of captured CO_2.[21] And even this number is hypothetical and might in fact be much lower, as it assumes continuous operations of the power plant into the year 2045, while the Draft EIR admits that the plant "may be forced to close sooner" due to California's fossil fuels policies.[22]

While the Draft EIR notes that other sources could be sending CO_2 to the Project, it fails to disclose *any* meaningful information regarding these sources. The Draft EIR makes only a few passing references throughout to future sources, claiming that "[a]ll future sources are required to be permitted with a separate CUP process and environmental review for compliance with CEQA."[23] It further argues that because these sources "have not been permitted or completed CEQA, information cannot be provided" regarding the CO_2 they will be storing or potential emissions.[24]

The project description section of the Draft EIR lists under "Cumulative Projects" several projects in the County. The Draft EIR provides nothing more than the name, location, type, acreage, and status of these projects. Some of the projects are listed as "Carbon Capture and Storage" projects, while others, such as the NLC Energy "Waste to Energy" or the Lone Cypress "Blue Hydrogen" projects, may be potential CO_2 sources for the CTV I Project. The Draft EIR does not provide any other useful information regarding these potential sources anywhere in its analysis.[25]

An accurate and stable project description is necessary so that the lead agency and the public have enough information to "ascertain the project's environmentally significant effects,

[18] Draft EIR, Vol. 1 at 3-1.
[19] Draft EIR, Vol. 1 at 3-1.
[20] Draft EIR, Vol. 1 at 4.8-19.
[21] Draft EIR, Vol. 1 at 4.8-24 (Table 4.8-4).
[22] Draft EIR, Vol. 1 at 4.8-24.
[23] Draft EIR, Vol. 1 at 4.8-19
[24] Draft EIR, Vol. 1 at 4.8-25.
[25] Draft EIR, Vol. 1 at 3-43 to 3-44.

assess ways of mitigating them, and consider project alternatives."[26] Information about the sources for the CO_2 that will be injected into the Project's storage facility is crucial for this very reason. The specific industrial processes that will emit the CO_2, the capture technology, the CO_2 properties, and the mode of transportation to the Project all have major implications for the CTV I Project's impacts on air pollution, greenhouse gas emissions, hazardous materials, and the public's health, to name just a few categories.

As just one example, whether CO_2 will be transported to the Project by trucks or pipelines, and the routes of such trucks or the locations of the pipelines, are all critical pieces of information necessary to assess the Project's potential impacts. Courts have held that an EIR for a mining operation failed as an informational document because it failed to include a "description of the facilities that will have to be constructed to deliver water to the mining operation."[27] In the same way, the Draft EIR fails to describe the methods and facilities that will be used to send CO_2 into the Project. As discussed below, an expert report attached to these comments also found that important information regarding pipelines is missing from the Draft EIR.

While the Draft EIR provides no information on the methods of CO_2 transportation from its potential sources, its project description section states that "[i]t is anticipated that diesel heavy heavy [sic] duty trucks would make 40 trips per day following the access routes designated for travel"[28] as part of the Project's operational traffic. The Draft EIR fails to include *any* explanation as to the reason for these heavy-duty truck trips. Moreover, these trips are not mentioned or analyzed in the transportation analysis section or in the air quality section.

Another example of the failure to properly include all related actions and reasonably foreseeable consequences is the Golden State Hydrogen project. On January 30, 2024, the Tulare County Board of Supervisors approved a Notice of Exemption for Golden State Hydrogen, a new hydrogen plant in Pixley, California, some 60 miles north of the CTV I Project. That project was approved without any CEQA review under the ministerial decision exemption.[29] The Golden State Hydrogen operating statement contemplates the building of a potential facility in Tulare County to capture and store CO_2 from this facility, but there is no guarantee it will ever be built. The statement states that until such project is built "the Applicant plans to sequester CO_2 by liquefying it on site and delivering it to the proposed Carbon Terravault I (CTV) at Elk Hills, California."[30] Despite the fact that there is a known facility that explicitly plans on sending its CO_2 for storage at the CTV I Project, this component of transporting CO_2 to the Project is missing from the Draft EIR completely.

Even beyond specific known facilities, the Draft EIR must include within its scope a discussion of potential industries that will be sending CO_2 to be stored, not only because these industries and the CO_2's modes of transportation are integral components of the "whole" CTV I

[26] *Sierra Club v. City of Orange* (2008) 163 Cal.App.4th 523, 533.
[27] *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal.App.3d 818, 829.
[28] Draft EIR, Vol. 1 at 3-36.
[29] Tulare County Resource Management Agency, *Notice of Exemption No.., CEQ 23-013 - Golden State Hydrogen Plant Pixley* (Jan. 30, 2024), https://ceqanet.opr.ca.gov/2024010948.
[30] Padre Associates, Inc., prepared for Proteum Energy, LLC, *Operating Statement – Golden State Hydrogen Plant Project* (Oct. 2023) at 9.

Project, but also to address the CTV I Project's potential impacts on the development of CO_2-sending industries in the County and beyond. These impacts include both incentivizing new CO_2-emitting industries, and extending the life of fossil fuel sources that would continue to operate under the guise of "zero emission" when they would have been phased out but for the Project.

The Draft EIR further argues in the greenhouse gas (GHG) section that information about future sources of CO_2 is unknown, and at the same time, that future sources will come from "essential but hard to decarbonize" industries.[31] Nothing in the Draft EIR indicates how this "essential but hard to decarbonize" category is defined or suggests the County will condition future sources on falling within it. The only disclosed source in the Draft EIR is a fossil fuel plant that sends power to oil production activities.[32]

Notably, the Project has no practical or financial justification without its CO_2-sending industries. As the Draft EIR itself admits, "[t]he life of the project is dependent on the sources permitted for injection into the storage, the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[33] The lack of information or standards regarding CO_2-sending industrial facilities creates a serious concern that instead of reducing and sequestering current CO_2 emissions, the Project will attract and incentivize the construction of new CO_2 generating facilities. This concern is illustrated by the fact that the cumulative projects table includes the "CTV energy park", described only as including "Multiple Projects" in an "[u]nknown (Elk Hills)" location.

Moreover, according to California Resource Corporation's (CRC's) website, a number of Carbon Dioxide Management Agreements (CDMAs) have been finalized to assure sequestration at the Project site by specific industrial facilities. All the projects that have entered into a CDMA should be included in the project description. These projects include: the Lone Cypress Blue Hydrogen project (CDMA entered into in May 2023), a new renewable dimethyl ether (rDME) production facility by InEnTec, Inc. (CDMA entered into in May 2023), a renewable gasoline plant by Verde Clean Fuels (CDMA entered into in July 2023), and a waste-to-energy production facility by NLC Energy (CDMA entered into in November 2023). All these projects are planned to be co-located at Elk Hills.[34] Moreover, and importantly, several of these projects contemplate CRC, CTV, or affiliated companies possessing an "equity stake" in the CO_2-sending facilities.[35]

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[31] Draft EIR, Vol. 1 at 4.8-26

[32] "The Elk Hills Power plant provides about one third of its power for oilfield operations and the remainder is distributed to the California power grid." Draft EIR, Vol. 1 at 3-3.

[33] Draft EIR, Vol. 1 at 4.8-24.

[34] CRC, *Carbon TerraVault Vaults*.

[35] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* (July 31, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Provides-Second-Quarter-2023-Update/default.aspx ("CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake") (accessed Mar. 1, 2024); CRC, *Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA* (May 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Announces-Two-New-Storage-Only-Carbon-Dioxide-Management-Agreements-and-Submission-of-Another-Class-VI-Permit-to-the-EPA/default.aspx ("CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake").

As CRC has noted publicly, these projects "play an important role within Carbon TerraVault's strategy" in developing the Project.[36]

Another project which must be included in the project description is the Avnos Direct Air Capture (DAC) project. This project is included in CRC's application to the U.S. Environmental Protection Agency (EPA) for a Class VI injection well permit and, should that permit be approved, will be an approved source of CO_2 for sequestration. In its 2023 operations updates, CTV describes the California DAC Hub as being "led by CTV's subsidiary CTV Direct, LLC" and states it was selected to receive approximately $12 million in DOE funding.[37]

The Draft EIR appendix includes a 350-page report prepared in June 2023 for the County's Planning and Natural Resources Department and titled "Envisioning a Carbon Management Park."[38] This "Carbon Management Park", whose location is undisclosed, includes various industries, some of which have potential serious environmental impacts, such as hydrogen and steel mills. The report prepared for the carbon management park is clear about the financial dependency of a carbon sequestration project on its sources, stating that "[f]or those wells to be cost effective, there will need to be a significant source of CO_2 – on the scale of millions of metric tons annually – available for injection."[39]

The Draft EIR must be revised to include a meaningful discussion of all the potential industries that will be sending CO_2 for sequestration in the CTV I Project, the CO_2 transportation modes for the Project, and their environmental impacts. It must also discuss the Project's potential to incentivize the creation of more GHG emissions sources and new industries, including fossil fuel facilities. Only by doing so would it potentially properly reflect the whole of the action that is being proposed for approval.

II. THE DRAFT EIR IMPROPERLY PIECEMEALS THE PROJECT

The Draft EIR is engaging in impermissible piecemealing under CEQA by failing to analyze at least two projects that should be analyzed as part of the Project: The Avnos DAC Project and Lone Cypress Blue Hydrogen Project.

Courts have used a two-prong test to determine whether an EIR must include an analysis of the environmental effects of future expansion or other action: whether (1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its

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[36] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* ("This project highlights the value proposition of our CTV Clean Energy Park and its important role within Carbon TerraVault's strategy . . . . We welcome NLCE as a trusted partner in developing and furthering California's decarbonization efforts and supporting Kern county's ambitions to become the leading carbon sequestration area in the state.").

[37] Business Wire, *Carbon TerraVault Provides 2023 Update* (Feb. 27, 2024), https://www.businesswire.com/news/home/20240227366330/en/Carbon-TerraVault-Provides-2023-Update.

[38] Draft EIR, Vol. 2, App'x K.2: Carbon Management Business Park 2023 Report, Envisioning A Carbon Management Business Park (June 2023).

[39] Draft EIR, Vol. 2, Envisioning A Carbon Management Business Park at 3.

environmental effects.[40]

Both the Avnos DAC Project and Lone Cypress Blue Hydrogen Project are included in CRC's application to the U.S. EPA for a Class VI injection well permit: "CTV plans to source carbon dioxide initially from Lone Cypress, a proposed hydrogen plant, Elk Hills pre-combustion gas treatment, and the proposed Avnos direct air capture facility."[41] Should EPA approve the Class VI permit for the CTV I Project (for which it already issued a draft permit for comments), it will include the DAC and the Lone Cypress Hydrogen facilities as approved source of CO_2.[42]

CTV I describes itself as responsible for assembling "a consortium of organizations across industry, technology, academia, national labs, community, government, and labor, to pursue U.S. Department of Energy (DOE) funding under its Regional Direct Air Capture (DAC) Hubs Initiative to create the California DAC Hub, the state's first full-scale DAC plus storage (DAC+S) network of regional DAC+S hubs."[43]

For the Lone Cypress Project, CRC's website states the company entered into a CDMA with Lone Cypress Energy Services, LLC in December 2022.[44]

Both projects, while in different stages, are in advanced enough stages to be a reasonably foreseeable consequence of the CTV I Project and are not speculative or uncertain.[45]

In a quarterly report to the California Public Utilities Commission from January 31, 2024, SoCalGas discloses that it is a member of the California Direct Air Capture Hub Consortium working toward the DAC project in Kern County and that the consortium was awarded an $11.8 million grant from DOE. It further states that the DAC facility's project manager "is currently in contract negotiations and expects to finalize the negotiation in early 2024, allowing for an expected project kickoff thereafter."[46]

As for the status of Lone Cypress, documents obtained through a California Public Records Act (PRA) request show that the project's application was deemed complete by Kern County in September 2023,[47] and a draft Notice of Preparation was already prepared for the

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[40] *Laurel Heights*, *supra*, 47 Cal. 3d 376 at 396.
[41] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* (Dec. 2023) at 1.
[42] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits*.
[43] CRC, *California DAC Hub*, https://www.crc.com/carbon-terravault/projects/california-dac-hub/default.aspx (last accessed Mar. 1, 2024).
[44] CRC, *Lone Cypress CDMA*, https://www.crc.com/carbon-terravault/projects/lone-cypress-cdma/default.aspx (last accessed Mar. 1, 2024).
[45] *Save Round Valley Alliance v. County of Inyo* (2007) 157 Cal.App.4th 1437, 1450.
[46] SoCalGas, *Quarterly Report on Status of Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), or Creating Helpful Incentives to Produce Semiconductors and Science Act (CHIPS) Projects Pursuant to Resolution E-5254* (Jan. 31, 2024) at 2.
[47] Email from Jamal Ferguson, Kern County, to Greg Brooks, *PLN23-00800 Project Meeting* (Sept. 13, 2023).

project EIR in December 2023.[48]

Both projects are not only a reasonably foreseeable consequence of the initial CTV I Project, but they are also dependent on the Project.[49] A DAC project, by definition, must be tied to a carbon sequestration reservoir to operate. In the same way, Lone Cypress relies on the CTV I Project's sequestration for its operations.

The June 2023 "Environmental Information Form" for Lone Cypress includes the following description of the project from the project proponent:

> The Lone Cypress Hydrogen Project will produce 65 Metric Tonnes (MT) per Day of liquid hydrogen using proven technology. The hydrogen will be manufactured by feeding approximately 13MM sdd of natural gas and 0.32 acre-feet per day (2,440 bpd) of water into a Steam Methane Reformer (SMR) (…) *The CO2 produced as a byproduct from the hydrogen generation will be captured, compressed to supercritical state, and transported via pipeline to a sequestration EPA Class VI well at CRC's CTV Project*. The Lone Cypress Hydrogen Project will sequester over 200,000 MT of carbon dioxide annually.[50]

In the same document, under "[a]sociated project", the applicant lists CTV I, and goes on to say that "CTV 1 will sequester CO_2 from the proposed project; therefore, *CTV must be completed before this project can commence operations*."[51]

Both the DAC and the Lone Cypress Hydrogen projects come with their own set of environmental impacts related to both construction and operations, which will likely affect the CTV I Project's environmental effects. Both projects must therefore be included in the Draft EIR, and their potential impacts must be disclosed and analyzed.

III. THE DRAFT EIR FAILS TO ANALYZE GROWTH-INDUCING IMPACTS

CEQA requires the Draft EIR to describe growth-inducing impacts of the CTV I Project,[52] including ways in which the Project could directly or indirectly foster economic growth that could lead to an adverse physical change to the environment.[53]

In a one-paragraph discussion, the Draft EIR explains that because Project operation would include five regular full-time employees, with five potential additional maintenance

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[48] Kern County Planning & Natural Res. Dept., *Draft Notice of Preparation/Initial Study Checklist, Elk Hills Blue Hydrogen by Lone Cypress Energy Services, LLC* (Dec. 2023).
[49] *Paulek v. Dept. of Water Res.* (2014) 231 Cal.App.4th 35.
[50] Environmental Information Form, *Elk Hills Blue Hydrogen Plant by Lone Cypress Holding* (filed June 1, 2023) at 2–3 (emphasis added).
[51] *Id.* at 3 (emphasis added).
[52] Pub. Resources Code, § 21100(b)(5); CEQA Guidelines, § 15126(d).
[53] CEQA Guidelines, §§ 15126.2(d), 15064(e); *Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) 124 Cal.App.4th 1184, 1205.

employees, the Project "would not result in a substantial influx of people" and "is not likely to induce any growth within Kern County."[54]

By focusing on the projected number of employees in the CTV I Project alone, the Draft EIR ignores the requirement to discuss the ways in which a proposed project could foster *economic growth*, not only population growth, directly or indirectly.[55] Clearly, as described above, the CTV I Project is just the first step in a much larger development, for which CTV already signed multiple CDMAs. In addition, the storage capacity proposed for approval can accommodate many more metric tons of CO_2 than the Draft EIR analyzes. Further economic growth from the Project is clearly what the Project proponents and the County envision, and it should be analyzed.

Moreover, a report prepared for the County to analyze the potential fiscal and economic benefits of a carbon management park found significant economic growth from such a park development: The potential volume ("output") associated with the carbon management park and related offsite activities is projected in the report to range from $4.5 billion to $6.9 billion per year. Regarding employment, the report finds that, at full buildout, the park and related offsite activities would directly and indirectly support 13,500 to 22,000 permanent jobs.[56] While this report does not directly analyze the specific projects envisioned for the Elk Hills oil field, it shows the potential economic growth that needs to be discussed under a proper growth-inducing analysis.

IV. THE DRAFT EIR FAILS TO PROVIDE ADEQUATE PROJECT OBJECTIVES

The Draft EIR does not provide an adequate set of project objectives. The document articulates no purpose, need, or objectives for the CTV I Project independent of a list of "the applicant's objectives" for the Project.[57] Because, as discussed below, the integrity and validity of an alternatives analysis depends in significant part on the articulation and assessment of the lead agency's project objectives, an EIR that lacks an adequate statement of those objectives will not be in compliance with CEQA. This deficiency is compounded by the likelihood that the Project will both attract and incentivize the construction of new CO_2-generating facilities instead of focusing on reducing and sequestering CO_2 emissions from existing facilities, and also be used as a rationale to extend the life of existing fossil-fuel infrastructure whose utility otherwise may cease sooner.

Here, the Draft EIR states:

The following are the applicant's project objectives:

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[54] Draft EIR, Vol. 1 at 5-7.
[55] CEQA Guidelines, § 15126.2(e).
[56] The Natelson Dale Group Inc., *Analysis of Potential Fiscal and Economic Benefits of Kern County Carbon Management Industry* (Apr. 4, 2023) at 6, https://psbweb.kerncounty.com/planning/pdfs/cmbp/CMBP_Potential_Fiscal_Economic_Benefit_Analysis.pdf.
[57] Draft EIR, Vol. 1 at 3-7, 6-7.

- Construct and operate a permanent underground storage facility for CO_2, in an economically feasible manner.
- Contribute to CRC's adopted goals of Full-Scope Net Zero emissions for Scope 1 (direct greenhouse gas emissions), Scope 2 (indirect greenhouse gas emissions associated with the purchase of electricity/steam/heat/cooling) and Scope 3 (all other indirect greenhouse gas emissions resulting from the company's business operations) emissions by 2045.
- Support California's Executive Order B-55-18, for California to achieve carbon neutrality by 2045 and net negative emissions thereafter.
- Site and design the project in an environmentally responsible manner consistent with current Kern County and California guidelines.
- Promote economic development and bring living-wage jobs to Kern County.[58]

The Draft EIR articulates no purpose, need, or objectives for the CTV I Project independent of this list of "the applicant's objectives" for the Project. But without a purpose, need, and objectives adopted by the lead agency, the Draft EIR cannot meaningfully assess impacts and develop or compare a reasonable range of alternatives to the proposed Project.[59] Because the applicant operates the oil field that will be a major source of CO_2 for the storage facility, and this facility appears to be designed at least in part to enable the oil field operations to continue to emit Scope 1, 2, and 3 emissions and to facilitate the development and operation of new GHG-emitting facilities, working against state carbon neutrality goals, it is particularly important to scrutinize the project objectives and ensure they reflect public agency goals.

V. THE DRAFT EIR FAILS TO ANALYZE ADEQUATE ALTERNATIVES

The Draft EIR is also unlawful for failing to properly put forward, describe, and analyze a reasonable range of alternatives. Under CEQA, a proper analysis of alternatives is essential to comply with the Act's mandate that significant environmental impacts be avoided or substantially lessened where feasible.[60] The analysis of alternatives lies at the "core of an EIR,"[61] and an EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[62]

The purpose of the requirement to contemplate alternatives is to identify ways to mitigate or avoid the significant effects of a project.[63] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental

[58] Draft EIR, Vol. 1 at 3-7, 6-7.
[59] *North Coast Rivers Alliance v. Kawamura* (2015) 243 Cal.App.4th 647, 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)) ("[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency"); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).
[60] Pub. Resources Code, § 21002; CEQA Guidelines, §§ 15002(a)(3), 15021(a)(2), 15126(d); *Citizens for Quality Growth v. City of Mount Shasta* (1988) 198 Cal.App.3d 433, 443–45.
[61] *Citizens of Goleta Valley v. Bd. of Supervisors* (1990) 52 Cal.3d 553, 564.
[62] *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 735; see also Pub. Resources Code, § 21002.1(a).
[63] Pub. Resources Code, § 21002.1.

effects."[64] The alternatives discussion must be "meaningful" and must "contain analysis sufficient to allow informed decision making."[65] The alternatives analysis is critical to the integrity of an EIR.[66] An EIR must "ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official."[67] An alternatives analysis under CEQA must focus on potentially feasible alternatives to the project, even if these alternatives would impede to some degree the attainment of project objectives, or would be more costly.[68]

As explained below, the Draft EIR's alternatives discussion fails to comply with CEQA. The alternatives discussion is flawed for at least seven reasons: (1) it relies on an inadequate project description; (2) it relies on an inadequate set of project objectives; (3) it relies on an inadequate understanding of the Project's own impacts; (4) it fails to consider a reasonable range of alternatives; (5) it fails to properly or coherently discuss the "no project" alternative and compare it to the Project; (6) it fails to meaningfully describe or analyze the action alternatives it considers; and (7) it fails to provide substantial evidence to support its comparisons of alternatives to the proposed Project. The Draft EIR must be revised to properly analyze project alternatives, as required by CEQA.

A. The Draft EIR Cannot Properly Consider Alternatives Without an Adequate Project Description, Adequate Description of the Lead Agency's Project Objectives, and Adequate Analysis of Project Impacts.

The Draft EIR's alternatives analysis fails in three threshold ways: it is not based on an adequate project description, it does not articulate a public purpose and need for the Project, and it does not describe, assess, or analyze impacts properly. These deficiencies render the alternatives analysis inadequate.

First, the Draft EIR's alternatives analysis is flawed because it is not based on a stable, accurate project description. As demonstrated above, the Draft EIR's analysis and mitigation are based on an improper project description that understates and misstates the CTV I Project's scope, and omits integral components of the full Project. Without a proper project description, it is not possible to effectively develop alternatives or compare Project impacts with alternatives in a way that is coherent and supported by substantial evidence.

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[64] *Save Panoche Valley v. San Benito County* (2013) 217 Cal.App.4th 503, 52 (citations omitted); see also Pub. Resources Code, §21081(a); CEQA Guidelines, §15091(a)(3); *Cal. Native Plant Society v. City of Santa Cruz* (2009) 177 Cal.App.4th 957, 1002.

[65] *Laurel Heights*, *supra*, 47 Cal.3d at 403–04.

[66] *In re Bay-Delta Programmatic Envtl. Impact Report Coordinated Proceedings*, 43 Cal.4th 1143, 1162 (2008) ("The EIR is the heart of CEQA, and the mitigation and alternatives discussion forms the core of the EIR.").

[67] *San Joaquin Raptor/Wildlife Rescue Center*, *supra*, 27 Cal.App.4th at 735; see also Pub. Resources Code, § 21002.1(a).

[68] CEQA Guidelines, § 15126.6(b), (f); see also Pub. Resources Code, § 21102.1(a) ("The purpose of an environmental impact report is to identify the significant effects on the environment of a project, to identify alternatives to the project, and to indicate the manner in which those significant effects can be mitigated or avoided.").

Second, without a proper description of the Project's purpose and need and a set of project objectives adopted by the lead agency, it is impossible to adequately assess alternatives to the Project in a way that complies with CEQA.

A proper statement of the lead agency's project objectives is essential to the development of an adequate alternatives analysis. This principle is apparent throughout the Guidelines and caselaw. For example, "[t]he process of selecting the alternatives to be included in the EIR begins with establishment of project objectives by the lead agency."[69] The Draft EIR must include "[a] clearly written statement of objectives," as this will guide the County in developing a reasonable range of alternatives.[70] CEQA Guidelines section 15124(b) notes that a "clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[71] That statement of the *lead agency's* objectives, in informing the *lead agency's* reasonable range of alternatives to a proposed project, cannot simply be delegated to a project proponent.

Moreover, "[a] lead agency may not give a project's purpose an artificially narrow definition. An agency 'may structure its EIR alternative analysis around a reasonable definition of underlying purpose and need not study alternatives that cannot achieve that basic goal. For example, if the purpose of the project is to build an oceanfront resort hotel or a waterfront aquarium [citation], a lead agency need not consider inland locations.'"[72] This principle requires, again, that the lead agency take responsibility for articulating the project purpose and need as well as the project objectives.

Here, as noted above, the Draft EIR articulates no purpose, need, or objectives for the Project independent of a list of "the applicant's objectives" for the Project.[73] The Draft EIR contains no further discussion of purpose, need, or objectives beyond this list. But, as reflected in the case law and Guidelines,[74] it is not possible for a lead agency to meaningfully undertake an independent evaluation of alternatives if the agency uncritically uses an applicant's objectives as the benchmark for evaluation, and fails to include its own statement of purpose and objectives. A range of alternatives that is based exclusively on "the applicant's project objectives," and not incorporating any public purpose, need, or objectives that have been adopted by the lead agency, thus cannot comply with CEQA. Moreover, reliance exclusively on applicant project objectives is particularly inappropriate where there are unmitigable significant impacts that will require the

[69] *North Coast Rivers Alliance*, *supra*, 243 Cal. App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b) (stating an EIR requires a statement of the objectives sought by the proposed project).
[70] CEQA Guidelines, §15124(b).
[71] CEQA Guidelines, § 15124(b).
[72] *North Coast Rivers Alliance*, *supra*, 243 Cal.App.4th at 668 (citing *Bay–Delta*, *supra*, 43 Cal.4th at 1166 [internal citations omitted]).
[73] Draft EIR, Vol. 1 at 3-7, 6-7.
[74] *North Coast Rivers Alliance*, *supra,* 243 Cal.App.4th at 666 (citing Pub. Resources Code, §21001(g) (internal quotation omitted)); see also CEQA Guidelines, §15124(b).

County to find overriding considerations, given the need for the objectives to "aid the decision makers in preparing findings or a statement of overriding considerations, if necessary."[75]

Third, without a proper analysis of the Project's impacts, any alternatives analysis is necessarily flawed because the comparison of Project impacts to the anticipated impacts of alternatives will be unsupported by substantial evidence. Here, the significant deficiencies in the Draft EIR's analysis of Project impacts make any comparison of those impacts with the impacts of proposed alternatives meaningless.

This deficiency in the Draft EIR—flawed impact analysis leading to flawed alternatives analysis—is apparent across multiple impact areas, discussed throughout these comments. Any comparison of the impacts of the Project with the impacts of alternatives will fail if the Project impacts are misstated or improperly analyzed. But the deficiency is most glaring in the context of GHG impacts, where the Draft EIR's alternatives analysis asks its readers to accept a paradox: first, the Project will have significant unmitigable impacts on GHG emissions.[76] Second, the no-project alternative will have less-than-significant impacts on GHG emissions.[77] And third, at the same time, according to the Draft EIR, the no-project alternative's impacts are "greater than project" impacts.[78] On its face, this analysis cannot stand scrutiny, since it is internally inconsistent. This internal inconsistency, in turn, is a consequence of a fundamental failure in the underlying Project GHG analysis and conclusions, as discussed in section VI.B of these comments.

These analytical failures render the Draft EIR deficient. And beyond that, the failures also constitute fundamental informational deficiencies in the Draft EIR. It is not possible for the public or a decisionmaker to compare the alternatives meaningfully if the conclusions being compared are incoherent or internally inconsistent, as is the case here.

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[75] CEQA Guidelines, § 15124(b); see *Preservation Action v. San Jose* (2006) 141 Cal.App.4th 1336, 1351–52 ("Since CEQA charges the agency, not the applicant, with the task of determining whether alternatives are feasible, the circumstances that led the applicant in the planning stage to select the project for which approval is sought and to reject alternatives cannot be determinative of their feasibility. The lead agency must *independently* participate, review, analyze and discuss the alternatives in good faith." [citing *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 736]).

[76] Draft EIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"), 6-21 (Project GHG impacts "significant and unavoidable").

[77] Draft EIR, Vol. 1 at 6-13 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]").

[78] Draft EIR, Vol. 1 at 6-21 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-23 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

B. The Draft EIR Fails to Adequately Consider a Reasonable Range of Alternatives.

An EIR must consider a reasonable range of alternatives which "offer substantial environmental advantages over the project proposal."[79] The Public Resources Code makes it clear that proper alternatives need to "substantially lessen" the significant environmental effects of a project.[80] Here, the Draft EIR rejects without analysis several alternatives that meet that criterion and satisfy at least some project objectives. This improper failure to consider alternatives appears to have occurred, at least in part, because the applicant's project objectives are drawn too narrowly[81], and the applicant's conception of "feasibility" is improperly constrained.[82]

The lead agency, not the applicant, bears the responsibility to evaluate alternatives based on project objectives, as demonstrated above.[83] "[A]n agency may not approve a proposed project if feasible alternatives exist that would substantially lessen its significant environmental effects."[84] The lead agency also must evaluate feasibility based on objective criteria. "Feasible" means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors."[85]

Here, the Draft EIR should have considered a wider range of alternatives that minimize or avoid impacts from the proposed Project. Alternatives that involve eliminating or reducing oil extraction from CRC's oil fields, for example, satisfy most of even the applicant's project objectives, including contributing to CRC's adopted goals of Full-Scope Net Zero emissions by 2045, supporting California's Executive Order B-55-18, and siting and designing the Project in an environmentally responsible manner. If the goal is to keep oil field-generated CO_2 out of the atmosphere, there are alternative ways to accomplish this that the Draft EIR fails to consider.

The Draft EIR should be revised to consider these and other reasonable alternatives, as required under CEQA.

C. The Draft EIR's Discussion of Alternative 1, the "No Project" Alternative, is Inadequate Under CEQA.

The Draft EIR's "no project" alternative discussion provides a brief examination, unsupported by evidence or analysis, of the environmental consequences of not permitting the Project or any alternative. This summary discussion of Alternative 1 is inadequate under CEQA because it fails to include basic information about the no-project alternative.

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[79] *Citizens of Goleta Valley*, *supra*, 52 Cal.3d at 566.
[80] Pub. Resources Code, § 21002; see also CEQA Guidelines, § 15126.6(a).
[81] *North Coast Rivers Alliance*, *supra*, 243 Cal.App.4th at 668.
[82] *Preservation Action*, *supra*, 141 Cal.App.4th at 1351–52.
[83] *Kings County Farm Bureau*, *supra*, 221 Cal.App.3d at 736; *Preservation Action*, *supra*, 141 Cal.App.4th at 1351–52.
[84] CEQA Guidelines, § 21081; *Mountain Lion Foundation v. Fish Game Com.* (1997) 16 Cal.4th 105, 134.
[85] Pub. Resources Code, § 21061.1; *Cal. Native Plant Society*, *supra*, 177 Cal.App.4th at 960.

The CEQA Guidelines require that the no project analysis discuss "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services."[86] Here, however, the discussion lacks "adequate information regarding the no-project alternative" that would allow the decisionmakers to make "an informed, reasoned decision on whether this Project should go forward."[87] In *Save the Hill Group v. City of Livermore*, the court found that a "no-project" alternative that failed to provide adequate information as to what would be reasonably expected to occur if a project would not go forward was in violation of CEQA, and set the EIR approval aside.[88]

The same reasoning applies here. The Draft EIR should contrast the impacts of the proposed Project with the impacts of the no-project alternative, with specificity and, where possible, quantification, across all impact categories. It should provide a "factually based forecast of the environmental impacts of preserving the status quo."[89] Instead, the Draft EIR includes a cursory narrative discussion, with no supporting evidence or analysis, articulating only what the applicant asserts the consequences of the no-project alternative would be. The Draft EIR then bases its comparison with the proposed Project on this thin discussion.

This missing information is, in the words of the *Save the Hill Group* court, "just the sort of information CEQA intended to provide those charged with making important, often irreversible, environmental choices on the public's behalf."[90] The alternatives analysis must be revised to provide a robust discussion of the "no-project" reasonable consequences.

Additionally, as discussed above, the analysis of the no-project alternative is inadequate because the comparison between the no-project alternative and the proposed Project is misleading, inconsistent, and incoherent. The Draft EIR's characterization of Alternative 1 as having greater GHG impacts than the Project, in particular, reflects a failure to adequately and coherently describe and analyze this alternative as well as a failure to coherently analyze the Project's impacts.[91]

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[86] CEQA Guidelines, § 15126.6(e)(2).
[87] *Save the Hill Grp. v. City of Livermore* (2022) 76 Cal.App.5th 1092, 1113, review denied (July 13, 2022).
[88] *Id.* at 1113.
[89] *Ctr. for Biological Diversity v. Dept. of Fish & Wildlife* (2015) 234 Cal.App.4th 214, 253.
[90] *Save the Hill Grp.*, *supra*, 76 Cal.App.5th at 1113.
[91] Compare Draft EIR, Vol. 1 at 4.8-28 ("Level of Significance After Mitigation: [GHG] Impacts would be significant and unavoidable."), 4.8-31 (same), 6-5 ("the project would conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of GHG, thus causing a significant and unavoidable impact, even with mitigation. Finally, the project would make a cumulatively considerable contribution to a cumulative GHG emissions impact, even with mitigation, and this impact is therefore significant and unavoidable"); 6-21 (Project GHG impacts "significant and unavoidable"), 6-13 ("Impacts would be less than significant under this alternative [Alternative 1, the "no project" alternative]") with Draft EIR, Vol. 1 at 6-21 (no-project alternative's GHG impacts identified as "Greater Than Project"), 6-23 ("Alternative 1, the No Project Alternative[,] would be environmentally superior to the project on the basis of the minimization or avoidance of physical environmental impacts but *would have greater impacts than the project for GHG emissions*" [emphasis added]).

Finally, Alternative 1 would also address the failures, highlighted elsewhere in these comments, in framing project objectives and in neglecting to analyze the fact that the Project is designed to facilitate and justify the continued extraction of oil and burning of fossil fuels for energy. An adequate comparative analysis between the impacts of Alternative 1 and the Project would require analysis of the Project's sources of CO_2 and of the Project's facilitation of fossil fuel extraction and combustion.

D. The Draft EIR Fails to Adequately Describe or Analyze Alternatives 2 and 3.

The Draft EIR's discussion of the two "action" alternatives, DAC (Alternative 2) and nature-based carbon storage (Alternative 3), is cursory and lacking in specificity and support.[92] The Draft EIR not only fails to describe either alternative with specificity, but also fails to disclose or even meaningfully attempt to discuss the projected impacts of either alternative. As a consequence, the Draft EIR fails to support its conclusions—where it compares alternatives' impacts with the Project's impacts—with substantial evidence.

First, Alternative 2, the DAC Alternative, fails to specify any of the major features of the hypothetical DAC facility that forms the basis of the alternative. The Draft EIR does not specify, for example, what technology will be used, the size and throughput of the facility, what infrastructure would be built and where, or what resources it would take to build and maintain that infrastructure and operate the facility. Instead, the document presents only a discussion of the generalized features of DAC technology and facilities, with not one word about how those features might or might not appear in the application of DAC as an alternative to the proposed Project, as discussed in sections I and II of these comments.[93] The Draft EIR then fails even to make a serious attempt to assess the impacts of the DAC alternative in each impact category[94]—a task that would have been fruitless, given the lack of specificity about the alternative's basic features. Correspondingly, the Draft EIR and appendices do not contain evidence, methodology, modeling, or calculations regarding any such impacts. And following from this, there is no substantial evidence—indeed, no evidence at all—supporting the Draft EIR's comparison of Project impacts with the purely speculative conclusions about the DAC alternative's impacts. Nor is the brief discussion of whether Alternative 2 meets project objectives[95] supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed.

Second, Alternative 3, the "Nature Based Carbon Storage" alternative, also fails to meaningfully specify any of the features of the alternative. While the Draft EIR sets forth some general ideas about what types of features this potential alternative might include, the alternative remains completely unformed.[96]

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[92] Draft EIR, Vol. 1 at 6-17 to 6-20 (containing the Draft EIR's entire discussion of these two alternatives).
[93] Draft EIR, Vol. 1 at 6-17 to 6-19 (containing the Draft EIR's discussion of Alternative 2, in full).
[94] Draft EIR, Vol. 1 at 6-17 to 6-19.
[95] Draft EIR, Vol. 1 at 6-17 to 6-19.
[96] Draft EIR, Vol. 1 at 6-19 to 6-20 (containing the Draft EIR's discussion of Alternative 3, in full).

This text, with the "example" of "planting of trees," comes closest to articulating the features of Alternative 3:

> The most applicable nature-based carbon storage alternative for the area of the project site would be regenerative agriculture, as it coincides with the current zoning. Planting of trees would be one example of regenerative nature-based carbon storage for the highest ability to store atmospheric carbon.[97]

It is clear on its face that this statement does not present a specific alternative to the proposed Project. As with Alternative 2, the Draft EIR lacks any discussion, beyond the speculation above, of what technology will be used, much less how the alternative would be configured or what, specifically, it would entail.[98] And the closest the Draft EIR comes to articulating the scope or size of this alternative is in a purely conditional, hypothetical statement: "If 9,000 acres of the project site were remediated of all oil and gas facilities and prepared for planting, an estimated 400 to 1,000 trees per acre could be planted, resulting in a new forest area of 3.6 million to 9 million trees."[99] Notably, even all these hypothetical statements in the Draft EIR lack any evidence or foundation in the Draft EIR or appendices, but instead just appear as assertions, without any references or citations to articulate or support any methodology, analysis, or conclusions.

Accordingly, there is no meaningful analysis of either the features or impacts of the alternative, making it impossible to compare the Project's impacts with the alternative's impacts, and making the conclusions in that attempted comparison lacking in substantial evidence for support. Nor is the brief discussion of whether Alternative 3 meets project objectives[100] supported by substantial evidence, for the same reasons—and additionally because, as explained above, the project objectives themselves are fatally flawed.

VI. THE DRAFT EIR FAILS TO ANALYZE AND MITIGATE SIGNIFICANT IMPACTS

The discussion of a proposed project's environmental impacts is an essential component of an EIR.[101] The fundamental purpose of CEQA is to "inform the public and its responsible officials of the environmental consequences of their decisions *before* they are made."[102] To do so, an EIR must contain facts *and* analysis, not just an agency's bare conclusions.[103]

As explained in detail below, the Draft EIR's environmental impacts analysis is deficient under CEQA because it fails to provide the necessary facts and analysis to allow the County and the public to make informed decisions about the CTV I Project.

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[97] Draft EIR, Vol. 1 at 6-19.
[98] Draft EIR, Vol. 1 at 6-19 to 6-20.
[99] Draft EIR, Vol. 1 at 6-19 to 6-20.
[100] Draft EIR, Vol. 1 at 6-19 to 6-20.
[101] See CEQA Guidelines, § 15126.2(a) ("An EIR *shall* identify and focus on the significant effects of the proposed project on the environment.") (emphasis added).
[102] *Laurel Heights Improvement Assn. v. Regents of Univ. of Cal.*, 6 Cal.4th 1112, 1123.
[103] *Citizens of Goleta Valley*, *supra*, 52 Cal.3d at 568.

CEQA also requires an EIR to describe and adopt all feasible mitigation measures to address a project's significant environmental impacts.[104] Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[105]

Generally, the "[f]ormulation of mitigation measures should not be deferred until some future time."[106] As an exception, "measures may specify performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way."[107] Crucially, there is a "distinction between stating a generalized goal and adopting specific performance criteria," and "[s]imply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[108] Further, even where the deferred formulation of mitigation might be allowable, there is a point beyond which delayed implementation is not allowed: "[o]nce the project reaches the point where activity will have a significant adverse effect on the environment, the mitigation measures must be in place."[109]

"Where several measures are available to mitigate an impact, each should be discussed and the basis for selecting a particular measure should be identified."[110]

As discussed below, throughout the Draft EIR, the County's proffered mitigation measures are insufficient, riddled with inconsistencies, and ultimately not adequate to satisfy CEQA's legal requirements.

A. The Draft EIR's Analysis and Mitigation of Air Quality Impacts is Inadequate.

1. The Draft EIR states heavy-duty truck traffic is expected for Project operations but does not describe or analyze the impacts of such traffic.

Within the chapter on project description, in the section for "Operational and Maintenance Activities," the Draft EIR describes five full-time employees who will be onsite at all times and another five employes who may need to be onsite when repairs or other maintenance is required.[111] The Draft EIR calculates "Operational Traffic" for these employees, who are expected to collectively make 20 daily trips in "Passenger Vehicles."[112]

Separately, the discussion of "Operational Traffic" includes a heading for "Truck Traffic," which is followed by one sentence that states: "It is anticipated that diesel heavy heavy [sic] duty trucks would make 40 trips per day following the access routes designated for

[104] Pub. Resources Code, § 21002; CEQA Guidelines, § 15126.4(a)(1).
[105] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).
[106] CEQA Guidelines, § 15126.4(a)(1)(B).
[107] *King & Gardiner Farms, LLC v. County of Kern* (2020) 45 Cal.App.5th 814, 856.
[108] *Id.* at 856.
[109] *Id.* at 860, quoting *POET, LLC v. Cal. Air Resources Bd.* (2013) 218 Cal.App.4th 681, 738.
[110] CEQA Guidelines, § 15126.4(a)(1)(B).
[111] Draft EIR, Vol. 1 at 3-35.
[112] Draft EIR, Vol. 1 at 3-35 to 3-36.

travel."[113] No further information on the nature, purpose, or impacts of this operational heavy-duty truck traffic is provided in the project description chapter. Nor is there any further discussion anywhere else in the Draft EIR.

As noted above, the Draft EIR must be revised to thoroughly explain this aspect of the CTV I Project. Based on the Notice of Preparation/Initial Study as well as other available information, it seems likely these trucks will be carrying CO_2 from offsite industrial sources, perhaps including but not limited to the Golden State Hydrogen Project that has been proposed in Pixley, California.[114]

In addition to fully explaining the nature and purpose of the operational heavy-duty truck trips in the project description, the impacts of such heavy-duty truck traffic during Project operation must be analyzed and mitigated consistent with CEQA's requirements. As acknowledged in the Notice of Preparation/Initial Study, truck and other vehicle traffic threatens significant direct and cumulative impacts in at least the following categories: air quality, energy demand and consumption, greenhouse gas emissions, hazards and hazardous materials, noise, and transportation and traffic.[115] Depending on the nature and purpose of the operational heavy-duty truck traffic, additional significant impacts are possible.

2. The Draft EIR must be updated to address the revised national ambient air quality standard for $PM_{2.5}$.

The Air Quality section of the Draft EIR must be updated to reflect the U.S. EPA's issuance of a new national ambient air quality standard (NAAQS) for fine particulate matter, also known as $PM_{2.5}$. On February 7, 2024, U.S. EPA strengthened the annual health-based NAAQS for $PM_{2.5}$ from a level of 12 micrograms per cubic meter to 9 micrograms per cubic meter.[116]

Beyond just acknowledging the new standard, the Draft EIR should also address the implications of the new annual $PM_{2.5}$ NAAQS: air quality in Kern County currently does not

[113] Draft EIR, Vol. 1 at 3-36.
[114] *Notice of Preparation/Initial Study* at 4 ("The proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project."); *Operating Statement – Golden State Hydrogen Plant Project*, *supra*, at 9 (noting that CO_2 emissions from new hydrogen plant in Pixley, CA will be liquefied and delivered to the CTV I Project until a CCS facility is developed in Tulare County).
[115] *Notice of Preparation/Initial Study* at 24–25, 29, 32, 34–35, 40, 44–45.
[116] See generally EPA, *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter* (prepublication version, signed Feb. 5, 2024), https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-final-frn-pre-publication.pdf; accord, EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* (Feb. 7, 2024), https://www.epa.gov/newsreleases/epa-finalizes-stronger-standards-harmful-soot-pollution-significantly-increasing.

meet the new standard[117] and is not expected to meet it in 2032,[118] meaning the San Joaquin Valley Air Pollution Control District (Air District) will have to institute further restrictions on polluting projects and activities through the San Joaquin Valley airshed, including in Kern County.[119]

3. The Draft EIR must be updated to make clear the full danger posed by increased $PM_{2.5}$ emissions.

a. The Draft EIR should disclose that there is no safe level of exposure to $PM_{2.5}$.

Along with U.S. EPA's issuance of its revised $PM_{2.5}$ NAAQS, the agency also summarized the latest scientific studies on the health effects of $PM_{2.5}$.

The Draft EIR should update its discussion of the health effects of $PM_{2.5}$ to reflect the latest science summarized by U.S. EPA in its standard-setting decision. Such an update is necessary because CEQA requires that an EIR conduct "an analysis that connect[s] the air quality effects to human health consequences."[120]

Of key importance to disclose to Kern County residents and decisionmakers: currently available evidence indicates there is no safe level of exposure to $PM_{2.5}$.[121] Consequently, it is essential that the County adopt all feasible mitigation for increased $PM_{2.5}$ emissions.

b. The Draft EIR should better address the relationship between $PM_{2.5}$ and DPM.

The Draft EIR's description of air pollutants and health effects discusses "Particulate Matter (PM_{10} and $PM_{2.5}$)" separately from "Diesel Particulate Matter."[122]

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[117] See EPA, *EPA Finalizes Stronger Standards for Harmful Soot Pollution, Significantly Increasing Health and Clean Air Protections for Families, Workers, and Communities* at Figure 1; accord EPA, *Fine Particle Concentrations for Counties with Monitors Based on Air Quality Data from 2020 – 2022* at 1, https://www.epa.gov/system/files/documents/2024-02/table_annual-pm25-county-design-values-2020-2022-for-web.pdf (last accessed Mar. 1, 2024).

[118] EPA, *EPA Projects More than 99% of Counties Would Meet the Revised Fine Particle Pollution Standard* (Feb. 7, 2024), https://www.epa.gov/system/files/documents/2024-02/2024-pm-naaqs-final-2032-projections-map.pdf.

[119] Lazo, *California's Pursuit of Clean Air Just Got Much Harder: New Soot Standards Set*, Cal Matters (Feb. 7, 2024) ("Achieving the new target will take wide-ranging new state and local regulations aimed at cutting emissions"), https://calmatters.org/environment/2024/02/california-new-soot-standards.

[120] *Sierra Club v. County of Fresno* (2018) 6 Cal.5th 502, 522.

[121] According to EPA: "[t]he currently available evidence does not identify particular PM2.5 concentrations that do not elicit health effects. Rather, health effects can occur over the entire distribution of ambient PM2.5 concentrations evaluated, and epidemiologic studies conducted to date do not identify a population-level threshold below which it can be concluded with confidence that PM2.5-related effects do not occur." EPA, *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter* (prepublication version) at 168.

[122] Compare Draft EIR, Vol. 1 at 4.3-13 to 4.3-15 with *id.* at 4.3-25 to 4.3-26.

The discussion of $PM_{2.5}$ notes that "$PM_{2.5}$ constitutes a large portion of combustion particulates, including diesel particulate matter (DPM)," (p. 4.3-14) but does not direct the reader to the separate, further discussion of the dangers of DPM.

To prevent confusion and to convey the full extent of the health risks posed by $PM_{2.5}$, the Draft EIR's discussion of $PM_{2.5}$ should include a cross reference to the more detailed discussion of DPM in the section that addresses "Health Effects and Risks of Toxic Air Contaminants."

Confusingly, the Draft EIR's discussion of $PM_{2.5}$ currently includes an erroneous cross reference. At Volume 1, page 4.3-15, the text states: "The section below entitled 'Oil and Gas Operations and Health Effects' further discusses potential health effects of $PM_{2.5}$ emissions, among other things." But no such section with that title exists.

c. The Draft EIR should address how $PM_{2.5}$ exacerbates illness and death from COVID-19.

The Draft EIR's discussion of the health effects of $PM_{2.5}$ fails to adequately address "the nature and magnitude"[123] of the CTV I Project's increased emissions because it does not acknowledge the studies that demonstrate that exposure to $PM_{2.5}$ has been found to lead to an increase in the death rate for COVID-19, especially for people of color.[124] Indeed, one recent study determined that thousands of COVID-19 deaths could have been prevented during the first year of the COVID-19 pandemic in California, especially in the San Joaquin Valley, if ambient levels of $PM_{2.5}$ pollution were lower.[125]

The Draft EIR therefore should be updated with a discussion of the health risks posed by COVID-19 generally, along with a further discussion of the COVID-19 morbidity and mortality increased by exposure to $PM_{2.5}$.

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[123] *Sierra Club*, *supra*, 6 Cal.5th at 522.

[124] See Cal. Dept. of Public Health, *State Officials Announce Latest COVID-19 Facts* (News Release No. NR20-111) (June 3, 2020), https://www.cdph.ca.gov/Programs/OPA/Pages/NR20-111.aspx; Chow, D.S. et al., *The Disproportionate Rise in COVID-19 Cases Among Hispanic/Latinx in Disadvantaged Communities of Orange County, California: A Socioeconomic Case-Series*, Johns Hopkins Bloomberg School of Public Health (2020), https://www.medrxiv.org/content/10.1101/2020.05.04.20090878v1.full.pdf; Goyal, M.K. et al., *Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children*, Pediatrics (2020), https://pediatrics.aappublications.org/content/pediatrics/early/2020/08/03/peds.2020-009951.full.pdf; Petroni, M., et al., *Hazardous Air Pollutant Exposure As a Contributing Factor to COVID-19 Mortality in the United States*, Environ. Res. Lett., Vol. 15, no. 9 (Sept. 11, 2020), https://iopscience.iop.org/article/10.1088/1748-9326/abaf86; Tian, H. et al., *Risk of COVID-19 is Associated with Long-term Exposure to Air Pollution*, medRxiv (Apr. 24, 2020), https://doi.org/10.1101/2020.04.21.20073700; Wu, X. et al., *Exposure to Air Pollution and COVID-19 Mortality in the United States: A Nationwide Cross-Sectional Study* (updated Nov. 4, 2020), https://projects.iq.harvard.edu/covid-pm/home; Zhu, Y., *Association Between Short-Term Exposure to Air Pollution and COVID-19 Infection: Evidence from China*, 727 Science of the Total Environment (Apr. 2020), https://doi.org/10.1016/j.scitotenv.2020.138704.

[125] English, P.B. et al., *Association Between Long-Term Exposure to Particulate Air Pollution with SARS-CoV-2 Infections and COVID-19 Deaths in California, U.S.A.*, Environmental Advances 9 (2022) 100270, https://doi.org/10.1016/j.envadv.2022.100270.

Notably, the Draft EIR includes a proposed mitigation measure (MM 4.3-6) that addresses COVID-19, stating that: "Owner/operators shall implement all orders related to the COVID-19 pandemic or any other pandemic mandated by Kern County Public Health on well sites and related to worker safety." To provide context for this mitigation measure, the Draft EIR should be revised as recommended above to make clear why COVID-19 is a health concern, particularly for a project that is expected to significantly increase $PM_{2.5}$ emissions.

4. The Draft EIR contradicts earlier statements about the nearest sensitive receptor.

The Draft EIR states: "The closest sensitive receptor to the project site is McKittrick Elementary School, which is 2.5 miles southwest of the facility pipeline and 4.46 miles from injection well 357-7R. The nearest residence is approximately 4.5 miles southeast of the injection line and 4.4 miles from injection well 345-36R."[126] In contrast, the Initial Study/Notice of Preparation states: "The sensitive receptor closest to the project site is the rural residence approximately 1 mile to the south of the project site."[127]

It is important for purposes of both impact analysis and mitigation that the Draft EIR correctly identifies the nearest sensitive receptor. The County must explain the discrepancy between the Draft EIR and the Initial Study/Notice of Preparation and, if the nearest sensitive receptor is actually only one mile away, revise its impacts analysis and mitigation measures accordingly.

5. The Draft EIR's air quality impact analysis is premised on unexplained and/or faulty assumptions.

As set forth in the attached report prepared by Dr. Ranajit Sahu (attached as Attachment A, hereafter "Sahu Report"), the Draft EIR's assessment of impacts and formulation of mitigation measures is inadequate because it is premised on assumptions that are unexplained if not faulty. For example:

- The data provided on "Existing Air Quality" is dated—covering 2019 to 2021—and therefore may not be representative of current air quality in Kern County.

- Nowhere does the Draft EIR or accompanying report prepared by Trinity Consultants explain the assumptions upon which the emissions estimates are made. It is unclear how the various emissions factors were selected and whether they are representative of expected activities and equipment for the CTV I Project.

- Further, assumptions about the expected project activities are unexplained despite their uncanny precision (e.g., well pad construction is expected to take 11 days; every well to be drilled is identified with a specific and unique depth; five hydrocranes are expected to operate exactly 1968.75 hours).

[126] Draft EIR, Vol. 1 at 1-5.
[127] *Notice of Preparation/Initial Study* at 3.

- The Draft EIR suggests false precision by failing to disclose quantitative error ranges and/or to qualitatively explain the uncertainty inherent in the emission estimates.

- Additionally, page 4-6 of the Trinity Consultants' report is completely blank. It is unclear whether this was intentional, or perhaps a formatting issue? To the extent information is missing—it should be provided to the public with appropriate time for review.

6. The Draft EIR fails to adequately address cumulative air quality impacts.

The Draft EIR acknowledges that the CTV I Project will contribute to cumulatively significant air quality impacts. It states: "Because the project's specific emissions would contribute to Kern County's 2020 emissions inventory and to the 2025 projected emissions of Kern County, *the project's incremental effects on air quality would be cumulatively considerable* and, even with mitigation, this potentially significant cumulative impact would be cumulatively significant and unavoidable."[128]

Although the Draft EIR acknowledges a significant cumulative impact on air quality, it does not evaluate or explain the severity of the impact or its consequences for local residents. The Draft EIR's bare conclusion—without further analysis—violates CEQA because "a sufficient discussion of significant impacts requires not merely a determination of whether an impact is significant, but some effort to explain the nature and magnitude of the impact."[129] Further, the Draft EIR is inadequate because, for an analysis of air quality impacts, an EIR must explain the "connection . . . between the two segments of information presented in the EIR—potential project emissions and human health impacts."[130]

To adequately address the CTV I Project's cumulative air quality impacts, the Draft EIR should address "how the environmental and public health burdens of a project might specially affect certain communities."[131] As part of this analysis, the Draft EIR should account for increased emissions from the Project "together with any pollution burdens [nearby] communities already are bearing, or may bear from probable future projects."[132]

A thorough analysis of cumulative air quality impacts is crucial because Kern County already experiences some of the worst and unhealthiest air quality in the country.[133] Such poor air quality is particularly burdensome because "Kern County has a higher percentage of Hispanic, linguistically isolated, and pollution burdened populations than do other areas of

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[128] Draft EIR, Vol. 1 at 1-11 to 1-12, 5-3 (italics added).
[129] *Sierra Club*, *supra*, 6 Cal.5th at 519.
[130] *Id.* at 520.
[131] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* (2012) at 3, https://oag.ca.gov/sites/all/files/agweb/pdfs/environment/ej_fact_sheet.pdf.
[132] *Id.* at 4.
[133] American Lung Assn., *State of the Air* (2023) at 14–18 (listing Bakersfield, CA as the most polluted city in U.S. for daily and annual particulate matter and the third-most polluted city for ozone), https://www.lung.org/getmedia/338b0c3c-6bf8-480f-9e6e-b93868c6c476/SOTA-2023.pdf.

California."[134] Indeed the majority-Hispanic residents (63.9 percent) nearest to the proposed CTV I Project are particularly overburdened already: the Project has been proposed for a census tract that already faces one of the highest pollution burdens in the state (96th percentile) as well as challenges posed by unemployment (89th percentile), poverty (86th percentile), and linguistic isolation (83rd percentile).[135]

Notably, in addition to thoroughly addressing the existing air pollution burden in the Project area, the Draft EIR must also address "probable future projects."[136] As discussed elsewhere in these comments, the CTV I Project represents merely one component of extensive further industrial development that is expected in the area.

In addition to adequately analyzing cumulative effects of the CTV I Project in the context of the existing pollution burden on frontline communities and expected future projects, the County must then reassess the Draft EIR's evaluation of alternatives and identification of all feasible mitigation measures. As explained by the Office of the Attorney General, "[w]here a local agency has determined that a project may cause significant impacts to a particular community or sensitive subgroup, the alternative and mitigation analyses should address ways to reduce or eliminate the project's impacts to that community or subgroup."[137] Pursuant to CEQA's requirements and consistent with the Office of the Attorney General's guidance, the County should work with the public and affected communities to develop mitigation measures that will adequately address the CTV I Project's cumulative impacts.

7. The Draft EIR fails to adopt all feasible mitigation to control fugitive dust.

The Draft EIR acknowledges that PM_{10} is largely emitted as fugitive dust, often generated by construction, demolition, excavation, extraction, and/or other earthmoving activities.[138] Such activities—as well as vehicle traffic, another source of PM_{10}—will occur at the CTV I Project site, and the Draft EIR concludes that the Project's construction and operational activities will cause a significant increase in PM_{10} emissions.[139] Consequently, all feasible mitigation for PM_{10} must be adopted.

Mitigation Measure (MM) 4.3-2 specifies that "The Owner/operator shall develop and implement a Fugitive Dust Control Plan in compliance with San Joaquin Valley Air Pollution

[134] Kern County Planning & Natural Resources Dept., *Final Supplemental Recirculated Environmental Impact Report (October 2020) for Revisions to Title 19-Kern County Zoning Ordinance–(2020 A), Focused on Oil and Gas Local Permitting* (Jan. 2021), section 7.2.6 (Response to Comments of Interested Parties), response to comment 0010-3.
[135] Office of Environmental Health Hazard Assessment (OEHHA), *CalEnviroScreen 4.0*, results for 6029003700, https://oehha.ca.gov/calenviroscreen/maps-data (last visited Feb. 26, 2024).
[136] Office of the Cal. Attorney General, *Environmental Justice at the Local and Regional Level* at 4.
[137] *Id.* at 4.
[138] Draft EIR, Vol. 1 at 4.3-14, 4.3-38 to 4.3-39.
[139] Draft EIR, Vol. 1 at 4.3-63 to 4.3-68.

Control District fugitive dust suppression regulations."[140] The Measure further specifies 14 specific "dust control measures [that] shall be implemented."[141]

The prescribed specific measures set forth in MM 4.3-2 are inadequate and do not represent all feasible mitigation for fugitive dust at the Project site. Inexplicably, MM 4.3-2 does not include all feasible measures identified by the San Joaquin Valley Air Pollution Control District in its most recent Guidance for Assessing and Mitigating Air Quality Impacts.[142] Nor does MM 4.3-2 institute all measures contemplated by the Air District's Regulation VIII.[143] Indeed, some of the measures set forth in MM 4.3-2 contradict stricter requirements set forth in Regulation VIII.

Consistent with CEQA's requirement to adopt all feasible mitigation, MM 4.3-2 should be revised to reflect stronger and/or additional mitigation to control fugitive dust. MM 4.3-2 must be strengthened not only to comply with CEQA, but to abide by the legislative directive that projects like CTV I "include . . . [s]trategies to minimize, to the maximum extent technologically feasible, copollutant emissions from facilities where CCUS or CDR technology is deployed to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."[144] Consequently, MM 4.3-2 should be revised to include the following:

- Work should be phased to reduce the amount of disturbed surface area at any one time.[145] The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.

- At all times, for all activities (i.e., *not* just excavated soil piles, construction activities on unpaved surfaces, and grading), visible dust emissions should be limited to 20% opacity.[146]

- Wind barriers should be constructed and maintained to limit visible dust emissions to 20% opacity.[147] The Owner/operator should be required to describe where and how it will construct and maintain wind barriers in the required Fugitive Dust Control Plan.

[140] Draft EIR, Vol. 1 at 4.3-58.
[141] Draft EIR, Vol. 1 at 4.3-58.
[142] See San Joaquin Valley Air Pollution Control District (SJVAPCD), *Guidance for Assessing and Mitigating Air Quality Impacts* (Mar. 19, 2015) at 77–78, https://www.valleyair.org/transportation/GAMAQI.pdf.
[143] The Air District's Regulation VIII and its constituent rules are described in the Draft EIR in Volume 1 at 4.3-38 to 4.3-39. Further, it is available on the Air District's website at https://ww2.valleyair.org/rules-and-planning/current-district-rules-and-regulations/regulation-viii-fugitive-pm10-prohibitions/.
[144] Health & Safety Code, § 39741.1(a)(3)(A).
[145] Rule 8021, section 5.2 and table 8021-1.
[146] Rule 8021, sections 5.0, 5.2, 5.4.1, and table 8021-1; Rule 8051, section 5.0.
[147] Rule 8021, section 5.2 and Table 8021-1.

- Traffic speeds on unpaved roads should be limited to 15 miles per hour (*not* 25), with speed limit signs posted.[148]

- Construction activities should be discontinued whenever visible dust emissions exceed 20% opacity, even if ambient wind speeds do not exceed 25 miles per hour.[149]

- Track out should be prevented by one of the following: a grizzly with rails, pipes or grates to dislodge debris off exiting vehicles; a layer of washed gravel at one inch or larger in diameter, three inches deep; extension of paved road at least 100 feet from publicly maintained road; or installation of a wheel washer.[150]

- All visible carryout and trackout on paved public roads or the paved shoulders of a paved public road should be removed at the end of each workday;[151] it is not sufficient to isolate carryout or trackout behind a locked gate.

- For empty haul trucks, the interior of the cargo compartment must be cleaned or covered before the empty truck leaves the site.[152]

Additionally, MM 4.3-2 must specify that no construction or grading permits shall be issued, and no activities expected to cause fugitive dust emissions may otherwise commence, unless and until the Air District approves a Fugitive Dust Control Plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[153]

8. The Draft EIR does not provide adequate mitigation to protect sensitive receptors.

a. MM 4.3-5 is inadequate and does not constitute all feasible mitigation.

To protect sensitive receptors, MM 4.3-5 states: "No Class VI or Class II well shall be located within 4000 feet of any sensitive receptor."[154] According to the Draft EIR, this measure

[148] Rule 8021, section 5.3.
[149] Rule 8021, section 5.4.1.
[150] See Rule 8041, sections 5.8 and 5.9; see also Kern County Planning & Natural Resources Dept., *Recirculated Draft Environmental Impact Report for 99 Houghton Industrial Park Project* (Oct. 2019) (hereinafter "99 Houghton Recirculated Draft EIR") at 4.3-43, https://psbweb.kerncounty.com/UtilityPages/Planning/EIRS/99_Houghton/DEIR/_99_Houghton_RDEIR_Vol%201.pdf.
[151] Rule 8041, section 5.1.
[152] Rule 8031, table 8031-1.
[153] *King & Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET, supra,* 218 Cal.App.4th at 738.
[154] Draft EIR, Vol. 1 at 1-30, 4.3-74.

is intended to mitigate an "escape" of CO_2 "into the atmosphere," which "could result in health impacts to humans and wildlife."[155]

While MM 4.3-5 appropriately establishes a sizeable setback from the CTV I Project's injection wells, it is unclear if the setback distance provides adequate mitigation because the Draft EIR does not explain how the distance of 4,000 feet was selected. The Draft EIR must be updated to substantiate that MM 4.3-5's setback distance is adequate to protect sensitive receptors, reflecting an assessment of site-specific factors.

Notably, as described in the "Failure Investigation Report" for the CO_2 pipeline rupture that occurred not far from Satartia, Mississippi, emissions from the rupture affected community members located "approximately one mile" away.[156] As a consequence of the rupture and the significant leak of CO_2, 45 people were taken to the hospital and all 200 residents of Satartia had to be evacuated.[157] The threat posed by CO_2 emissions from an injection well—particularly in the event of a blowout—would seem to be equal if not greater than the threat posed by a pipeline rupture.

Beyond the need to substantiate MM 4.3-5's setback distance for injection wells, the stated rationale for the measure makes plain the measure's inadequacy. As the Draft EIR aptly notes, the escape of CO_2 "via either well failure *or pipeline rupture* . . . could result in health impacts to humans and wildlife."[158] Indeed, the incident near Satartia demonstrates that it is not only injection wells that pose a threat to public health, but also pipelines and presumably any other equipment or structure that could leak significant quantities of CO_2. Consequently, MM 4.3-5 should be revised to require a protective setback from not only the injection wells, but also the Project's pipelines and any other structures or equipment containing or conveying CO_2.

b. MM 4.3-7 constitutes inadequate and unlawfully deferred mitigation.

As a further measure to address air quality impacts on sensitive receptors, MM 4.3-7 sets forth the following monitoring requirements:

> Prior to issuance of any construction or grading permits, the Owner/operator shall consult with the San Joaquin Valley Air Pollution Control District and develop a draft Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project including but not limited to: criteria pollutants, CO_2, and H_2S. The plan shall be reviewed and approved by both the San Joaquin Valley Air District and the California Air Resources Board, with a draft copy to the EPA UIC Program and Kern County Planning and Natural Resources, and implemented before any construction on the CCS facilities can occur. The final

[155] Draft EIR, Vol. 1 at 4.3-73.
[156] Draft EIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC (May 26, 2022) at 3.
[157] Draft EIR, Vol. 2, Failure Investigation Report – Denbury Gulf Coast Pipelines LLC at 2.
[158] Draft EIR, Vol. 1 at 4.3-73 (italics added).

approved plan shall be provided to the EPA UIC Program and Kern County Planning and Natural Resources.[159]

Given the CTV I Project's potential to expose nearby community members to substantial concentrations of air pollution, both criteria air pollutants and toxic air contaminants, the County can and should insist on a robust monitoring plan to detect elevated pollution levels.

Unfortunately, MM 4.3-7 does nothing more than generically require development and approval of a future plan. The Measure fails to identify any performance standards to be used to develop the monitoring plan and, equally important, neglects to identify performance standards for the mitigation to be instituted when the monitoring identifies significant impacts. This open-ended and therefore potentially meaningless promise of a mitigation measure to be developed sometime in the future violates CEQA's requirements for deferred mitigation.

In *Gray v. County of Madera* (2008) 167 Cal.App.4th 1099, the court rejected—for lack of any performance standards—a mitigation measure that required monitoring private wells near a quarry and, if an impact was found, specified that the project must replace the lost water from existing wells on the proponent's property. Even though the respondent county in *Gray* had "committed itself to a specific mitigation goal—the replacement of water lost by neighboring landowners because of mine operations," the court concluded the goal was not a specific performance standard that complied with CEQA.[160]

MM 4.3-7 is even more deficient than the mitigation measure rejected in *Gray*, as the Draft EIR does not identify any performance standards for the monitoring plan to be established beyond the pollutants to be addressed, let alone any performance standards for the mitigation to be implemented upon the identification of impacts. To meet CEQA's requirements, MM 4.3-7 should identify:

- Specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters;

- Requirements for reporting monitoring results to the County and responsible agencies and/or performance standards to be used to develop such reporting requirements;

- Requirements for reporting monitoring results to affected communities, regional community-based organizations, and to the public online and/or performance standards to be used to develop such meaningful public disclosure;

- Threshold level(s) and requirements for notification of nearby residents, other affected communities, and schools when a threshold is exceeded and/or performance standards to be used to develop such public notification requirements;

[159] Draft EIR, Vol. 1 at 1-31, 4.3-74.
[160] *Gray, supra,* 167 Cal.App.4th at 1119.

- Threshold levels of air pollution that, if detected at the fenceline, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation;

- Mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

To adequately protect community members, monitoring parameters for the plan to be developed pursuant to MM 4.3-7 should be developed with input from nearby residents and affected communities. Community input is particularly valuable and important for determining the locations of monitors (including, but not limited to, near sensitive receptors and along the project fenceline), the number of monitors, and the thresholds that will trigger community notification and response requirements.

9. The Draft EIR fails to adopt all feasible mitigation to address Valley Fever.

The Draft EIR institutes one mitigation measure, MM 4.3-6, to address Valley Fever.[161] MM 4.3-6 is inadequate and does not incorporate all feasible mitigation to address Valley Fever.

MM 4.3-6 should be revised to include the fuller protections that the County previously devised for the 99 Houghton Industrial Park Project, as set forth in MM 4.3-1 of the Recirculated Draft EIR for the project:[162]

- The Owner/operator should be directed to thoroughly clean equipment, vehicles, and other items of dust before they are moved offsite to other work locations.

- Grading and trenching work should be phased so that earthmoving equipment is working ahead or down-wind of workers on the ground. The Owner/operator should be required to describe how it intends to phase work in the required Fugitive Dust Control Plan.

- The area immediately behind grading or trenching equipment should be sprayed with water before ground workers move into the area.

- In the event that a water truck runs out of water before dust is sufficiently dampened, any ground workers that otherwise would be exposed to dust should be directed to leave the area until a full truck resumes water spraying.

- All heavy-duty earth-moving vehicles should be closed-cab and equipped with a HEPA-filtered air system.

- Evidence of required training on how to spot and report the symptoms of Valley Fever and how to properly use personal protective equipment should be provided by the Owner/operator to the Kern County Planning and Natural Resources Department within 24 hours of the training session.

[161] Draft EIR, Vol. 1 at 1-30 to 1-31, 4.3-74.
[162] See 99 Houghton Recirculated Draft EIR at 1-27, 4.3-48 to 4.3-49.

10. The Draft EIR fails to adopt all feasible mitigation for cumulatively significant net increases in nonattainment air pollutants, including $PM_{2.5}$.

The Draft EIR acknowledges that the CTV I Project will result in a cumulatively considerable net increase of criteria air pollutants for which the San Joaquin Valley has been designated a "nonattainment" area pursuant to applicable state and federal ambient air quality standards. In particular, the Draft EIR states that "[t]he project's total emissions would exceed the San Joaquin Valley Air Pollution Control District thresholds for nitrogen oxides (NOx), particulate matter with a diameter of 10 micrometers or less (PM_{10}), and particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), for which the project region is nonattainment under an applicable federal or State ambient air quality standard."[163]

To address the CTV I Project's significant criteria air pollutant emissions, the Draft EIR includes MM 4.3-9, which "requires the execution of a Developer Mitigation Agreement (DMA)" with the Air District.[164] According to the Draft EIR: "[t]he implementation of a DMA (MM 4.3-9) to reduce criteria pollutants of NO_X, ROGs, and PM net incremental emissions generated by a project has been incorporated into development projects in the county since 2008."[165]

In several respects, MM 4.3-9 does not meet CEQA's requirement that the County adopt all feasible mitigation, nor does it comply with the requirement of Health and Safety Code section 39741.1(a)(3)(A) that CCS projects "minimize, to the maximum extent technologically feasible, copollutant emissions . . . to ensure that the use of carbon dioxide removal technologies and carbon capture and storage technologies does not have an adverse impact on local air quality and public health, particularly in low-income and disadvantaged communities."

a. The County must approve the DMA and institute other requirements to ensure MM 4.3-9 is enforceable and enforced.

While MM 4.3-9 appropriately requires the Owner/Operator enter into the DMA and pay associated fees due to the Air District prior to the approval of any grading or construction activity, the Measure fails to specify that the agreement must be approved by the County as well, subject to public review and comment. In litigation over Kern County's Oil and Gas Ordinance, courts have found that the specific terms of such an implementing agreement are consequential and must provide for "particular" and "enforceable" mitigation.[166] Further, in correspondence between the County and Air District concerning such agreements, the County has confirmed that it—as lead agency—is ultimately "responsible for the implementation of all mitigation

[163] Draft EIR, Vol. 1 at 1-11.
[164] Draft EIR, Vol. 1 at 4.3-68.
[165] Draft EIR, Vol. 1 at 4.3-68.
[166] *King & Gardiner Farms, LLC v. County of Kern* (Fifth District Court of Appeal Case No. F077656, Feb. 25, 2020), Slip Opinion at 67-74; *Vaquero Energy Inc., et al. v. County of Kern, et al.* (Kern County Superior Case No. BCV-15-101645-GP, June 7, 2022), Ruling on Petitions for (Third) Writ of Mandate at 21–23.

measures."[167] For these reasons, the County must itself review and approve the DMA, subject to the additional steps for community input and public review discussed below.

The County should withhold its approval of the DMA unless and until the California Air Resources Board confirms in writing that the DMA meets the requirements of section 39471.1 of the California Health and Safety Code. MM 4.3-9 currently specifies that the DMA "shall be reviewed by the California Air Resources Board for compliance with" section 39741.1 "before execution and adoption,"[168] but does not specify if or how compliance will be confirmed. MM 4.3-9 should be revised to specify that written confirmation of compliance is required.

To ensure that MM 4.3-9 and all the other mitigation measures set forth in the Draft EIR are implemented and fully enforceable, the County should specify in the CUPs required by the CTV I Project that compliance is required, with construction as well as subsequent operational activities conditioned upon initial and ongoing compliance.

Further, MM 4.3-9 should be revised to require: (a) reporting by the Owner/operator to verify that actual CTV I Project emissions are consistent with the Draft EIR's emissions estimates and the fee paid; (b) reporting by the Air District to confirm that funding by the Owner/operator is sufficient to fund local pollution-reducing projects that, in fact, offset the Project's actual emissions; and (c) a mechanism that requires the Owner/operator to pay a supplemental fee or fees if actual Project emissions exceed the Draft EIR's estimates and/or the initial fee proves to be insufficient.

b. MM 4.3-9 is ambiguous about exactly what mitigation is required.

The Draft EIR and MM 4.3-9 are not clear about precisely what mitigation will be required under the mitigation measure. MM 4.3-9 states:

> The Owner/operator shall pay fees to fully offset Project emissions of NOx (oxides of nitrogen), ROG (reactive organic gases), PM10 (particulate matter of 10 microns or less in diameter), and PM2.5 (particulate matter of 2.5 microns or less in diameter) (including as applicable mitigating for reactive organic gases by additive reductions of particulate matter of 10 microns or less in diameter) (collectively, "designated criteria emissions") to avoid any net increase in these pollutants.[169]

[167] Letter from Kern County Planning & Natural Resources Dept. to SJVAPCD (Sept. 15, 2020) at 2; accord Letter from SJVAPCD to County of Kern Planning and Natural Resources Department (Oct. 30, 2020) at 2 (stating the Air District "is not responsible for making whole any shortfalls for emission reductions that the District is not able to achieve with the mitigation funds it receives from the County" pursuant to an emissions reduction agreement because "as the lead agency under CEQA," it is the County's "obligation to ensure implementation of all mitigation measures included in the Environmental Impact Report").
[168] Draft EIR, Vol. 1 at 1-32. 4.3-71.
[169] Draft EIR, Vol. 1 at 1-31, 4.3-70.

MM 4.3-9's requirement to "fully offset Project emissions . . . to avoid any net increase in these pollutants" is ambiguous. It is unclear if the County is mandating that, for each air pollutant emitted by the CTV I Project, the DMA will require an equivalent, offsetting reduction in the same air pollutant. Conversely, the County may intend to treat all the criteria air pollutants collectively and interchangeably, with the DMA only required to ensure that the combined sum of all increased criteria air pollutant emissions will be offset by an equivalent reduction in criteria air pollutants—no matter the particular air pollutant reductions achieved. Either way, the Draft EIR should be revised to clarify what the terms in the mitigation measure mean. For example, if it is the County's intention to allow reductions in PM_{10} to be credited as mitigation for $PM_{2.5}$ under MM 4.3-9, the Draft EIR should say as much so that the public and decisionmakers fully understand how MM 4.3-9 will operate.

c. The County must require that increases in $PM_{2.5}$ emissions be offset with commensurate reduction in $PM_{2.5}$.

To the extent the County intends to treat all the criteria air pollutants interchangeably for purposes of mitigation, such an approach fails to ensure that significant increases in particular air pollutants will be reduced, as CEQA requires. In this regard, the conflation of $PM_{2.5}$ and PM_{10} is especially problematic.

In reviewing mitigation for the Kern County Oil and Gas Ordinance, the courts have twice found that treating $PM_{2.5}$ and PM_{10} interchangeably for purposes of mitigation is unlawful. In 2020, the Fifth District Court of Appeal agreed with petitioners that the County's 2015 EIR failed to adequately mitigate $PM_{2.5}$ pollution. Reviewing the issue as a matter of law, the court observed that $PM_{2.5}$ and PM_{10} "are not the same" and faulted the County's mitigation measure and a related emissions reduction agreement for "[l]umping them together."[170] According to the appellate court, absent a finding that it would be infeasible, the County was required to adopt "fully enforceable" mitigation in the form of a "particular requirement" for $PM_{2.5}$.[171]

More recently, in 2022, the Kern County Superior Court again agreed with petitioners that the County unlawfully failed to adopt all feasible mitigation for $PM_{2.5}$ and to make such mitigation enforceable. In its ruling, the court faulted the County for continuing to "conflat[e] … PM2.5 and PM10."[172]

Although MM 4.3-9 mentions both $PM_{2.5}$ and PM_{10} separately, that is insufficient. Instead, MM 4.3-9 should specify that the Project's $PM_{2.5}$ emissions will be mitigated by funding projects that result in an equivalent quantity of $PM_{2.5}$ reductions. Absent such an explicit requirement in MM 4.3-9, significant increases in $PM_{2.5}$ may, in fact, evade mitigation. In its 2020 opinion, the Fifth District explained how this could happen in a detailed hypothetical:

> Suppose that during a proposed project's first year of operation it was estimated to emit 16 tons of PM2.5 and to emit 17 tons of PM10 that was larger than PM2.5. If the project proponent were to enter into offset agreements that reduced PM10

[170] *King & Gardiner Farms* Slip Opinion at 70–72.
[171] *King & Gardiner Farms* Slip Opinion at 70–73; accord *King & Gardiner Farms*, 45 Cal.App.5th at 830.
[172] *Vaquero Energy*, Ruling on Petitions for (Third) Writ of Mandate at 22.

that was larger than PM2.5 by 30 tons in the first year, then the net particulate matter emissions for the first year would be three tons, which is below the standard of significance for both PM10 and PM2.5. However, the 16 tons of PM2.5 emissions would not have been offset and, under Air District's 15-ton per year threshold of significance for that air pollutant, one would conclude that the project would have a significant adverse effect on air quality despite the offsets of PM10.[173]

d. Additional changes are required to ensure that MM 4.3-9 will effectively reduce air quality impacts to the extent feasible.

MM 4.3-9 recognizes the importance of addressing air quality impacts where the CTV I Project's increased air pollution emissions will be experienced most acutely—i.e., in the communities nearest to the proposed Project. MM 4.3-9 therefore appropriately requires that monies collected pursuant to the DMA will be used to fund pollution-reducing mitigation projects within a 20-mile radius.[174]

MM 4.3-9 also responds to the need for outreach to local community members to ensure effective operation of the DMA, requiring the Owner/operator to pay an annual fee "for the creation of a county managed community liaison position to provide technical support to the Eligible CCS Air Funding Communities and coordination with the San Joaquin Valley Air Pollution Control District to expedite use of the funding for air mitigation projects."[175] This likewise is a welcome and appropriate requirement.

Nonetheless, further steps can and should be taken to ensure the DMA effectively reduces air quality impacts. Specifically:

- MM 4.3-9 should require the Owner/operator and the Air District to establish a community-led steering committee made up of affected residents that live within Eligible CCS Air Funding Communities. The purpose of this steering committee would be to provide input to the Owner/operator and the Air District as the terms of the DMA are developed, and to advise the Air District on its funding decisions once the DMA is executed.

- MM 4.3-9 should also specify that, with the support of the DMA-funded community liaison, the steering committee will hold periodic public meetings and/or workshops to hear residents' concerns and to provide information about the availability of DMA funds.

- In addition to requiring funding for the community liaison position, MM 4.3-9 should also require additional funding to ensure that the public liaison and steering committee can conduct outreach in English as well as Spanish—with an ability to provide written materials in both languages as well as interpretation at meetings and/or workshops.

[173] *King & Gardiner Farms* Slip Opinion at 71.
[174] Draft EIR, Vol. 1 at 4.3-71.
[175] Draft EIR, Vol. 1 at 4.3-71.

B. The Draft EIR's Analysis and Mitigation of Climate Impacts is Inadequate.

1. The Draft EIR's GHG analysis is inadequate under CEQA.

The Draft EIR's GHG emissions analysis is unsupported, self-contradicting, and violates CEQA's requirements for proper analysis.

The GHG analysis reveals a contradiction at the heart of the premise of this Project: the Draft EIR's analysis of GHG impacts concludes that even though permanent CO_2 sequestration and reductions in CO_2 emissions are CTV I Project's main objectives, the Project has a potentially significant impact from GHG emissions. Even worse, the Draft EIR reaches this conclusion in part based on the assertion that it cannot guarantee that the CO_2 it proposes to inject underground will actually be put underground and remain there permanently without release or leakage. And no meaningful analysis or evidence supports the Draft EIR's conclusions relating to any of these points. The GHG analysis fails, too, for the same reason the project description is inadequate: the analysis does not incorporate the full scope of Project facilities and activities or their GHG emissions—and relatedly, the Draft EIR does not grapple with whether and to what extent the Project may extend the life of existing fossil fuel facilities and associated GHG emissions. The analysis does not adequately assess consistency with plans and policies relating to GHGs. The Project improperly fails to have a plan for monitoring the CO_2 to guarantee it will remain sequestered. And finally, the mitigation is inadequate, including an improper reliance on offset credits as mitigation for its potentially significant GHG impacts.

a. The GHG analysis fails to disclose important information regarding the Project's emissions.

The Draft EIR's analysis of GHG emissions is informationally inadequate. It fails to disclose the full range of projected emissions from the overall scope of activities relating to the Project, or even from the full operations of capture and storage activities.

The GHG impact analysis discloses that the County plans to issue entitlements for the whole storage capacity of 49.25 MMT of CO_2, as well as CCS facilities capturing CO_2 from the existing plants (the gas plant and power plant) at the Elk Hills oil field. Future sources, according to the Draft EIR, "are required to be permitted with a separate CUP process and environmental review for compliance with CEQA."[176]

The analysis then provides an estimate of the construction and operational emissions. The analysis is provided only for the existing plants and the new capture facilities built for them. Under Table 4.8-4, "Estimated Operational Greenhouse Gas Emissions", the Draft EIR presents the expected emissions from the existing plant, the projected emissions from mobile sources of the capture facility, and the projected amounts of CO_2 captured and sequestered until the year

[176] Draft EIR, Vol. 1 at 4.8-19.

2045.[177] The Draft EIR concludes that over 20 years, the Project will result in net emissions reduction of 31,217,430 MT CO_2e.[178]

But the Draft EIR fails to disclose the operational emissions from the capture facility *stationary sources* and includes only its mobile emissions in Table 4.8-4. This is misleading and inadequate. The Sahu Report notes that the analysis is missing, and should include, GHG emissions associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance.[179] The analysis must include the projected GHG emissions from *all* Project operations.

b. The GHG analysis fails to properly analyze future sources of CO_2 injection.

As discussed above, the project description and scope are too narrow. This flaw also renders the GHG emissions analysis inadequate.

The Draft EIR reviews the total potential CO_2 storage of the Project, which is almost at 50 MMT, and the projected injection up until 2045.[180] Regarding the sources of this CO_2, the Draft EIR acknowledges that "[a]dditional sources will need to be identified and permitted by the applicant"[181] and claims that "[e]ach of those sources will have capture facilities with the same amine technology or better and a reasonable assumption can be made that it would produce the same GHG emissions per ton of capture as evaluated for this initial source."[182] The Draft EIR goes on to argue that:

> All known sources are shown in Section 3.9 of Chapter 3, Project Description, but as they have not been permitted or completed CEQA, information cannot be provided on the total amount of GHG emissions they produce, how much will be captured, how much stored, how much additional created or how much will still be released to the atmosphere.[183]

The Draft EIR fails to analyze GHG impacts from the full range of facilities and activities that constitute and relate to the Project, as explained more fully in this letter's discussion of project description and cumulative impacts. Moreover, the document presents an internally contradictory picture of reasonably foreseeable CO_2 sources for the storage facility. The Draft EIR argues that information about future sources of CO_2 is unknown, and at the same time argues that future sources will come from "essential but hard to decarbonize" industries.[184] If the information regarding future sources is still unknown, it is unclear how the Draft EIR can assume they will come from such industries. Nothing in the Draft EIR indicates that the County will

[177] Draft EIR, Vol. 1 at 4.8-24 ("Table 4.8-4 shows only the initial source permitted with this EIR (collection of pre-combustion oilfield gas from in-field CRC facilities) at the same rate").
[178] Draft EIR, Vol. 1 at 4.8-24.
[179] Sahu Report at 4.
[180] Draft EIR, Vol. 1 at 4.8-25.
[181] Draft EIR, Vol. 1 at 4.8-25.
[182] Draft EIR, Vol. 1 at 4.8-25.
[183] Draft EIR, Vol. 1 at 4.8-25.
[184] Draft EIR, Vol. 1 at 4.8-26.

condition future sources on falling within the "essential but hard to decarbonize" category, or defines which industries qualify for that category. This is especially concerning given the fact that the only fully-disclosed source in the Draft EIR is a fossil fuel plant that sends power to oil production activities.[185]

The Draft EIR also provides no support for the claim that future sources will use the same amine technology and create the same levels of operational emissions. Again, nothing in the Draft EIR mitigation measures conditions future sources on using that same technology or better. In fact, the Draft EIR admits the possibility of "additional, unmitigated GHG emissions be[ing] created from the capture facility operations"[186] but fails to disclose what the circumstances, likelihood, or magnitude of those "additional, unmitigated GHG emissions" are.

Not only is the Draft EIR analysis not supported by evidence, but it is also contradicted by the evidence. As discussed above, available information about future sources is available well beyond what the Draft EIR discloses and analyzes. The Draft EIR fails to account in any way for the emissions generated by the facilities that will send their CO_2 for sequestration, including through transportation, and fails to analyze the Project's GHG emissions throughout its projected life span. It must include that information and account for its impacts on GHG emissions.

c. The GHG analysis fails to analyze the whole Project's lifespan.

The Draft EIR also fails to explain why the analysis goes only to the year 2045 and up to 31 MMT of CO_2,[187] when the Draft EIR seeks to approve the whole storage capacity of almost 50 MMT, and the Project's lifespan is currently estimated to be 30 years (or roughly to 2054),[188] and potentially longer. EPA's docket for the CTV I Project Class VI permit indicates that CTV would be required to implement an EPA-approved Post-Injection Site Care and Site Closure Plan, and that it will include post-injection monitoring for at least 50 years and until it demonstrates non-endangerment of underground sources of drinking water (USDW) based on monitoring and other site data.[189]

The analysis should account for the whole storage capacity the Draft EIR is seeking to approve, and for the whole projected life of the related CCS facilities and sources.

d. The GHG analysis fails to account for potential life extension of fossil fuel facilities.

The first proposed source for CO_2 sequestration in the CTV I Project is the pre-combustion Elk Hills oil field gas, which is processed at the natural gas plant (CGP-1) facility

[185] Draft EIR, Vol. 1 at 3-3.
[186] Draft EIR, Vol. 1 at 4.8-26
[187] Draft EIR, Vol. 1 at 4.8-26
[188] Draft EIR, Vol. 1 at 4.2-14.
[189] EPA, *Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits* at 4–5.

and used at the Elk Hills power plant.[190] The GHG analysis assumes continuous operations of the power plant, which is already over 20 years old, at least into the year 2045.[191]

The GHG analysis fails to provide any information about the expected life of the power plant independently of its role as a CO_2 source for the Project, despite acknowledging that California aims to reduce its dependency on fossil fuels.[192] In some places, the Draft EIR even assumes continued operations for the 30-year duration of the proposed Project. [193]

As the Sahu Report notes, the proposed Project would require the power plant to operate for over 50 years, while "[w]ithout significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project."[194]

The Draft EIR fails to address the critical question of whether the CTV I Project may facilitate extending the life of the Elk Hills power plant or of any other fossil fuel source, and the resulting GHG emissions implications.

e. The GHG analysis does not disclose potential offset credit generation.

The DEIR does not discuss or disclose whether Project proponents believe its operations will—or should—receive credit as offsets in the cap-and-trade market. A recent report by the Independent Emissions Market Advisory Committee noted that "there are conflicting views on whether carbon dioxide removals should be given credit as offsets in the cap-and-trade market and resolving this will be an important issue for CARB and the legislature."[195] CRC's presentation regarding the CTV I Project from November 2023 states that "[t]he capture project is targeting 45Q credit generation as well as the potential for LCFS qualification and Cap & Trade (C&T) avoidance."[196]

The question of whether the CTV I Project can generate offset credits is crucial for a full analysis of the Project's impacts. If the Project is allowed to generate credits, it means its overall GHG impacts will be materially different than those claimed under the GHG analysis, as its operation may allow for continued emissions elsewhere. The analysis must disclose and analyze the issue of offset credits generation by the Project.

f. The GHG analysis is not supported by the evidence.

The Draft EIR's analysis for Impact 4.8-1, "Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment," is unsupported

[190] Draft EIR, Vol. 1 at 3-1.
[191] California Energy Commission (CEC), *Elk Hills Power Project* (last accessed Feb. 28, 2024), https://www.energy.ca.gov/powerplant/combined-cycle/elk-hills-power-project.
[192] Draft EIR, Vol. 1 at 4.8-24.
[193] Sahu Report at 3
[194] Sahu Report, at 3–4.
[195] Independent Emissions Market Advisory Committee, *2023 Annual Report* (Feb. 2024) at p. 27.
[196] CRC and CTV, *Third Quarter 2023 Results* (Nov. 01, 2023).

by substantial evidence and internally contradictory. This analysis assumes that unless "any of the injected CO2 leak at injection," or "additional, unmitigated GHG emissions be created from the capture facility operations," the injected CO_2 will remain in the reservoirs, resulting in reduction of CO_2 emitted by the CO_2 source industries.[197] The Draft EIR also, however, acknowledges briefly that leaks might happen "at injection." And even more confusingly, the Draft EIR makes a significance finding based on the acknowledged (and vaguely-stated) risk of a GHG "release due to unforeseen circumstances or equipment failure."[198] Moreover, as the expert report of Dr. Dominic DiGiulio (attached as Attachment B, hereafter "DiGiulio Report") shows, to the extent the Draft EIR relies on the assumption that stored CO_2 will actually both reach and remain in the reservoirs as required for the Project to meet its objectives, that assumption is not supported by the evidence.

In his report, Dr. DiGiulio concludes that "[i]nformation presented in the DEIR and Class VI permit applications does not support a finding that the project will retain 99% of stored CO_2 in excess of 100 years at cessation of injection, as required by the California Air Resources Board."[199] Dr. DiGiulio explains that the retention is not credible due to the large number of wellbore penetrations in the area, the high pressure of storage, the fact the storage will primarily consist of supercritical fluid, and the elevated risk of seismic activity in the vicinity of the Project area.[200]

Dr. DiGiulio explains that leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2.[201] Given the large number of well penetrations in the area, a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection is required to assess the CO_2 retention.[202] However, as the DiGiulio Report shows, the Draft EIR fails to support its conclusions regarding CO_2 retention with evidence.

The full extent of the failure to support the Draft EIR's analysis and conclusions is detailed in the DiGiulio Report. A few examples of that failure are provided below.

The Draft EIR identified 204 wellbores in the 26R reservoir that penetrate the Reef Ridge Shale - the primary confining layer in both storage areas. For the 26R reservoir area, the Draft EIR states that "*Appendix 1*" lists the wells individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements. However, Appendix 1 is missing from the Draft EIR.[203] A document that might be a part of that missing appendix was submitted to the EPA. However, that does not absolve the Draft EIR from the duty to "adequately inform the public and decision makers, who may not be previously familiar with the details of the project."[204] Moreover, there is no mention of

[197] Draft EIR, Vol. 1 at 4.8-26
[198] Draft EIR, Vol. 1 at 4.8-26.
[199] DiGiulio Report at 8.
[200] DiGiulio Report at 8.
[201] DiGiulio Report at 3.
[202] DiGiulio Report at 8.
[203] DiGiulio Report at 11.
[204] *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal. 4th 412, 443, as modified (Apr. 18, 2007).

preparation of the same type of Appendix for the A1 – A2 Reservoir area. Appendix 1 must be included in a recirculated version. The Draft EIR must be revised to include a detailed wellbore-by-wellbore evaluation in order to assess leakage potential and minimize it.[205]

Class VI permit applications require "A tabulation of all wells within the area of review which penetrate the injection or confining zone(s)." That information was provided late, to the EPA only, and is not included in the Draft EIR.[206] Moreover, the document that was provided to the EPA is still missing critical information and riddled with vague and indefinite terms. The DiGiulio Report explains that records of plugging and/or completion should at least include wellbore schematics including actual details of plugging and completion. The Draft EIR must be recirculated with the necessary information. This should include all information associated with wellbores relevant to wellbore integrity, including, for example, internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, and cement squeeze operations.[207]

The DiGiulio Report notes that the Draft EIR assumes a 0.0% wellbore barrier failure rate for 354 wellbores, which is not only at odds with the published rates of wellbore failure, ranging from 2-75% in the literature, but also unsupported by any data that can be independently reviewed.[208] Dr. DiGiulio notes that it does not appear the EPA conducted an independent evaluation of wellbore integrity of well penetration, and that there is no supporting evidence to accept the statement of no wellbore barrier failure.[209] The Draft EIR must be revised to include all relevant information, including but not limited to wellbore diagrams, cement evaluation logs, and internal and external mechanical integrity tests, to support its conclusions with evidence.

Finally, Dr DiGiulio highlights the fact that there are inconsistencies between the Draft EIR and the documents filed with the EPA for the Project's Class VI permit applications: most notably, there are discrepancies in the number of wellbores requiring plugging.[210] These discrepancies must be addressed and the Draft EIR must be revised accordingly.

In sum, the analysis takes credit for the potential CO_2 storage of the Project, but fails to support the conclusion that CO_2 will be retained in the ground with evidence.

2. The Draft EIR's halfhearted and contradictory finding of potentially significant GHG impacts violates CEQA.

The Draft EIR finds that "[a]ccounting for the GHG emissions reductions from CCS, the Project's impacts related to GHG emissions would be less than significant."[211] But then it goes on to make a significance finding, saying:

[205] DiGiulio Report at 11.
[206] DiGiulio Report at 11.
[207] DiGiulio Report at 10–11.
[208] DiGiulio Report at 12.
[209] DiGiulio Report at 12.
[210] DiGiulio Report at 10–11.
[211] Draft EIR, Vol. 1 at 4.8-26.

> However, the estimated reductions are contingent upon injected CO_2 remaining in the identified geographically confined reservoirs for storage in perpetuity without leakage from injection and capture activities. Should any of the injected CO_2 leak at injection or additional, unmitigated GHG emissions be created from the capture facility operations, then GHG emissions from the project would be potentially significant.[212]

With this brief statement, the Draft EIR concludes that despite implementation of several mitigation measures, "the possibility of a release due to unforeseen circumstances or equipment failure remains" and the CTV I Project's impacts from GHG emissions "remain significant and unavoidable."[213] This specific acknowledgment of significant impact from the risk of unintended releases of GHGs is articulated in the Draft EIR's GHG impacts section as one of the rationales for the GHG significance finding, but is not included in the summary of impacts in Table 1.1.[214] Moreover, as discussed more fully above and in the DiGiulio Report, the Draft EIR's impact analysis ignores this risk completely.

First, if this conclusion is correct—if the Project may have a significant (negative) impact on GHG emissions because of the risk of release from failure at any stage in Project operations—then the County should not approve the CTV I Project, as it does not fulfill its fundamental objective: to capture and permanently store CO_2 emissions underground.

Second, the Draft EIR's handling of this issue violates CEQA. The Draft EIR attempts to avoid accounting for the Project's impacts by acknowledging the possibility of leakage and finding that risk to be a significant and unavoidable impact, and at the same time failing to include any analysis of the nature, extent, or magnitude of this risk—and elsewhere the Draft EIR appears to deny the risk even exists. The Draft EIR thus does not comply with CEQA's requirement that an EIR will "be prepared with a sufficient degree of analysis to provide decisionmakers with information which enables them to make a decision which intelligently takes account of environmental consequences."[215] And the conclusions are thus not supported by substantial evidence.

The courts are clear that "[A]n EIR's designation of a particular adverse environmental effect as 'significant' does not excuse the EIR's failure to reasonably describe the nature and magnitude of the adverse effect."[216] Yet the Draft EIR does exactly that. The GHG discussion makes no reasonable effort "to explain the nature and magnitude of the impact" from GHG leakage, as CEQA requires.[217] It includes no information regarding the probability of CO_2 leakage, the circumstances under which it might happen, the potential magnitude of such leakage, or its impacts on GHG emissions. It simply classifies the impact as significant and unavoidable without any meaningful discussion. By doing so, it also violates the rule set by the courts that an EIR must set forth the bases for its findings; a bare conclusion regarding an

[212] Draft EIR, Vol. 1 at 4.8-26.
[213] Draft EIR, Vol. 1 at 4.8-26.
[214] Draft EIR, Vol. 1 at 1-13.
[215] *Sierra Club, supra*, 6 Cal.5th 502 at 514.
[216] *Cleveland Nat'l Forest Found. v. San Diego Assn. of Governments* (2017) 3 Cal.5th 497, 514.
[217] *Sierra Club, supra*, 6 Cal.5th 502 at 519.

environmental impact without an explanation of its factual and analytical basis is not sufficient.[218]

As stated in the DiGiulio Report, CO_2 leakage from geologic storage is bound to occur, and "the important question is not whether there will be leakage, but whether the extent of leakage is acceptable […] and how leakage will be monitored and quantitated."[219] The Draft EIR fails to do just that.

There are several leakage risks that a proper analysis must account for and analyze. First, the risk of leakage from well penetration: the DiGulio Report notes the presence of 354 well penetrations in the storage area, leading to a well penetration density of 16.4 wells/km^2. As explained in the report, research shows that more than 8 wells/km^2 concentrations are of concern regarding CO_2 retention in the ground.[220] The Draft EIR must be revised to include a robust evaluation of wellbore integrity of both plugged and unplugged wells, to properly reflect the risk of leakage from these wells.

Leakage from wellbores can also be manifested in the form of a CO_2 well blowout.[221] Despite the fact that release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions, the Draft EIR fails to discuss the probability of such an event when discussing GHG emissions impacts.[222]

The Draft EIR also fails to analyze the issue of lateral confinement to storage areas. As the DiGiulio Report shows, there is no evidence to support the assumption that CO_2 stored in reservoirs will in fact be confined and will not migrate beyond them.[223] The Draft EIR must be revised to support these assumptions and assess the risk of leakage from lateral migration.

The DiGiulio Report also shows that the Draft EIR's analysis of seismic risk is highly deficient and not supported by the evidence, as it fails to properly account for all factors of seismic risk.[224] The flaws in the Draft EIR's seismic analysis are discussed in detail below. However, as explained in the DiGiulio Report, the effects of natural or induced seismicity are of particular concern at the CTV I Project, due to its effect on wellbores, which can occur even after a well is permanently plugged and abandoned. The Draft EIR must be revised to properly account for the seismicity risks, and once this is done, to properly account for the risk of CO_2 leakage resulting from seismic activity.

The Draft EIR's GHG analysis must be revised to include an accurate, meaningful discussion of GHG impacts that is supported by the evidence, and this evidence-supported

[218] *Laurel Heights*, *supra*, 47 Cal. 3d at 404.
[219] DiGiulio Report at 7.
[220] DiGiulio Report at 7.
[221] DiGiulio Report at 4.
[222] DiGiulio Report at 5.
[223] DiGiulio Report at 6–7.
[224] DiGiulio Report at 20.

analysis must reflect a consistent conclusion as to the nature, magnitude, and significance of the impact.

3. The Draft EIR's GHG consistency analysis is inadequate under CEQA.

Under Impact 4.8-2, the Draft EIR purports to analyze whether the Project will conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gas.[225] Under this impact area, the Draft EIR first analyzes the CTV I Project's consistency with CARB's 2022 Scoping Plan.[226] The Scoping Plan analysis is inadequate under CEQA. Not only it is short, generic, and superficial, but it also fails to address important ways in which the Project is not consistent with the Scoping Plan.

The Draft EIR's consistency analysis is made up of a few paragraphs generally describing the Scoping Plan discussion of carbon capture, removal and sequestration, followed by a bullet point list of the Scoping Plan's "Strategies for Success" in the sector, and ending with a single paragraph stating flatly that the Project "would support the Strategies for Success identified in the CARB 2022 Scoping Plan," "would comply with any new regulations developed as a result of implementation of the identified Strategies" and "is reasonably expected to reduce region wide and Statewide GHG emissions." The paragraph concludes with no further discussion to show the Project would be consistent with the CARB 2022 Scoping Plan.[227]

First, the analysis is generic. It fails to provide the reader with "sufficient information to foster informed public participation and to enable the decision makers to consider the environmental factors necessary to make a reasoned decision,"[228] as required under CEQA. The analysis also fails to provide substantial evidence to support its conclusions. Except for flatly declaring consistency, the analysis does not address any of the Scoping Plan Strategies beyond simply listing them. It fails to make a connection between the Strategies and the Project, and explain how the Project is consistent with them, or how they are even relevant to the Project. Just as an example, the identified Strategies that call for the state to "Evaluate and streamline permitting barriers to project implementation while protecting public health and the environment" and to "update the CARB Carbon Capture and Sequestration Protocol with the best available science and implementation experience" have nothing to do with the Project.

Second, the analysis fails to address the crucial issue of the Project's CO_2 sources' consistency with the Scoping Plan. The Scoping Plan states that CCS is included in the Scoping Plan "to address emissions from limited sectors, including electricity generation, cement production facilities, and refineries."[229] The Scoping Plan also discusses implementation in the electricity sector in or before 2045 as well as the potential to support hydrogen production.[230] As

[225] Draft EIR, Vol. 1 at 4.8-28.
[226] Draft EIR, Vol. 1 at 4.8-28.
[227] Draft EIR, Vol. 1 at 4.8-30.
[228] *Berkeley Keep Jets Over the Bay Comm. v. Bd. of Port Comm'rs*, 91 Cal.App.4th 1344, 1356, 111 Cal. Rptr. 2d 598, 606 (2001), as modified on denial of reh'g (Sept. 26, 2001).
[229] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 86.
[230] *Id.*

discussed above, the Draft EIR fails to provide information regarding its future CO_2 sources and therefore cannot conclude the Project is consistent with the Scoping Plan. Moreover, the only disclosed CO_2 source in the Draft EIR is the pre-combustion Elk Hills oil field gas which provides about one third of its power for oil field operations—not even a sector the Scoping Plan lists for CCS implementation. The Draft EIR's conclusion that the CTV 1 Project is consistent with the Scoping Plan is therefore not only unsupported by the evidence, but is also contradicted by it.

Finally, the Draft EIR fails to address the fact that the CTV 1 Project's proposed mitigation measures are inconsistent with the Scoping Plan. As discussed below, a primary mitigation measure proposed in the Draft EIR, in addition to monitoring plans and compliance with regulations, is buying credits to offset GHG emissions.[231] However, the Scoping Plan makes clear that GHG mitigation measures come in a hierarchical order: first, the lead agency must "exhaust[] all the on-site GHG" mitigation. Then, "CARB recommends prioritizing local, off-site GHG mitigation measures" and only then use "non-local off-site mitigation, and voluntary offsets issued by a recognized and reputable voluntary carbon registry."[232] As discussed below, the Draft EIR fails to comply with the requirement that offsets will be issued by a recognized and reputable registry, and it also fails to exhaust, or even discuss, all onsite GHG mitigation and other local measures. Finally, it fails to acknowledge and discuss the fact that by improperly relying on offsets, it is inconsistent with the Scoping Plan.

4. The Draft EIR fails to analyze and mitigate cumulatively considerable GHG emissions impacts.

The Draft EIR's analysis of the CTV I Project's cumulative GHG emissions impacts suffers from many of the same flaws pointed out above regarding its project-level analysis, and from several other serious flaws. The Draft EIR must be revised to correct these flaws before any decision can be made regarding the Project.

First, there are basic misstatements and inconsistencies that call the analysis into question. As one example, the analysis claims that "Table 4.8-3 shows total GHG reductions of 3,967,977 MT CO_2e over 20 years from implementation of the project".[233] In fact, Table 4.8-3 shows the estimated construction GHG Emissions, not total reductions,[234] and those projected reductions of the Project, according to the other tables in the GHG analysis, are 31,217,430 MT CO_2e over 20 years, not 3,967,977 as stated in the cumulative analysis.[235]

Moreover, the Draft EIR frames its cumulative GHG analysis in fundamentally misleading ways. For example, the document includes the following statement: "Since the project individually results in a net reduction in GHG emissions, the project would also contribute to reductions in cumulative GHG emissions."[236] First, this statement directly

[231] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[232] CARB, *2022 Scoping Plan for Achieving Carbon Neutrality* at 270–71.
[233] Draft EIR, Vol. 1 at 4.8-32.
[234] Draft EIR, Vol. 1 at 4.8-22.
[235] Draft EIR, Vol. 1 at 4.8-24.
[236] Draft EIR, Vol. 1 at 4.8-32.

contradicts the Draft EIR's cumulative GHG significance finding, which concludes that the Project will contribute to cumulatively considerable significant GHG emissions.[237] And second, this statement completely misses the point of cumulative impact analysis: that "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[238] In other words, if a CEQA analysis could infer a project's cumulative impacts directly from its individual impact, there would be no need for a cumulative impact analysis at all.

Another major flaw is that the cumulative impact analysis fails to analyze the CTV I Project's cumulative *projects*. Under CEQA, cumulative impact analysis requires consideration of "other projects causing related impacts,"[239] including "probable future projects."[240] The Draft EIR provides a list of cumulative projects under its project description section. But it fails to analyze their impacts in the GHG analysis, claiming that "information cannot be provided" regarding their potential GHG impacts.[241] This claim is not supported by the evidence and is in fact contradicted by it, as discussed above. The cumulative impacts analysis must analyze the projects in its cumulative projects list, as well as any probable future project that plans on sending CO_2 for sequestration at the CTV I Project (as discussed in detail, above in the discussion of project description and below in this letter's final section on cumulative impacts analysis).

Instead of discussing the cumulative projects the Draft EIR discloses, as well as other related cumulative projects the Draft EIR fails to disclose, the Draft EIR focuses on the CTV I Project's cumulative impacts together with the impacts of "past, present and reasonably foreseeable future oil and gas development including wells and abandonment activity," explaining this focus is "[d]ue to the proposed project's location within an existing oil and gas field."[242] This is underinclusive. While geographic proximity can be a factor in identifying cumulative projects, it is not the only determinative factor.[243]

The Draft EIR fails to explain why it focuses on the cumulative impacts of the CTV I Project with only the oil and gas development. It is riddled with vague statements like "impacts from oil and gas development in Kern County on cumulative GHG emissions were determined to remain significant and unavoidable despite implementation of mitigation measures"[244] that lack any explanation as to their relevance to the CTV I Project's cumulative analysis. Potentially, there is a connection between the oil field operations and CTV I because of the Project's usage of depleted oil and gas reservoirs, but that cannot explain the analysis, since the depleted reservoirs are already identified. It is unclear whether this connection stems from plans to

[237] See, e.g., Draft EIR, Vol. 1 at 1-13 ("The project's cumulative contribution to GHG emissions after implementation of the recommended mitigation measures would remain cumulatively significant and unavoidable").
[238] *Communities for a Better Env't v. Cal. Resources Agency* (2002) 103 Cal.App.4th 98, 114, 126.
[239] CEQA Guidelines, § 15130(a)(1).
[240] CEQA Guidelines, § 15130(b)(1)(A).
[241] Draft EIR, Vol. 1 at 4.8-25.
[242] Draft EIR, Vol. 1 at 4.8-31.
[243] CEQA Guidelines, § 15130(b)(1)(A).
[244] Draft EIR, Vol. 1 at 4.8-32.

sequester more CO_2 sourced from oil and gas production. The Draft EIR must be revised to clarify this point, as well as the rest of the connection between the Project and future oil and gas development.

The Draft EIR's cumulative GHG impact analysis is legally inadequate, not supported by substantial evidence, and must be revised to address all the inaccuracies, inconsistencies, and unsupported assumptions, include all relevant cumulative projects, and explain its analysis.

5. The Draft EIR does not provide adequate mitigation for GHG impacts.

The GHG mitigation measures identified in the Draft EIR fail to meet CEQA's standards for effective, enforceable mitigation. The proposed measures are ineffective, unenforceable, and vague, and there is no evidence to support their efficacy. To the extent that some of the vagueness will be clarified in the future, the DEIR also illegally defers that mitigation.

Under CEQA, proposed mitigation measures must be "fully enforceable" through permit conditions, agreements, or other legally binding instruments.[245] Any proposed mitigation must also provide assurance that such implementation will in fact occur.[246] The proposed measures fail on all counts.

a. MM 4.8-1 constitutes inadequate and unlawfully deferred mitigation.

To mitigate what the Draft EIR finds to be a potentially significant impact from GHG emissions, it proposes a monitoring plan under MM 4.8-1. This mitigation measure requires that prior to injection, the owner/operator will submit "a monitoring plan that complies with all requirements of the EPA UIC permit" for the Project, to demonstrate the retention of the CO_2 in the reservoir. The Measure states that that the plan shall be submitted to the County, concurrent with submittal to the EPA for review, and that "[a] copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department."[247]

Given how crucial it is to guarantee that CO_2 stored in the reservoir will remain there, both for mitigating a potentially significant impact and for achieving the Project's stated goal of CO_2 storage, it would be expected the Draft EIR will develop a robust monitoring plan. However, the proposed Mitigation Measure is anything but robust.

In fact, all this Mitigation Measure does is reiterate an already existing rule – that CCS projects that receive a UIC permit from the EPA must prepare a monitoring, reporting, and verification (MRV) plan and submit it for the EPA's approval.[248] This Measure adds nothing to this rule except requiring that a copy of the approved plan will be provided to the County.

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[245] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, §15126.4(a)(2).
[246] *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1186–87.
[247] Draft EIR, Vol. 1 at 4.8-27.
[248] 40 C.F.R § 98.448.

Relying solely on the future EPA MRV plan is inadequate under CEQA and constitutes an impermissible deferral of mitigation. The EPA UIC permit is issued under the Safe Drinking Water Act. As a result, it does not, and cannot, cover all relevant aspects of monitoring for CO_2 leakage. This is evident simply from the fact that there are no storage effectiveness criteria in the Class VI federal regulations.[249] Specifically, Dr. DiGiulio notes that the monitoring plan submitted for the Project in the Class VI permit applications does not directly consider leakage from well penetrations – although this is the most likely source of loss of CO_2.[250]

A major flaw in relying on EPA's MRV plan is the fact that these plans lack clear performance standards. CEQA allows for details to be developed in future time, as long as the agency adopts specific performance standards the mitigation will achieve.[251] MRV plans that were developed under the EPA permit program have been heavily criticized for failing to include specific monitoring strategies, for containing ambiguous language, and for being difficult to verify and enforce.[252] By relying on EPA's future MRV plan for the CTV 1 Project, the Draft EIR impermissibly defers its mitigation.

The DiGiulio Report makes clear why reliance on the EPA MRV plan fails to comply with CEQA's requirement for effective mitigation. For example, Dr. DiGiulio notes that continuous monitoring in the Etchegoin Formation is important to detect leakage, but further notes that under the EPA permit application, there will be only one such well in the 26R Reservoir. A proper monitoring plan should analyze and support the number of required monitoring wells above confining zones to guarantee effective detection of leakage.[253]

The DiGiulio Report also explains that in the Corrective Action Plan filed with the EPA, CTV states that all wellbores within the Area of Review will be pressure tested prior to abandonment and will be reviewed to demonstrate adequate confinement "if necessary" and "if conditions allow". As Dr. DiGiulio notes, these statements are far too vague to be of any use,[254] and thus reliance on the plan cannot serve as enforceable and effective mitigation.

Finally, the requirement to submit a monitoring plan "[p]rior to any injection of CO2"[255] is vague and unenforceable. CO_2 injection will be ongoing in the Project. The Measure must be revised to clarify at what point exactly a monitoring plan should be submitted, clarify that the approval of such a monitoring plan will be a condition on each new injection from each source, and clarify and guarantee the means of enforcing the plan.

In particular, MM 4.8-1 must be revised to include a monitoring plan that will effectively address the potentially significant impact of CO_2 leakage or other release from the CTV 1

[249] DiGiulio Report at 7.
[250] DiGiulio Report at 8.
[251] CEQA Guidelines, § 15126.4(a)(1)(B).
[252] Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* (Dec. 2023), https://environmentalintegrity.org/news/epas-rules-for-verifying-carbon-capture-projects-are-riddled-with-holes/.
[253] DiGiulio Report at 13.
[254] DiGiulio Report at 12.
[255] Draft EIR, Vol. 1 at 4.8-27.

Project. As explained in the DiGiulio Report, such monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage.[256] To the extent the revised measure is lacking any specific elements or details, it must at a minimum identify performance standards to be used in developing it, as required under CEQA.[257] Given the potential impacts of the GHG emissions from the Project, it is also crucial that the monitoring plan will be open for public comments and will require the approval of CARB in addition to the County.

Finally, and crucially, a monitoring plan alone will not fully mitigate the risk of leakage or release to the extent feasible. GHG mitigation measures must also include an action plan that addresses what will happen to address any release, mitigate fully the emissions from any release, and ensure the integrity of the reservoir and overall storage mechanism.

b. MM 4.8-6 is an ineffective, unenforceable, and impermissibly deferred mitigation measure.

The first part of MM 4.8-6 states as follows:

> The project shall offset all greenhouse gas emissions associated with the capture facility, and construction equipment not covered by the Cap and-Trade program or other mandatory greenhouse gas emission reduction measures through owner/operator reductions of greenhouse gas emissions as verified by the San Joaquin Valley Air Pollution Control District, through acquisition of offset credits from the California Air Pollution Control Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District, or through inclusion in an Emission Reduction Agreement, to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur. [258]

In essence, this Measure purports to offset any GHG operational emissions "associated with" the Project's capture facility (as well as some construction emissions) using the tool of emission credits, and claims to thus achieve a "no net increase" in GHG emissions from the Project construction or operations. This Measure is not only inappropriate and unlawful as mitigation, but also reveals a fundamental failure in the Project's ability to meet its objectives.

i. MM 4.8-6 goes against the Project's fundamental premises and objectives.

The CTV I Project is a carbon sequestration project. Its main goals are to permanently store CO_2 in the ground and support California's climate goals.[259] But MM 4.8-6 proposes to allow the Project to allow "acquisition of offset credits from the California Air Pollution Control

[256] DiGiulio Report at 13.
[257] CEQA Guidelines, § 15126.4(a)(1)(B)
[258] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[259] Draft EIR, Vol. 1 at 1-5.

Officers Association Exchange Register or other third party greenhouse gas reductions as verified by the San Joaquin Valley Air Pollution Control District", to offset any "emissions associated with the capture facility" and "to offset Project-related greenhouse gas emissions that are not included in the Cap-and-Trade program to assure that no net increase in greenhouse gas emissions from the Project construction or operation occur."[260] This Measure thus contemplates that the Project and associated facilities may emit substantial amounts of GHG emissions—potentially without limit—into the atmosphere, as long as they purportedly offset these emissions with emissions credits.

The notion of a carbon sequestration project that may use carbon credits to offset its own emissions is absurd, and undercuts the rationale behind carbon sequestration. An effective carbon sequestration project should be the place where CO_2 is being put in the ground physically and permanently, not a link in a chain of offsets that creates profits for its owners and harm to the public and the environment.

If a CO_2 sequestration project is allowed to offset its emissions through acquisition of offset credits, then the following scenario is possible: A GHG emitting facility that is looking to mitigate its GHG emissions can go and buy offset credits from certain registries. Alternatively, and higher in the hierarchy of preferred mitigation, that facility can send its CO_2 for sequestration at the CTV I Project and achieve the same GHG mitigation goals. The facility chooses sequestration, theoretically putting the CO_2 in the ground permanently. But the CO_2 the facility sends to CTV I may not stay in the ground; instead, CTV I may purchase the same offset credits the emitting facility could have bought in the first place, to offset the emissions from its sequestration project. The futility of this scenario is clear even before going into the many problems with relying on carbon offsets and before considering the added emissions from CO_2 transportation and the operations of the CTV I Project.

ii. MM 4.8-6's reliance on offset credits is not supported by the evidence.

Under CEQA, an agency must have specific evidentiary support for a conclusion that mitigation will be effective.[261] The Draft EIR lacks evidentiary support, however, that offset credits can achieve emission reductions.

Offset programs, in general, are a contentious tool for curbing GHG emissions, and there is mounting criticism in the scientific and environmental communities against using credits in the effort to stop climate change.[262] Research shows that nature-based solutions cannot effectively offset fossil fuel combustion due to the different nature of CO_2 emissions in the two

[260] Draft EIR, Vol. 1 at 4.8-27 to 4.8-28.
[261] See, e.g., *Sierra Club v. County of San Diego* (2014) 231 Cal.App.4th 1152, 1168.
[262] Amazon Watch, *Statement: Offsets Don't Stop Climate Change* (Oct. 6, 2021), https://amazonwatch.org/news/2021/1006-statement-offsets-dont-stop-climate-change.

categories,[263] and offsets are likely to increase GHG emissions rather than decrease them.[264] Environmental justice advocates have pointed out that offsets perpetuate environmental injustice by increasing the relative burden of pollution on already overburdened communities, including low-income communities of color, while GHG reduction is happening, if at all, elsewhere. [265]

There is also a consensus that, to be effective, offsets credits must be real, permanent, additional, verifiable, and enforceable.[266] Additionality is especially hard to ascertain: "additional" emission reductions are reductions not otherwise required by law or likely to occur anyway. Assembly Bill (AB) 32, California's landmark GHG reduction statute, clarifies that "additional" means "in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur."[267] To be "additional," therefore, an offset credit must not result from actions otherwise legally required, *and* it must be in addition to any reduction that would otherwise occur. MM 4.8-6 fails to include any requirement for additionality of credits, nor for any of the other requirements listed above, and thus there is no support for the effectiveness of the mitigation measure.

The Draft EIR also lacks evidence that there exist any offset programs capable of ensuring that offsets are "additional." This is a particular concern given that MM 4.8-6 does not include any requirements regarding the offsets' origin, allowing for international offsets, which are especially challenging to verify.[268] There is also no support for the assumption there are enough GHG offset credits available to satisfy the mitigation measures' requirements. This problem is exacerbated by the fact that the Draft EIR fails to quantity the volume of emissions that will need to be mitigated using offsets.

iii. MM 4.8-6 is ineffective, unenforceable, and impermissibly deferred.

Even if offset credits could be, under certain conditions and limitations, a proper mitigation measure for GHG emissions, and even if they could be acceptable mitigation for a carbon sequestration project, MM 4.8-6 is inadequate under CEQA's mitigation requirements.

First, as mentioned before, there are no performance standards for offsets, and no requirement they will be real, permanent, additional, verifiable, and enforceable. Instead, the measure relies on offsets issues by different parties, including unidentified "third parties," to

[263] Carton, W. at el, *Undoing Equivalence: Rethinking Carbon Accounting for Just Carbon Removal*, Frontiers in Climate (Apr. 16, 2021), https://www.frontiersin.org/articles/10.3389/fclim.2021.664130/full.
[264] Anderegg, W., *Gambling With the Climate: How Risky of a Bet Are Natural Climate Solutions?,* AGU Advances (July, 22 2021), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021AV000490.
[265] Amazon Watch, *Statement: Offsets Don't Stop Climate Change*.
[266] *Golden Door Properties, LLC v. County of San Diego* (2020) 50 Cal. App. 5th 467, 511.
[267] Health & Safety Code, § 38562(d)(2).
[268] *Golden Door Properties, LLC*, *supra*, 50 Cal.App.5th 467 at 513.

issue the credits. As courts have recognized, protocols adopted by voluntary market registries may not meet standards necessary to ensure that credits in fact reduce emissions.[269]

The only check on any offsets' effectiveness in mitigating GHG impact is the requirement that they will be "verified" by the San Joaquin Valley Air Pollution Control District (SJVAPCD) or through inclusion in an Emission Reduction Agreement. MM 4.8-6 thus impermissibly defers mitigation.[270] By leaving the decision on verification of the credits solely to the judgment of the SJVAPCD, without setting any performance standards and process for the verification and only generally requiring "no net increase," the Measure violates CEQA. "Simply stating a generalized goal for mitigating an impact does not allow the measure to qualify for the exception to the general rule against the deferred formulation of mitigation measures."[271]

The option given in the Mitigation Measure to offset emissions through inclusion in an Emission Reduction Agreement is also invalid under CEQA, for the same reasons. Emission Reduction Agreements are not defined anywhere in the Draft EIR in the context of GHG emissions and are used by the Air District for reduction of certain other air pollutants, not GHGs. CARB's review of SJVAPCD Emission Reduction Credit System states with respect to GHG that:

> Ultimately, the impact of these GHG ERCs is not clear, as there is no currently authorized use in an NSR context consistent with District rules or in the context of GHG Cap and Trade programs. To CARB's knowledge, none of these GHG ERCs have been used.[272]

Finally, MM 4.8-6 is unenforceable. Mitigation measures must be "fully enforceable through permit conditions, agreements, or other legally binding instruments."[273] Here, the Measure fails to specify in any detail how the Air District will quantify the emissions reductions it needs to achieve, or does achieve, through this measure, the process by which the offsets will be purchased, and proof of their purchase filed, or any enforcement mechanism to ensure that this Measure is actually implemented.

In fact, aside from vaguely stating that the Project "shall offset," the Mitigation Measure fails to state at what point any offset "shall" happen, or whether the Air District or the County will require offsets as a condition of approval of any permit.

The last part of MM 4.8-6 deals with future sources that will be sending CO_2 for injection in one sentence. It summarily states: "All sources providing CO_2 for injection must certify that

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[269] *Golden Door Properties, LLC*, *supra*, 50 Cal. App. 5th 467 at 511–12.
[270] *King & Gardiner Farms*, *supra*, 45 Cal.App.5th at 856.
[271] *Id.* See also *Sierra Watch v. County of Placer* (2021) 69 Cal.App.5th 86, 110; *Golden Door Properties, LLC*, *supra*, 50 Cal.App.5th 467 at 517.
[272] CARB Enforcement Division, *Review of the San Joaquin Valley Air Pollution Control District Emission Reduction Credit System* (June 2020) at 30, https://ww2.arb.ca.gov/sites/default/files/2020-06/SJV_ERC_FINAL_20200604.pdf
[273] CEQA Guidelines, § 15126.4(a)(1)(B), (a)(2).

any additional CO_2 generated from the source capture facility has been mitigated to "no net increase" before injection at Carbon Terra Vault 1".[274]

This part of the Mitigation Measure aimed at future sources suffers from the same severe flaws as described above, only exacerbated. It is entirely ineffective and unenforceable, as it only requires vaguely that future CO_2 sources will "certify" that any "additional" CO_2 has been "mitigated to 'no net increase'". It fails to explain what type of certification can be used and under what conditions, or even to name the agency to whom such "certification" will be submitted and how it will be verified. It also fails to explain what "additional" means in the context of this Measure.

Moreover, the Measure fails to address in any way the carbon generated by *trucks* that will bring CO_2 for injection. As stated before, the Draft EIR, though it fails to provide any analysis on the issue, anticipates that some sources will ship their CO_2 using trucks. Such GHG emission sources must be addressed under the Draft EIR's GHG mitigation measures.

c. MM 4.8-2 through MM 4.8-5 unlawfully rely on reporting requirements or existing or future regulations or plans, without demonstrating these measures meaningfully mitigate Project impacts.

The remaining GHG mitigation measures do not, individually or together, succeed in mitigating GHG impacts.

MM 4.8-2 requires quarterly reporting on the amount of CO_2 injected into the CCS project, and the source of the CO_2.[275] While such reporting is essential, it is not enough, taken together with the other mitigation measures, to mitigate impacts to the extent feasible.

MM 4.8-3 merely requires permitted stationary sources to comply with the Cap-and-Trade regulation and implement Best Performance Standards (BPS) applicable to greenhouse gas reduction for Components at Light Crude Oil and Natural Gas Production, Natural Gas Processing Facilities.[276] But these BPS only apply to certain types of facilities, and if these facilities are not subject to Cap-and-Trade, this mitigation measure will not apply to them at all. Moreover, the Final Staff Report prepared for the SJVAPCD Climate Action Plan states explicitly that "[u]se of performance based standards is not a method of mitigating emissions."[277]

Similarly, MM 4.8-4 and MM 4.8-5 merely require compliance with SJVAPCD regulations (Rule 4401 and 4409) and regulations adopted or amended for methane.[278]

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[274] Draft EIR, Vol. 1 at 4.8-28.
[275] Draft EIR, Vol. 1 at 4.8-27.
[276] Draft EIR, Vol. 1 at 4.8-27.
[277] SJVAPCD, *Final Staff Report - Climate Change Action Plan: Addressing GHG Emissions Impacts under CEQA* (2009) at 59.
[278] Draft EIR, Vol. 1 at 4.8-27.

MM 4.8-3, MM 4.8-4, and MM 4.8-5 rely on existing or future regulations, without adding any standards or measures to mitigate potential impacts from GHG emissions. CEQA allows the use of compliance with regulatory standards as mitigation, but only where the regulatory standards ensure actual mitigation of project impacts to the extent feasible. CEQA therefore requires that a determination that compliance will be sufficient to prevent significant impacts be based on a project-specific analysis of potential impacts and the effect of regulatory compliance.[279]

C. The Draft EIR's Analysis and Mitigation of Energy Use Impacts is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the CTV I Project's impacts to energy resources. CEQA Guidelines, Appendix F lays out the following directives for proper discussion of a proposed project's energy impacts in an EIR:

> The goal of conserving energy implies the wise and efficient use of energy. The means of achieving this goal include:
>
> (1) decreasing overall per capita energy consumption,
>
> (2) decreasing reliance on fossil fuels such as coal, natural gas and oil, and
>
> (3) increasing reliance on renewable energy sources.[280]

The analysis required under CEQA thus provides the opportunity for project proponents to evaluate the energy consequences of their decisions.

The Draft EIR applies, as a threshold of significance, whether the Project will "result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation."[281] The Draft EIR concludes that:

> [C]onstruction activities associated with the proposed project would result in the consumption of petroleum-based fuels. However, there are no unusual project characteristics that would necessitate the use of construction equipment or vehicles that would be less energy efficient than at comparable construction sites in other parts of the state. Therefore, it is expected that construction fuel consumption associated with the proposed project would not be any more inefficient, wasteful, or unnecessary than at other construction sites in the region.[282]

In this conclusion, the Draft EIR applies, as a threshold, whether the Project would be "*more* inefficient, wasteful, or unnecessary than at other construction sites in the region." But

[279] *Californians for Alternatives to Toxics v. Dept. of Food & Agric.* (2005) 136 Cal.App.4th 1.
[280] CEQA Guidelines, Appendix F, § 2.
[281] Draft EIR, Vol. 1 at 4.6-12.
[282] Draft EIR, Vol. 1 at 4.6-14.

CEQA instead requires an evaluation of whether this project is energy-efficient, not average; CEQA requires mitigation of impacts to energy consumption, where feasible. The claim that the Project has no significant impact on energy resources is thus not supported by substantial evidence. The EIR should require, for example, use of electricity-powered construction equipment and vehicles in all feasible applications.

Moreover, the Draft EIR does not provide sufficient information or analysis to evaluate the Project's overall relationship to energy consumption, and does not even address this question. CO_2 storage projects will often tend to substitute for, rather than facilitate, decreasing reliance on fossil fuels such as coal, natural gas, and oil. The Project's energy conservation analysis fails for many of the same reasons its project description, GHG impact analysis, and cumulative impact analysis are inadequate. In particular, an analysis that includes information about the relationship between Project CO_2 storage operations and Project CO_2 sources is necessary, to fully disclose and analyze whether and to what extent CTV I will facilitate development and use of fossil fuel infrastructure or extend the life of existing fossil fuel CO_2-emitting industries. The Draft EIR's failure to include any meaningful discussion of the Project's CO_2 sources renders the discussion inadequate to evaluate how the Project will decrease reliance on fossil fuels or increase reliance on renewable energy.

D. The Draft EIR's Analysis and Mitigation of Geologic Risks is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the significant geologic impacts of the CTV I Project in this region. These failures are unacceptable given the setting in which the Project may occur and render the Draft EIR defective as an informational document.

The expert report of Dr. Dominic DiGiulio addresses the numerous deficiencies in the County's analysis and why it underestimates the severity of the Project's geologic impacts in further detail. Dr. DiGiulio's analysis highlights the serious risk of CO_2 leaks from the storage reservoirs as well as seismic hazards on wellbores in the Elk Hills oil field, and concludes:

> Given the large number of well penetrations, high pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. . . .
>
> In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, neither the [Draft EIR] nor the Class VI permit applications should be approved.[283]

1. The Draft EIR must fully account for the significant risk of leaks due to existing wellbores at the Elk Hills oil field.

The Draft EIR fails to properly consider any of these issues because it fails at the outset to fully account for the geologic setting at the Elk Hills oil field. When analyzing a project's adverse environmental impacts under CEQA, "[t]he significance of an activity depends on the setting."[284] It is imperative that an EIR accurately and fully describe a project's environmental

[283] DiGiulio Report at 31–32.
[284] *Kings County Farm Bureau*, 221 Cal.App.3d at 718; see also CEQA Guidelines, § 15125.

setting because this description forms the baseline for evaluating its environmental impacts.[285] Indeed, the Draft EIR here must demonstrate not only that the CTV I Project's geologic impacts were adequately investigated but that these impacts were "considered *in the full environmental context.*"[286] It is impossible for the Draft EIR to fulfill its informational purpose if it is not adequately describing and considering the existing environment and geologic setting that may be impacted by the Project.

The Elk Hills oil field and its surrounding region have been deeply shaped by oil and gas drilling activity for many decades. Elk Hills is one of the oldest and largest oil fields in the U.S., discovered over 100 years ago, and is characterized by "the presence of a large number of well penetrations."[287] As discussed in the DiGiulio Report, "[l]eakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2" and the large number of wellbores at Elk Hills therefore "increases the possibility of leakage" which could be "catastrophic."[288]

These risks are exacerbated where, as here, wellbores have not been permanently plugged back to surface, and the Draft EIR contains discrepancies in the number of wellbores that require plugging.[289] Some recent estimates indicate that Elk Hills contains nearly 1,400 idle, unplugged wells that have not produced oil or gas for an average 14 years.[290]

Even if properly plugged, Dr. DiGiulio notes that wellbore integrity failure and leaks from plugged wells "is not uncommon," with research finding failure rates from 2-75%.[291] Yet the Draft EIR found an implausible 0% failure rate in both storage reservoirs, with no wellbores deemed deficient or requiring corrective action.[292]

The Draft EIR fails to acknowledge these issues or disclose the inherent and heightened risks of CO_2 storage in a depleted oil field like this one, which renders it lacking in substantial evidence to support its subsequent conclusions about impacts and mitigation.

2. The Draft EIR must be recirculated with the missing "Appendix 1."

In fact, many of the Draft EIR's conclusions about geologic impacts are "impossible to verify" due to missing details.[293] Dr. DiGiulio notes that the Draft EIR excludes critical information needed to assess wellbore integrity at the Elk Hills oil field and the likelihood of leaks from the storage reservoirs. Specifically, the Draft EIR repeatedly references an "Appendix

[285] See CEQA Guidelines, § 15125(a).
[286] CEQA Guidelines, § 15125(c) (emphasis added).
[287] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem*, LA Times (Feb. 6, 2020), https://www.latimes.com/projects/california-oil-well-drilling-idle-cleanup/; DiGiulio Report at 3–4.
[288] DiGiulio Report at 3–4, 5; see also Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects* at 5–6.
[289] DiGiulio Report at 10–11.
[290] Olalde & Menezes, *The Toxic Legal of Old Oil Wells: California's Multibillion-Dollar Problem*.
[291] DiGiulio Report at 9, 12.
[292] *Id.* at 12.
[293] *Ibid.*

1" that "lists the wells [in the field] individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements" but does not provide it in the document.[294] This "wellbore-by-wellbore evaluation" with these details and others like "each well's type, construction, date drilled, location, depth, and record of plugging and/or completion" is needed "to assess wellbore integrity issues prior to plugging to plug wells in a manner to minimize leakage to the extent possible."[295]

The Draft EIR thus violates CEQA's mandate for an EIR to "include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project."[296] Even if pieces of this information are included in EPA's Class VI permit materials or elsewhere, the County is required to include the full Appendix with the Draft EIR for public review and comment, and to use it to inform its own analysis of impacts and appropriate mitigation for the CTV 1 Project. The failure of the Draft EIR to include the Appendix means the County must recirculate it with the missing information discussed in the DiGiulio Report included, and provide an adequate public comment period on the recirculated draft.

3. The Draft EIR must address how seismic hazards will exacerbate potential geologic impacts.

The Draft EIR also does not accurately describe and consider the full environmental context related to seismic activity in the region. Although the Draft EIR notes that the County is in the highest seismic hazard zone and discusses the basic seismic history of the region,[297] it inappropriately narrows its analysis of impacts to the bounds of the Elk Hills oil field, which fails to capture potentially significant adverse geologic and safety impacts in the broader region. The analysis otherwise waves away further review of the potential impacts of natural or induced seismicity due to the project because "there are no known major faults within the project area."[298]

By contrast, Dr. DiGiulio classifies the impacts of seismicity on the Project area as "high risk" (vs. the Draft EIR's classification of "low to medium" risk) and recommends the County conduct a detailed seismicity evaluation in order to properly determine that seismicity will not impact containment of injected CO_2.[299] The report defines the appropriate "region of concern" as encompassing all seismic events within 200 kilometers from the storage reservoirs, discusses key seismic events in the region's history, and points out that the Draft EIR's discussion of seismic events within a smaller 100-kilometer range of the oil field is insufficient for ensuring the Project avoids catastrophic loss of containment.[300] Critically, the Draft EIR's seismic risk analysis fails entirely to consider legacy wells or the significant consequences of leaks through these wells.[301]

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[294] See, e.g., Draft EIR, Vol. 2, App'x E.2: EPA Class VI UIC Permit Application Narratives for the Elk Hills 26R Storage Project and the A1A2 Storage Project at 2019.
[295] DiGiulio Report at 11.
[296] *Laurel Heights*, *supra*, 47 Cal.3d at 405.
[297] Draft EIR, Vol. 1 at 4.7-13, 4.7-3.
[298] Draft EIR, Vol. 1 at 4.7-18.
[299] DiGiulio Report at 15–25.
[300] DiGiulio Report at 15–18.
[301] DiGiulio Report at 20.

The Draft EIR's omission of this requisite level of analysis renders the geologic impacts section lacking in substantial evidence to support its conclusions.

In addition, the County's dismissal of the risks of seismicity induced from injection of CO_2 at Elk Hills as "unlikely" is inconsistent with the scientific literature linking fluid injection into deep underground wells with earthquakes.[302] The DiGiulio Report notes "[e]ven in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of [magnitude] 4."[303] The report discusses numerous real-world examples of injection-induced seismicity that the Draft EIR fails to disclose or address when considering the impacts of the CTV I Project, including in particular incidents of CO_2 injection inducing seismic events.[304]

Dr. DiGiulio further explains that "[f]or induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the [Draft EIR] adequately consider induced seismicity."[305] Thus, the County cannot outsource its obligations to properly analyze and mitigate the potential impacts of induced seismicity by ceding those obligations to EPA, a tactic it deploys throughout the geologic impacts section.[306]

Given the risks of natural and induced seismicity and the fact that Kern County and the region surrounding the Elk Hills oil field is already one of the most seismically active in the state—the Central Valley is considered a "hot spot" where oil and gas wells and earthquakes are clustered in space[307]—the Draft EIR cannot dismiss potential impacts. Indeed, Dr. DiGiulio notes "[s]eismicity may be induced tens of kilometers away from large-scale injection" which further expands the impact area the County should consider for the Project well beyond the Elk Hills oil field.[308]

Potential impacts here could include damage to project infrastructure like pipelines, compressors, injection wells, or other wells in the oil field, damage to other structures in the

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[302] Draft EIR, Vol. 1 at 4.7-18; see, e.g., Goebel, T.H.W. et al., *Wastewater Disposal and Earthquake Swarm Activity at the Southern End of the Central Valley, California*, Geophys. Res. Lett., 43 (2016), 1092–99 (hydrogeological modeling reveals wastewater disposal likely contributed to seismicity via localized pressure increase along a seismically active fault, with results suggesting induced seismicity may remain undetected in California without detailed analysis of local geologic setting, seismicity, and fluid diffusion, and proximity of high-rate injectors and large active faults can cause noticeable earthquakes under certain geologic conditions).

[303] DiGiulio Report at 26.

[304] DiGiulio Report at 26–27.

[305] DiGiulio Report at 28.

[306] See Environmental Integrity Project, *Flaws in EPA's Monitoring and Verification of Carbon Capture Projects*.

[307] Kang, M. et al., *Potential Increase in Oil and Gas Well Leakage Due to Earthquakes*, Environ. Res. Commun. (2019), 1: 121004 at 3, https://doi.org/10.1088/2515-7620/ab576e.

[308] DiGiulio Report at 26–27; see also Kuchment, *Drilling for Earthquakes*, Scientific American (2016), 315, 1, 46–53, https://www.scientificamerican.com/article/drilling-for-earthquakes/ ("Evidence suggests that earthquake risks can spread for miles beyond the original disposal sites and can persist for a decade or more after drilling stops.").

region like roads and buildings, and dangerous CO_2 leaks to air and groundwater that harm the environment and health of nearby communities.[309] Even ground shaking from small- to moderate-sized earthquakes is consequential for a CO_2 repository and capable of creating leakage pathways to the surface.[310] The omission of this information violates CEQA's mandate that the data in an EIR "must be presented in a manner calculated to adequately inform the public and decision makers, who may not be previously familiar with the details of the project," and to give the readers "a better road map to the information it intends to convey."[311]

Overall, the County fails to provide substantial evidence to support the assumptions and conclusions in the geologic impacts section.

4. The Draft EIR fails to adequately address cumulative geologic impacts.

The Draft EIR's failures described above taint its cumulative impact analysis and render it inadequate under CEQA. While it acknowledges the impacts of cumulative induced seismic activity from the CTV I Project are significant and unavoidable, it otherwise waves away all other geologic impacts and fails to conduct further analysis on the nature and magnitude of the significant risks "due to the uncertainty of the implementation of multiple [CCS] projects and the ability to simultaneously cease injection during a[] [seismic] event."[312] The Draft EIR's bare conclusion violates CEQA.[313]

As discussed throughout these comments, the Draft EIR must also address "probable future projects."[314] This includes the numerous other CO_2 sources being prepared for CTV I as well as further industrial development that is expected in the region in connection with the Project.

5. The Draft EIR fails to adopt all feasible mitigation to address geologic risks.

The Draft EIR sets forth mitigation measures to address the geologic impacts of the CTV I Project that are wholly inadequate under CEQA. The DiGiulio Report details numerous deficiencies in the County's mitigation measures and why they must be addressed.

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[309] See, e.g., Millman, *California Earthquakes Caused $200 Million in Damage, Report Says*, Wall Street Journal (July 24, 2019), https://www.wsj.com/articles/california-earthquakes-caused-200-million-in-damage-report-says-11564006544 (pair of recent 6.4 and 7.1 magnitude earthquakes in Kern County caused about $200 million in property damage alone, not including damage to infrastructure such as roads or to a nearby naval base); Natural Resources Defense Council (NRDC), *Drilling in California: Who's at Risk?* (2014) at 9, https://www.nrdc.org/sites/default/files/california-fracking-risks-report.pdf.
[310] Zoback, M. & Gorelick, S., *Earthquake Triggering and Large-Scale Geologic Storage of Carbon Dioxide*, 109 PNAS 10164 (2012) at 10165–66, https://doi.org/10.1073/pnas.1202473109.
[311] *Vineyard Area Citizens*, *supra*, 40 Cal. 4th at 443.
[312] Draft EIR, Vol. 1 at 4.7-24 to 4.7-25.
[313] *Sierra Club*, *supra*, 6 Cal.5th at 519.
[314] Pub. Resources Code, § 21083(b)(2).

The Draft EIR acknowledges that earthquakes may disturb surface and subsurface facilities like wellbores at the Project site and could result in loss, injury, or death.[315] It also acknowledges that the site may be subject to strong ground shaking that could cause structural damage and other Project components that could injure people.[316] Thus, the County must adopt all feasible mitigation.

MM 4.7-1 requires CRC to prepare a comprehensive seismic activity monitoring plan that includes connection to the Statewide seismic monitoring program of the California Seismic Network and compliance with state requirements, including "[a]ppropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; [i]dentification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures."[317]

The elements of MM 4.7-1 are inadequate and do not represent all feasible mitigation for the impacts of earthquakes and ground shaking. The DiGiulio Report points out that, while a seismic monitoring plan would be able to detect an earthquake, it does not reduce damage to surface and subsurface facilities, and thus the impacts should be considered significant and unavoidable, rather than less than significant as the Draft EIR concludes.[318]

The DiGiulio Report provides numerous recommendations for seismic monitoring network design that are missing and should be included in MM 4.7-1 to comply with CEQA's requirement to adopt all feasible mitigation.[319] As the report notes, "monitoring of natural seismicity is not mitigation."[320]

In addition, MM 4.7-1 is riddled with vague and indefinite terms. Under CEQA, a mitigation measure must include criteria or performance standards against which the mitigation's actual implementation can be measured.[321] MM 4.7-1, however, is a laundry list of vague actions such as "appropriate" subsurface monitoring, "[i]dentification of hazards and conditions," and "notification protocols for all applicable agencies and emergency procedures."[322] The Draft EIR must be revised to include measurable and enforceable mitigation measures to address the Project's impacts. Open-ended and therefore potentially meaningless terms in a mitigation measure that will be developed at an unspecified time in the future also violate CEQA's requirements for deferred mitigation.

MM 4.7-1 is also effectively unenforceable because the Draft EIR does not contain permit conditions, agreements, or other legally binding instruments that ensure the seismic monitoring plan will be prepared and implemented, and who will enforce it.[323] The Measure must specify that no construction or grading permits shall be issued, and no activities expected to

[315] Draft EIR, Vol. 1 at 4.7-17.
[316] Draft EIR, Vol. 1 at 4.7-18.
[317] Draft EIR, Vol. 1 at 4.7-17.
[318] DiGiulio Report at 23–24.
[319] DiGiulio Report at 28–30.
[320] DiGiulio Report at 23.
[321] *San Joaquin Raptor Rescue Ctr.*, *supra*, 149 Cal.App.4th at 670.
[322] Draft EIR, Vol. 1 at 4.7-17.
[323] Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4(a)(2).

cause earthquakes or ground shaking may otherwise commence, unless and until the County, EPA Region 9, CARB, and California Seismic Network all approve the seismic monitoring plan for the CTV I Project. The County must specify such a limitation because "mitigation measures must be in place" when a "project reaches the point where activity will have a significant adverse effect on the environment."[324]

The DiGiulio Report points out that the Draft EIR's claim that mitigation of strong ground shaking "is typically provided by designing structures in accordance with the latest edition of the California Building Code" is flawed.[325] Because the Building Code does not address wellbore integrity, compliance would not mitigate potential impacts for this Project, thus the impacts should be considered significant and unavoidable, not less than significant.[326]

It is important to note that merely requiring compliance with agency regulations or other existing requirements like the California Building Code does not conclusively indicate that the Project would not have a significant and adverse impact. Those legal requirements may not be strong enough to protect against environmental impacts. In *Kings County Farm Bureau v. City of Hanford*, for example, the court found that the fact that EPA and the local air pollution control district had issued the necessary air emission permits for the construction of a coal fired cogeneration plan did not nullify the CEQA requirement that the lead agency analyze the significant air quality impacts of the entire project.[327] Similarly here, the Draft EIR cannot rely on the Building Code to conclude that impacts would not be significant based on those requirements, without at least describing what those requirements are and how they would reduce the Project's geologic impacts to less than significant.

MM 4.7-3 is also inadequate and does not represent all feasible mitigation for the impacts of unstable soil or land that could result in landslides, subsidence, liquefaction, or collapse. The Measure states that CRC "shall implement all requirements of a site-specific geotechnical report" with no further detail or direction.[328] This language is vague and indefinite, and defers development of the geotechnical report until an unspecified time in the future. The Draft EIR must be revised to include measurable and enforceable terms for the report to address the Project's impacts. Moreover, without any permit conditions or other legally binding instruments to ensure the report will be prepared and implemented, this measure is entirely unenforceable. The Draft EIR must specify that no permits shall be issued and no activities expected to cause landslides, subsidence, liquefaction, or collapse may begin until the County and other relevant agencies approve the report.

The flaws in the Draft EIR's analysis of geologic risks also impacts its development of mitigation measures to address cumulative impacts. After acknowledging significant and unavoidable cumulative impacts, the Draft EIR makes no attempt to adopt feasible mitigation, claiming "there are no other feasible and reasonable mitigations available" other than the

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[324] *King and Gardiner Farms, supra,* 45 Cal.App.5th at 860, quoting *POET, supra,* 218 Cal.App.4th at 738.
[325] Draft EIR, Vol. 1 at 4.7-18.
[326] DiGiulio Report at 24.
[327] *Kings County Farm Bureau*, *supra*, 221 Cal.App.3d at 716.
[328] Draft EIR, Vol. 1 at 4.7-21.

deficient measures discussed above.[329] This failure violates CEQA, particularly given the analysis and recommendations in the DiGiulio Report.

In addition to addressing the deficiencies in the Draft EIR's current mitigation measures for geologic impacts and strengthening its seismic monitoring and mitigation plan measures, the DiGiulio Report recommends numerous additional feasible mitigation measures that the County should adopt to address the CTV I Project's serious impacts. One example that would protect nearby communities—and reflect measures already considered for other impacts in the Draft EIR—is to "determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s)."[330]

E. The Draft EIR's Analysis and Mitigation of CO_2 Pipeline Safety Hazards is Inadequate.

The Draft EIR fails to adequately disclose, analyze, and mitigate the serious carbon dioxide pipeline safety hazards of the CTV I Project. The expert report of Richard Kuprewicz (attached as Attachment C, hereafter "Kuprewicz Report") addresses the numerous deficiencies in the County's analysis in further detail and why they obscure the severity of the Project's pipeline safety impacts. The issues raised in the report highlight why the Draft EIR is defective as an informational document.

1. The Draft EIR fails to provide critically important pipeline information.

As the Kuprewicz Report concludes, "[i]mportant pipeline information is missing in the [Draft EIR] that will not permit decisionmakers to make an informed decision about this Project."[331] The report offers a list of key examples of the Draft EIR's "major shortcomings" and failure to disclose critical details about the Project.[332]

The missing details about the nature of the CTV I Project's pipeline construction and operations prevent understanding of the applicable regulations and safety jurisdiction of relevant agencies, and thus a complete analysis and appropriate mitigation. The Draft EIR also contains inaccurate and misleading details that obscure a full understanding of potential pipeline safety impacts. For example, the Kuprewicz Report discusses the Draft EIR's attempts to minimize the extent of impacts from the Satartia, MS pipeline rupture.[333] Relatedly, the Draft EIR also completely fails to address the possibility of a CO_2 injection well blowout, which "can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases."[334]

[329] Draft EIR, Vol. 1 at 4.7-25.
[330] DiGiulio Report at 5.
[331] Kuprewicz Report at 2.
[332] *Id.* at 2–5.
[333] *Id.* at 6.
[334] *Id.* at 6–7.

The deficiencies in the Draft EIR are particularly consequential given the history of explosions and disasters that have harmed people in pipeline-related incidents,[335] and the ongoing harms faced by communities in the Elk Hills region due to oil and gas activity. In fact, as recently as February 2024, a pipeline burst in Bakersfield, releasing barrels of oil on a public street next to Buena Vista Elementary School.[336] Between January 1, 2010, and January 19, 2023, a total of 8,140 pipeline incidents were reported to the Pipeline and Hazardous Materials Safety Administration (PHMSA), an average of 1.7 incidents per day. Hazardous liquid pipelines (which encompass CO_2 pipelines) accounted for more than half of these incidents.[337] The DiGiulio Report also discusses at length examples of large-scale CO_2 releases and their impacts on neighboring communities.[338]

Notably, an earlier similar carbon capture proposal in the Elk Hills oil field that would have compressed CO_2 from a hydrogen plant and transported it to the field via pipeline to 25 injection wells for enhanced oil recovery found serious safety risks.[339] Specifically, the project risk assessment for its approximately 3 mile pipeline—about a quarter of the length of the CTV I Project's planned pipelines—determined that a large amount of CO_2 could be released into the atmosphere if it failed.[340] Studies find that exposure to large amounts of CO_2 could lead to harmful impacts like irritation, chronic or irreversible tissue damage, or narcosis, and to irreversible health effects, impairing, or even death for close exposure to the release.[341] None of these issues are addressed in the Draft EIR, rendering it lacking in substantial evidence to support its conclusions.

The Draft EIR's failures are particularly stark given the evidence that most CCS pipelines fall largely within environmental justice communities, like those surrounding Elk Hills, that live in close proximity to industrial pollution.[342]

Given its serious deficiencies, the Draft EIR's dismissal of all pipeline-related impacts, including cumulative impacts, as less than significant is not supported by substantial evidence.

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[335] See, e.g., Zegart, Dan, *The Gassing of Satartia*.
[336] LaVigne, *Pipe Burst Spills Oil in Front of Buena Vista Elementary School*, KERO-TV (Feb. 8, 2024), https://www.turnto23.com/news/in-your-neighborhood/bakersfield/pipe-burst-spills-oil-in-front-of-buena-vista-elementary-school.
[337] FracTracker Alliance, *2022 Pipeline Incidents Update: Is Pipeline Safety Achievable?* (Feb. 1, 2023), https://www.fractracker.org/2023/02/2022-pipeline-incidents-update-is-pipeline-safety-achievable/.
[338] DiGiulio Report at 4–5.
[339] Submitted by Occidental of Elk Hills, Inc. to Cal. Dept. of Conservation, *Proposed Enhanced Oil Recovery Project (Phase 1), Underground Injection of Carbon Dioxide Gas, Stevens Reservoirs – T30, 31S, R23, 24E, Sections 33S, 34S, 35S, 2G, 3G, & 4G, Engineering Study, Geologic Study, and Injection Plan* (Oct. 2, 20212) at 1, 6.
[340] Stantec, *Hydrogen Energy Center Application for Certification Amendment –Attachment D: Hazards Assessment of CO_2 Supply Line* (Apr. 12, 2011) at 7.
[341] *Id.* at 6–7.
[342] Rota, M., *Carbon Dioxide Waste Capture and Injection: A False Solution for Louisiana and the World* (2023), https://healthygulf.org/carbon-waste-injection-false-solution-for-louisiana/.

2. The Draft EIR fails to adopt all feasible mitigation to address pipeline safety hazards.

Because of the missing and inaccurate information regarding CO_2 pipeline safety issues, it is impossible for the Draft EIR to satisfy CEQA's requirement to adopt all feasible mitigation measures for these impacts. The proposed measures are also ineffective, unenforceable, and vague, and illegally defer mitigation.

For example, MM 4.9-4 requires a construction permit site plan for all CO_2 pipelines, which will be reviewed and approved by the County and California State Fire Marshall (OSFM), noting that PHMSA has delegated CO_2 pipeline oversight to OSFM.[343] In addition to this Measure being vague and improperly deferring the plan to an unspecified future date, it is unclear whether OSFM actually has proper jurisdiction over the CTV I Project's CO_2 pipelines. As discussed in the Kuprewicz Report, the Draft EIR's failure to provide CO_2 purity information and clearly distinguish between facility and injection pipelines impacts whether either agency has jurisdiction and responsibility for the Project.[344] The report also highlights that federal pipeline safety regulations are seriously inadequate, thus the County cannot rely on compliance alone to avoid fulfilling its own separate obligations under CEQA to properly assess and mitigate impacts.[345]

As another example of the Draft EIR's deficient mitigation measures, MM 4.9-10 only requires compliance with EPA's Class VI permit before injection can begin.[346] As discussed throughout these comments, merely requiring compliance with existing regulations or other requirements like the Class VI requirements does not conclusively indicate that the Project would not have significant and adverse impacts.

These highlighted examples are just a sample and illustrate the overall failures of the Draft EIR to analyze and adopt all feasible CO_2 pipline safety mitigations for the CTV I Project. The Kuprewicz Report recommends additional feasible mitigation measures that the County should adopt to address CO_2 pipeline impacts, including, as noted elsewhere, that the County should adopt setbacks from the pipelines.[347]

F. The Draft EIR's Analysis and Mitigation of Water Supply Impacts is Inadequate.

An accurate analysis of the CTV I Project's impact on the local water supply is crucial because water is scarce in Kern County and groundwater pumping has occurred at unsustainable levels for decades, resulting in overdraft conditions region-wide, county-wide, and within the

[343] Draft EIR, Vol. 1 at 4.9-57 to 4.9-58.
[344] Kuprewicz Report at 2–3.
[345] *Id.* at 5.
[346] Draft EIR, Vol. 1 at 4.9-60.
[347] Kuprewicz Report at 4–5; DiGiulio Report at 5; see also Hillebrand, M. et al., *Toxicological Risk Assessment in CO_2 Capture and Storage Technology*, International Journal of Greenhouse Gas Control 55 (2016) 118–43 (concentrations of CO_2 releases from pipelines are function of distance, thus safety distances have to be calculated wherein no hazardous concentrations are reached, varying between <1 m and 7.2 kilometers).

Project Area. Unfortunately, the Draft EIR fails to adequately disclose and analyze water supply impacts and correspondingly fails to adopt all feasible mitigation.

As an initial matter, it is worth noting that the Draft EIR is confusing because the header for the section on Utilities and Service Systems—one of the several sections that address water supply issues—is mislabeled as "4.17 Utilities and Service Systems." The section on Utilities and Service Systems is actually section 4.19. The erroneous header should be corrected because it is confusing to the reader and complicates navigation of the document.

1. The Draft EIR's description of the environmental and regulatory setting for water supply is inadequate.

The Draft EIR is misleading and fails as an informational document because, remarkably, it fails to acknowledge the most basic fact about water supply in Kern County: there is "no surplus water available" in the County to meet domestic and/or irrigation demands, meaning that any use of municipal and industrial ("M&I") quality water by the proposed CTV I Project necessarily "reduces potential supplies for other purposes and users."[348] The Draft EIR should disclose this reality upfront to the public and decisionmakers.

The details that the Draft EIR does provide downplay the Project's water supply impacts and are inadequate. For example, in describing the relevant "Environmental Setting" for the CTV I Project's impact on water supply, the Draft EIR merely notes that "[t]he project site is located within the Tulare Lake Basin," which "is ranked as 'high priority' in a statewide ranking of groundwater importance."[349] The Draft EIR also notes "[t]he Kern County Subbasin ('Subbasin') is the specific groundwater subbasin in which the project resides."[350]

To meaningfully inform readers, the Draft EIR must explain the significance of the Tulare Lake Basin's designation of "high priority" and offer more details on conditions in the Tulare Lake Basin generally and the Kern County Subbasin specifically.

The Tulare Basin is designated as "high priority" both because the region is heavily reliant on groundwater and because groundwater supplies are in a condition of "critical overdraft."[351] Similarly, the Kern County Subbasin has been identified as "high priority," reflecting that the area is "critically overdrafted" and suffers from related problems including

[348] Kern County Planning & Natural Resources Dept., *Draft Supplemental Recirculated Environmental Impact Report for Revisions to Title 19-Kern County Zoning Ordinance, Supplemental Water Supply Baseline Technical Report* (July 2020) at 4, 58.
[349] Draft EIR, Vol. 1 at 4.10-1.
[350] Draft EIR, Vol. 1 at 4.10-2.
[351] Draft EIR, Vol 2., Water Supply Assessment for the Carbon Terravault 1 Project at 2–3.

"land subsidence and groundwater quality degradation."[352] Persistent overdraft of groundwater also "dries up wells."[353]

Although the Draft EIR acknowledges that the Kern County Subbasin, "as a whole, has an overdraft of 324,326 acre-feet per year over the baseline conditions,"[354] nowhere is the significance of this fact explained.

The Draft EIR is similarly misleading and incomplete in its description of the regulatory setting for water supply. The Draft EIR includes a general discussion of the Sustainable Groundwater Management Act (SGMA) and how it is being implement in the Project Area.[355] As part of this discussion, the Draft EIR notes the status of six groundwater sustainability plans (GSPs) that have been prepared for the San Joaquin Valley Kern County Subbasin.[356] However, nowhere does the Draft EIR explain that SGMA applies to Kern County and the Project Area because the Act was designed to address chronic groundwater overdraft and its negative consequences.

Further, the Draft EIR neglects to address whether or how the six GSPs will affect the available water supplies in the Kern County Subbasin generally or for the Project specifically. Although the Draft EIR indicates that state authorities have determined that the six GSPs are deficient in some respects, the Draft EIR also confirms that, under SGMA, local Groundwater Sustainability Authorities are still "required to begin implementation of the plans . . . while working to amend the plans and address the deficiencies."[357] The Draft EIR should address the expected consequences of the GSPs—if any—on the proposed CTV I Project and its planned operations and water use.

2. The Draft EIR's analysis of the Project's impact on water supply is contradictory, inaccurate, and misleading.

The Draft EIR fails as an informational document because it does not clearly explain the source or amount of water that will be used by the Project.

First, the Draft EIR makes conflicting statements about the source of water to be used by the CTV I Project. In section 4.10, the Draft EIR states: "[t]he proposed project would use water during construction and for operation of the project. Water for the project would be supplied by

[352] Draft, EIR, Vol. 2, West Kern Water District, Urban Water Management Plan 2020 Update (June 2021) at 34
[353] Rachel Becker, *San Joaquin Valley growers may face probation for failing to protect groundwater*, Cal Matters (Oct. 12, 2023), https://calmatters.org/environment/2023/10/san-joaquin-valley-groundwater/.
[354] Draft EIR, Vol. 1 at 4.10-35, 4.19-2, 4.19-21 to 4.19-22.
[355] Draft EIR, Vol. 1 at 4.10-15 to 4.10-17, 4.19-7 to 4.19-8.
[356] Draft EIR, Vol. 1 at 4.10-16 to 4.10-17, 4.19-8; see also id. at 4.19-13 to 4.19-14.
[357] Draft EIR, Vol. 1 at 4.10-17, 4.19-8, 4.19-14.

the WKWD from existing water allocations for Elk Hills and CRC."[358] Further, according to section 4.10, "all water would be trucked to the site from the WKWD." [359]

The foregoing description of the source of the Project's water supply is contradicted by text in section 4.19 which states that—for Project operations—"[w]ater to operate the carbon capture and storage (CCS) facilities is proposed to be sourced from produced water from existing oil and gas operations within Elk Hills."[360]

Second, no matter the source, the Draft EIR inaccurately and misleadingly describes the Project's water supply demand. Table 4.19-2 describes the Project's water demand as follows:

Table 4.19-2: Water Supply Availability

	Allotment (acre-feet per year)	Project Demand	Usage of Water Allotment
Elk Hills	3,000		
CRC	2,200		
Construction (18 months)		75 acre-feet	1.4%
Operation (per year)		19.49 acre-feet	0.37%
Total	**5,200**	**94.49 acre-feet**	**1.77%**

Key:
CRC = California Resources Corporation

This table is clearly wrong. The table incorrectly combines a one-time water demand for construction (75 acre-feet) with an annual operational demand (19.49 per year) and concludes that the "Total" Project demand is 94.49 acre-feet. But this is not an accurate total. Just the first phase of the Project is expected to last 26 years,[361] meaning that operational water demand will amount to at least 506.74 acre-feet (19.49 acre-feet annually x 26 years). The Draft EIR must be revised to eliminate Table 4.19-2, which is inaccurate and misleading. Further, the Draft EIR must disclose how much water the Project will use over its full operational lifetime.

3. The Draft EIR's finding that the Project will not substantially reduce groundwater supplies is not supported by substantial evidence.

The Draft EIR offers several reasons to support its conclusion that the CTV I Project will not substantially decrease groundwater supplies, all of which are erroneous.

First, the Draft EIR states: "Project operation would not rely on locally sourced groundwater wells, as all water would be trucked to the site from the WKWD [West Kern Water District]." [362] But WKWD supplies the water it provides from "groundwater within the Kern

[358] Draft EIR, Vol. 1, at 4.10-34.
[359] Draft EIR, Vol. 1 at 4.10-35.
[360] Draft EIR, Vol. 1 at 4.19-19.
[361] Draft EIR, Vol. 1 at 1-6, 2-1, 3-2, 3-12.
[362] Draft EIR, Vol. 1 at 4.10-35.

County subbasin,"[363] meaning the Project's water use will still impose a burden on local groundwater supplies.

Second, the Draft EIR asserts that, even accounting for pre-Project water use at the Project site, water use is expected to remain below the WKWD's future water budget for CRC and Elk Hills, which affords 5,200 acre-feet per year.[364] As an initial matter, it is unclear if the future water budget adopted for the Project site by WKWD in 2020 remains valid, given that the Kern Groundwater Authority (KGA) is currently responsible for an annual overdraft of 239,346 acre-feet per year,[365] and state authorities have disapproved KGA's proposed Groundwater Sustainability Plan for the area.[366]

In any event, the fact that the WKWD may have budgeted for operations at the site does not mean that the Project's expected water use will not have a significant impact. As noted above, there is no surplus water in Kern County, groundwater in the Kern Subbasin is suffering from critical overdraft, and the water to be used by the Project will all be sourced from groundwater. Whether water use at the site was anticipated or not, the Project will still be using substantial quantities of groundwater.

Third, the Draft EIR avers that, "[s]hould the project require water supplies in excess of the allotment from the District, impacts to water supplies would be considered potentially significant. In order to address this, MM 4.19-1 would be implemented, ensuring that any groundwater or reclaimed water used is accounted for and regulated."[367]

The Draft EIR's adoption of MM 4.19-1 does not support a finding that the Project's groundwater use will be mitigated to a level of insignificance. That is because MM 4.19-1 in no way limits or mitigates the Project's water use. Rather, the Measure just specifies that the Project Owner/operator shall "provide information on any groundwater . . . that will be used," and County officials, in turn, "shall compile the water use information in a report" to be posted online annually.[368] This measure does not reduce or limit water use; it merely requires that "that any groundwater . . . used is accounted for."[369]

4. The Draft EIR fails to adopt all feasible mitigation for the Project's cumulative impacts on water supply.

Putting aside the Draft EIR's unsupported finding that the Project will not have a significant direct impact on groundwater supplies, the Draft EIR does acknowledge that "the cumulative impacts of any use of groundwater in the area are considered significant."[370] Consequently, the County must adopt all feasible mitigation to address this cumulative impact.

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[363] Draft EIR, Vol. 1 at 3-34; accord 4.19-2 (stating "WKWD primarily pumps groundwater").
[364] Draft EIR, Vol. 1 at 4.19-20 to 4.19-21.
[365] See, e.g., Draft EIR, Vol. 1 at 4.19-21
[366] See, e.g., Draft EIR, Vol. 1 at 4.19-13 to 4.19-14.
[367] Draft EIR, Vol. 1 at 4.10-35.
[368] Draft EIR, Vol. 1 at 1-65, 4.19-21 to 4.19-22.
[369] Draft EIR, Vol. 1 at 4.19-27.
[370] Draft EIR, Vol. 1 at 4-10-43.

The Draft EIR identifies several mitigation measures that will purportedly address this significant cumulative impact on water supply: MMs 4.9-1, 4.10-1, 4.10-2, 4.10-3, 4.10-4, 4.10-5, and 4.19-1.[371] But none of these measures will actually reduce the Project's impact on groundwater supplies:

- MM 4.9-1 provides worker training on the handling of hazardous substance,[372] but the Project site is not a source of groundwater for municipal and industrial (M&I) uses, which is supplied from elsewhere by WKWD.[373]

- MMs 4.10-1 through 4.10-5 all address onsite operations (i.e., stormwater measures and management of drilling muds, drilling fluids, and produced water)[374] but, again, the Project site is not a source of groundwater for M&I uses, which is supplied from elsewhere by WKWD.

- MM 4.19-1, as discussed above, merely requires reporting on groundwater use, and does not limit its use in any way.

Consistent with CEQA's requirement to adopt all feasible mitigation, the County should require the following feasible measures to mitigate the Project's impacts on local groundwater supplies:

- The County should identify specific purposes for which the Project may use M&I quality water—limited to those purposes for which such high-quality, freshwater is truly necessary—and direct that all other water uses in the Project area shall be met by recycling oil field-produced water. The Draft EIR indicates that such recycling and reuse of oil filed-produced water already occurs at the site.[375] The County should make this voluntary practice mandatory.

- The County should set a cap on the CTV I Project's water use. According to the Draft EIR, if construction activities (75 acre-feet) and operational activities (19.49 acre-feet) were to occur in the same year, the Project's water demand would total 94.49 acre-feet annually.[376] The Project should be held accountable for its estimated water needs and limited to an annual cap of 95 acre-feet per year or less for its CCS operations. In setting the cap, the County should subtract any use(s) included in the Project's estimated water demand that could be met by recycling oil field-produced water.

[371] Draft EIR, Vol. 1 at 4.10-44.
[372] Draft EIR, Vol. 1 at 1-45, 4.9-55.
[373] Draft EIR, Vol. 1 at 4.10-7 to 4.10-8 (noting "there is no appreciable quantity of groundwater in the project area" and "any groundwater encountered in this area is generally unusable"); 4.19-2 (stating WKWD's "[w]ater supply is obtained within the District from wells located in the northeast corner of the District in the underflow area of the Kern River Basin and from an area north and adjacent to the State of California's Tule Elk Reserve.").
[374] Draft EIR, Vol. 1 at 1-52 to 1-55, 4.10-29 to 4.10-33.
[375] Draft EIR, Vol. 1 at 4.10-8.
[376] Draft EIR, Vol. 1 at 4.19-21.

- The County should levy and collect an annual "fair-share" fee from the Owner/operator to be paid to the KGA to account for the Project's contribution to cumulative impacts on local groundwater supplies that KGA must mitigate pursuant to SGMA.

5. The Draft EIR inadequately analyzes and mitigates disposal of oil field-produced water.

The Draft EIR notes that "[a] significant percentage of the oil field-produced water in the project area is either recycled into the same geologic zones from which it was produced or is sequestered in deeper zones that are isolated from sources of drinking water."[377] Water that is not recycled or sequestered underground requires disposal. According to the Draft EIR, produced water "may also be transported, via truck or pipeline to existing wastewater treatment facilities permitted to receive production water for disposal" or "stored in surface impoundments where it percolates into groundwater and/or evaporates."[378]

The Draft EIR is inadequate as an informational document because it does not specify what percentage of the oil field-produced water is currently (in the oil field) or will be (for the Project) recycled and reinjected onsite as opposed to disposed of in some other way. Instead, the Draft EIR merely surmises that "very little water is disposed of . . . because purchasing fresh water is more expensive than recycling water."[379] The Draft EIR can and should be more specific to inform the public and decisionmakers; it should detail current water disposal volume(s) and practice(s) at the Project site and how these are expected to change, if at all, with the construction and operations of the proposed CCS facility.

It is important that the Draft EIR accurately address the fate of oil field-produced water because it has consequences for the CTV I Project's impacts:

- As the Draft EIR suggests, a high rate of recycling would lessen the degree to which the Project will compete with other users for scarce municipal and industrial-quality water.[380]

- Conversely, if transportation of the oil field-produced water by truck or pipeline is required for disposal, related environmental impacts must be evaluated and mitigated. For example, the Draft EIR notes that truck traffic impacts air quality.[381]

- Surface disposal of oil field-produced water in ponds also threatens impacts that should be disclosed if the practice will occur. "Because it was commingled with hydrocarbons in the formation," produced water "typically contains chemicals associated with the formations, such as salts, oils and greases, inorganic and organic chemicals, and naturally occurring radioactive material, that exceed state and federal standards for drinking

[377] Draft EIR, Vol. 1 at 4.10-8.
[378] Draft EIR, Vol. 1 at 4.9-7.
[379] Draft EIR, Vol. 1 at 4.10-8.
[380] Draft EIR, Vol. 1 at 4.10-8.
[381] See, e.g., Draft EIR, Vol. 1 at 4.3-63, 4.3-66, 4.3-72.

water."[382] Disposal in surface impoundments can therefore increase air pollution as well as contaminate the soil and harm biological resources.

Although the Draft EIR does not analyze the impact, the Draft EIR seems to contemplate that surface impoundments will, in fact, be used for disposal of oil field-produced water. More specifically, MM 4.10-5 states: "[t]he Owner/operator shall not discharge produced water into any surface disposal facility unless the facility has received the Waste Discharge Requirements from the Central Valley Regional Water Quality Control Board, or the need for Water Discharge Requirements has been waived by the Central Valley Regional Water Quality Control Board."[383] Likewise, MM 4.1-2 states: "[s]umps and ponds shall be permitted only to the extent authorized by the Central Valley Regional Water Quality Control Board . . . and shall comply with all applicable legal requirements and mitigation measures for . . . percolation or evaporation ponds for produced water."[384]

If the CTV I Project proposes to use such surface impoundments at the Project site, the extent to which they may be used and the impacts of such use must be disclosed. An adequate impact analysis is necessary to inform the development of all feasible mitigation measures and to include meaningful public input on the impacts and proposed mitigation.

G. The Draft EIR's Analysis and Mitigation of Biological Resources Impacts is Inadequate.

1. The Draft EIR must account for the threatened, endangered, and sensitive animal and plant species in the Central Valley and Elk Hills oil field.

The Elk Hills oil field and surrounding area is known to support high densities of species protected by state and federal law. The California Department of Fish and Wildlife (CDFW) has specifically called out several species known to be supported in the area through prior biological surveys, including the blunt-nosed leopard lizard, giant kangaroo rat, San Joaquin kit fox, Swainson's hawk, San Joaquin antelope squirrel, American badger, short-nosed kangaroo rat, burrowing owl, California glossy snake, and California jewelflower.[385] CDFW recommended additional surveys for special status plant species and also noted the potential for San Joaquin pocket mouse.[386] In addition, CDFW shared with the California Geologic Energy Management Division (CalGEM) in 2022 that "there is potentially suitable habitat [in the Elk Hills oil field] within the well pad footprints and/or adjacent to the wells that can serve as refugia, denning, breeding, foraging, and dispersal habitat" for additional species "likely to occur within th[e] oil field," including the Tipton kangaroo rat, tricolored blackbird, Temblor legless lizard, Kern mallow, San Joaquin woolly threads, Buena Vista Lake shrew, LeConte's thrasher, loggerhead shrike, Tulare grasshopper, San Joaquin coachwhip, California glossy snake, coast horned lizard,

[382] Draft EIR, Vol. 1 at 4.9-7.
[383] Draft EIR, Vol. 1 at 4.10-33.
[384] Draft EIR, Vol. 1 at 4.1-23.
[385] Letter from Bob Stafford, California Department of Fish and Wildlife, to Cindi Hoover, Kern County Planning & Natural Resources Dept. (April 6, 2022), Draft EIR, Vol. 2, App'x A.2: Comment Letters at 148.
[386] *Id.* at 159, 162.

western pond turtle, western spadefoot, prairie falcon, California horned lark, and Crotch bumble bee.[387] That 2022 letter also notes that several special-status plant species may occur in the oil field, including California Rare Plant Rank species Horn's milk-vetch, heartscale, Lost Hills crownscale, slough thistle, recurved larkspur, Temblor buckwheat, Tejon poppy, alkali-sink goldfields, pale-yellow layia, showy golden madia, California alkali grass, and oil neststraw.[388]

Table 1. *Threatened, Endangered and Sensitive Animals, Plants, and Plant Communities of the Elk Hills Area (threatened and endangered species are bolded)*

Common Name	***Scientific Name***	***Federal/State Status***	***CDFW Letter[389]***
Plants			
California jewelflower	***Caulanthus californicus***	***FE/CE, 1B.1***	**1, 2**
San Joaquin woollythreads	***Monolopia congdonii***	***FE/1B.2***	**2**
Kern mallow	***Eremalche parryi ssp. kernensis***	***FE/1B.2***	**2**
Horn's milk-vetch	*Astragalus hornii var. hornii*	*S/1B.1*	2
heartscale	*Atriplex cordulata var. cordulata*	*S/1B.2*	2
Lost Hills crownscale	*Atriplex coronata var. vallicola*	*S/1B.2*	2
Slough thistle	*Cirsium crassicaule*	*S/1B.1*	2
recurved larkspur	*Delphinium recurvatum*	*S/1B.2*	2
Temblor buckwheat	*Eriogonum temblorense*	*S/1B.2*	2
Tejon poppy	*Eschscholzia lemmonii ssp. kernensis*	*S/1B.1*	2
alkali-sink goldfields	*Lasthenia chrysantha*	*--/1B.1*	2
pale-yellow layia	*Layia heterotricha*	*S/1B.1*	2
showy golden madia	*Madia radiata*	*S/1B.1*	2
California alkali grass	*Puccinellia simplex*	*S/1B.2*	2
oil neststraw	*Stylocline citroleum*	*S/1B.1*	2
Insects			
Crotch bumble bee	*Bombus crotchii*	*--/WL*	2
Amphibians			
western spadefoot	*Spea hammondii*	*S/SSC*	2
Reptiles			
Temblor legless lizard	*Anniella alexanderae*	*Under Review / Candidate*	2
western pond turtle	*Actinemys marmorata*	*/SSC*	2
California glossy snake	*Arizona elegans occidentalis*	*--/SSC*	1, 2
blunt-nosed leopard lizard	***Gambelia sila***	***FE/CE, FP***	**1, 2**
San Joaquin coachwhip	*Masticophis flagellum ruddocki*	*--/SSC*	2

[387] Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW (revised Aug. 12, 2022) at 1.
[388] *Id.* at 6.
[389] CDFW Letter 1: Letter from Bob Stafford, Cal. Department of Fish & Wildlife, to Cindi Hoover, Kern County Planning & Natural Resources Dept. (April 6, 2022), Draft EIR, Vol. 2, App'x A.2: Comment Letters at 148; Letter, 2: Letter from CDFW to CalGEM, Elk Hills Oil Field, Kern County, Special-Status Species Information from CDFW (revised Aug. 12, 2022).

coast horned lizard	*Phyrnosoma blaimvillii*	*/SSC*	2
Birds			
burrowing owl	*Athene cunicularia*	*S/SSC*	1, 2
tricolored blackbird	***Agelais tricolor***	***CT***	**2**
loggerhead shrike	*Lanius ludovicianus*	*/SSC*	2
California horned lark	*Erempohila alpestris actia*	*/WL*	2
prairie falcon	*Falco mexicanus*	*/WL*	2
Le Conte's thrasher	*Toxostoma lecontei*	*S/SSC*	2
Swainson's hawk	***Buteo swainsoni***	***CT***	**1, 2**
Mammals			
Nelson's (San Joaquin) antelope squirrel	***Ammospermophilus nelsoni***	***S/CT***	**1, 2**
giant kangaroo rat	***Dipodomys ingens***	***FE/CE***	**1, 2**
short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	*S/SSC*	1, 2
Tipton kangaroo rat	***Dipodomys nitratoides nitratoides***	***FE/SE***	**1, 2**
Buena Vista Lake shrew	Sorex *ornatus relictus*	*FE/SSC*	2
Tulare grasshopper mouse	*Onychomys torridus tularensis*	*S/SSC*	2
San Joaquin pocket mouse	*Perognathus inornatus*	*--/SSC*	1
American badger	*Taxidea taxus*	*--/SSC*	1, 2
San Joaquin kit fox	***Vulpes macrotis mutica***	***FE/CT***	**1, 2**

Federal Designation

FE—Federally listed as endangered
FT—Federally listed as threatened.
S—BLM Sensitive Species.

State Designation

CE—State listed as endangered.
CT—State listed as threatened. Species that although not presently threatened in California with extinction are likely to become endangered in the foreseeable future.
SSC—California Department of Fish and Wildlife's "Species of Special Concern." Species with declining populations in California.
WL—Watch List
1B.1—Plant rare, threatened or endangered in Cal. and elsewhere, and very threatened in Cal.
1B.2—Plant rare, threatened or endangered in Cal. and elsewhere, and fairly threatened in Cal.

Many of these same species were listed in the letter the Center for Biological Diversity, Central Valley Air Quality Coalition, and Central California Environmental Justice Network submitted in response to the Notice of Preparation for the Project, based on species found in the U.S. Geologic Survey quadrangles surrounding the Project site.

2. The Draft EIR must address construction and operation impacts to species.

Though the Draft EIR claims there are no significant and unavoidable Project impacts to biological resources, this misses the mark and reflects a failure to account for the evidence

showing that operating CCS projects can be severely detrimental, or even deadly, to wildlife, plants, and habitats.

The Project poses risks to biological resources from leakage and uncontrolled blowouts of compressed CO_2 from pipelines and injection wells.[390] Compressed CO_2 forms a low dense cloud that can spread long distances from the release site and sicken and asphyxiate living things, including plants and animals.[391] CO_2 injection in oil fields and CO_2 pipeline transport have resulted in leakage and blowouts in several states that have caused wildlife deaths and significant habitat degradation. For example, a CO_2 injection well blowout in the Tinsley field, Mississippi, took 37 days to bring under control and killed deer, birds, fish, and other animals.[392] The blowout ejected CO_2 along with mud and drilling fluids, requiring the removal of 27,000 tons of drilling mud and contaminated soil and 32,000 barrels of liquids, and causing extensive habitat damage.[393] Other examples of CO_2 harms to wildlife and plants, and research on this topic, include:

- In 1986, a sudden, catastrophic release of CO_2 from Lake Nyos in Cameroon killed 1,700 people and 3,000 cattle. The CO_2 spread 10 km from the lake. Bird, insect, and small mammal populations in the area were not seen for at least 48 hours after the event.[394]

- Experiments with controlled injections of CO_2 into soil showed adverse effects on plants in response to CO_2 exposure. Biomass changes were seen in all plants studied; for example, clover plants decreased by 79% while grass decreased by 42%. The researchers' overarching conclusion was that elevated concentrations of soil CO_2 damages both soil microbiology and growing vegetation.[395]

- Other research on CO_2 and plants showed reduced plant growth and extensive mortality where CO_2 concentrations were greatest in the soil. For the plants that survived, root and shoot growth was significantly lower than in controls. Reproductive variables such as

[390] The Project's Biological Study Area (BSA), for example, includes "everything within the limits of the project footprint (the carbon capture and storage [CCS] Surface Land Area) and a 250-foot survey buffer, where feasible." Draft EIR, Vol. 1 at 4.4-3. Accordingly, the impacts to species from CO_2 leaks and blowouts must be considered within the scope of the BSA.
[391] See Pipeline Safety Trust and AccuFacts, *CO_2 Pipelines: Dangerous and Under-Regulated* (March 2022), https://pstrust.org/wp-content/uploads/2022/03/3-23-22-Final-Accufacts-CO2-Pipeline-Report2.pdf.
[392] Zegart, *The Gassing of Satartia*.
[393] Amy, *Oil spills in Mississippi, Alabama lead to $3.5 million in penalties for the company,* Clarion Ledger (Apr. 30, 2019), https://www.clarionledger.com/story/news/2019/04/30/oil-spills-penalties-mississippi/3625587002/.
[394] Kling, G.W. et al., *The 1986 Lake Nyos Gas Disaster in Cameroon, West Africa*, 236 Science 169 (1987).
[395] Smith, K.L. et al., *Environmental Impacts of CO2 Leakage: Recent Results from the ASGARD Facility, UK*, 37 Energy Procedia 791 (2013).

number of seeds per plant and seed dry weight per plant were also reduced compared to controls.[396]

The Draft EIR's analysis must also consider the impacts posed to burrowing species in the Project site, including the area in which the CO_2 plume is expected to spread. (The Draft EIR acknowledges that construction could cause loss of burrows and dens during construction at p. 4.4-40, but not during Project operation.) Burrowing animals are particularly vulnerable to death from CO_2 suffocation in the event of CO_2 pipeline or injection well blowout, since released CO_2 could fill nearby burrows where animals are resting or retreating. Federally listed burrowing species in the Project area include the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and blunt-nosed leopard lizard.

3. The Draft EIR must comply with CEQA's biological resources review requirements.

Protecting biological resources is a fundamental tenet of CEQA. Under Public Resources Code section 21001(c), it is the policy of the state to "[p]revent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities." EIRs must provide an in-depth analysis of whether a project will: Reduce substantially the habitat of a fish or wildlife species; Cause a fish or wildlife population to drop below self-sustaining levels; Threaten to eliminate a plant or animal community; or Reduce substantially the number or restrict the range of an endangered, rare, or threatened species.[397]

In addition to review under CEQA, when a project has the potential to significantly impact a species listed under the federal or California Endangered Species Act, consultation with wildlife agencies and an Incidental Take Permit are required.[398]

4. The Draft EIR's reconnaissance surveys are deficient.

There are deficiencies in the reconnaissance surveys that the Draft EIR relies upon to identify potentially impacted species. In evaluating whether a project will affect endangered, rare, or threatened species, lead agencies can use reconnaissance-level surveys, rather than protocol-level surveys or other methods, only where the choice of methodology is supported by substantial evidence.[399]

Of the 39 species CDFW identified as potentially occurring in the Project area (see Table 1 in section VI.G.1), the Draft EIR identifies just 27 that may be potentially affected by the Project following literature, database analysis, and reconnaissance surveys in September – December 2022. But the initial database review and reconnaissance surveys were insufficient to identify all sensitive species that may potentially occur in the Project area. In particular, despite the poor timing of the reconnaissance surveys to detect many species, the Draft EIR relies on the

[396] Al-Traboulsi et al., *Potential Impact of CO2 Leakage from Carbon Capture and Storage (CCS) Systems on Growth and Yield in Spring Field Bean*, 80 Environ. Exper. Botany 43 (2012).
[397] CEQA Guidelines, § 15065(c)(1).
[398] Cal. Fish and Game Code, § 2081; Endangered Species Act, § 10.
[399] *Gray*, *supra*, 167 Cal.App.4th at 1124.

database review and reconnaissance surveys to exclude the Tipton kangaroo rat and several plant species that CDFW has noted occur or have the potential to occur near the Project site.

a. Tipton Kangaroo Rat

CDFW wrote in comments on the scoping phase of the Project that Tipton kangaroo rat "have been documented to occur near the Project site" and that suitable habitat is present for the species to "occupy or colonize the Project."[400] CDFW went on to recommend a trapping plan to determine the presence of Tipton kangaroo rat, to be reviewed and approved by CDFW prior to execution, and that "these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities in order to determine if impacts . . . could occur."[401] Contrary to CDFW's recommendation, the Biological Analysis Report did not include a plan submitted to and approved by CDFW and did not take place between April 1 and October 1. As expected, no Tipton kangaroo rat were observed during winter reconnaissance surveys. Rather than include this species for further evaluation in protocol-level surveys, it was removed from consideration with the following rationale: "The BSA is outside of the known geographic range (east of the California aqueduct) of the species."[402] This statement is not supported by substantial evidence and is contradicted by multiple letters from CDFW. The species should have been included in the Draft EIR as potentially occurring in the Project area to ensure it was included in future surveys and covered by mitigation measures.

b. Special Status Plants

CDFW identified multiple plant species that may be located in the Project area. The agency recommended in comments on the Notice of Preparation for the Project that Project sites should be surveyed "by a qualified botanist following the 'Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities' . . . . This protocol, which is intended to maximize detectability, includes the identification of reference populations to facilitate the likelihood of field investigations occurring during the appropriate floristic period."[403] The protocol is "meant to help people meet California Environmental Quality Act (CEQA) requirements for adequate disclosure of potential impacts to plants" and further recommends that field surveys be conducted multiple times during flowering or fruiting, when plants will be evident and identifiable.[404] The Draft EIR's methodology and recommendations are at odds with this protocol.

Surveys are particularly important because information in databases is voluntarily submitted and is "obtained opportunistically and is often focused on protected lands or on lands where development has been proposed."[405] CDFW identified with aerial imagery that many plant species could be impacted by the development in the Elk Hills oil field, including Horn's milk

[400] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[401] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 155.
[402] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1701.
[403] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 159.
[404] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (Mar. 2018) at 1.
[405] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1618.

vetch, slough thistle, alkali-sink goldfields, pale-yellow layia, and California alkali grass.[406] CDFW further stated that:

> [i]n order to adequately assess any potential impacts to biological resources, focused biological surveys are advised to be conducted by a qualified wildlife biologist during the appropriate survey period(s) in order to determine whether or not any special status species may be present within the well development areas and prior to any ground-disturbing activities. Survey results can then be used to inform the level of environmental review and identify any mitigation, minimization, and avoidance measures necessary to reduce potential impacts to special status biological resources to less than significant.[407]

The Biological Analysis Report also appears to recognize the importance of surveys to supplement information in databases. It says that "the absence of recorded occurrence in these databases at any specific location does not preclude the possibility that a special-status resource may be present, which is why site-specific surveys were undertaken." However, it is not clear if the determination of whether species had the potential to occur was made prior to or after reconnaissance surveys.[408] And, if made after reconnaissance surveys, the "site-specific surveys" conducted for the Biological Analysis Report are not the same as the surveys recommended by CDFW to determine the species in the Project area and develop mitigation. For example, they were conducted between September and December, outside bloom times. There is also no evidence that the surveyors possess specific plant knowledge or have experience "conducting floristic botanical field surveys" or that the surveys followed other requirements in CDFW's 2018 protocols for surveying document.[409] CDFW's protocol specifically states that it is inappropriate to conduct "'[f]ocused surveys' that are limited to habitats known to support special status plants or ***that are restricted to lists of likely potential special status plants***" because they "are not adequate to identify all plants in a project area to the level necessary to determine if they are special status plants,"[410] but this is exactly what the Draft EIR proposes.[411]

5. The Draft EIR's proposed mitigation measures are unsupported and/or insufficient.

A large number of species-specific mitigation measures lack support, ignore scientific evidence, and/or expert agency recommendations submitted during the scoping period, fail to

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[406] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 151.
[407] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 146–47.
[408] Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1618 ("The results of the database inquiries were reviewed to develop a comprehensive list of sensitive biological resources that may be present on or in the vicinity of the Project site (see Table A-1 in App'x A). This list was then evaluated against existing site conditions observed during the biological field surveys of the BSA to determine which special-status resources have the potential to occur and then the potential for impacts to those resources as a result of the implementation of the Project.").
[409] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* at 11.
[410] CDFW, *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* at 4.
[411] Draft EIR, Vol. 1 at 4.4-57.

adhere to legal requirements, and ultimately must be substantially revised. Further, the Draft EIR lacks entirely mitigations for specific species or offers vague and/or yet-to-be-determined mitigation plans that must be specified and recirculated for comment from the public and experts.

a. Blunt-nosed Leopard Lizard

The blunt-nosed leopard lizard (BNLL) is a Fully Protected species in California and the proposed Project is located in "what is known as the highest quality BNLL habitat" within the oil field.[412] The Draft EIR fails to provide sufficient mitigation measures to detect the species and avoid take, just as it fails to adequately respond to concerns, evidence, and suggestions offered by the CDFW during the Project scoping period. And as a minor initial matter, the Draft EIR mischaracterizes the BNLL as a snake.[413] It is instead a rather large lizard that is part of the iguana family. This error should be corrected.

Surveys

First, the Draft EIR ignores the CDFW's concerns about survey protocols. The proposed mitigation measures provide that "[n]o more than one year prior to ground disturbing activities, focused surveys . . . shall be conducted in all potential" habitat" (MM 4.4-9(b)); as well as "[w]ithin 30 days before any ground-disturbing activities in special-status species habitat, the qualified biologist shall conduct a pre-disturbance survey" (MM 4.4-1(C)). But as the CDFW pointed out in their scoping comment: "Protocol-level surveys for BNLL are not synonymous with 30-day 'preconstruction surveys' often recommended for other wildlife species. In addition, the BNLL protocol specifies different survey effort requirements based on whether the disturbance results from maintenance activities or if the disturbance results in habitat removal (CDFW 2019)."[414] The Draft EIR does not address the difference between protocol-compliant surveys and 30-day preconstruction surveys, or the difference in survey type based on Project activity and impact. The BNLL mitigation measures for surveys must provide more specifics on how the proposed surveys will comply with the nuances in the protocols.

Second, the mitigation measures must be clearer on the timing of the one-year survey and provide more explanation for how the timing will fit with the BNLL's complex lifecycle and the fact that the species can remain below ground for years at a time. MM 4.4-9 says only that "focused surveys . . . shall be conducted" within a year of construction. The BNLL breeds from May to June, and eggs hatch in July and August.[415] The species is then active during the day in the spring, summer, and fall months, though adult activity decreases during the hot summer months of July and August, just as the hatchlings emerge from the burrows.[416] At that point, adults generally retreat into their burrows for the winter. Hatchlings stay out until October or

[412] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.
[413] Draft EIR, Vol. 1 at 4.4-45.
[414] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.
[415] California Herps, *Blunt-Nosed Leopard Lizard - Gambelia sila*, https://californiaherps.com/lizards/pages/g.sila.html (last accessed Mar. 1, 2024).
[416] U.S. Fish and Wildlife Service (FWS), *Blunt-Nosed Leopard Lizard*, https://www.fws.gov/species/blunt-nosed-leopard-lizard-gambelia-silus (last accessed Mar. 1, 2024).

November, before going into burrows.[417] Adults are capable of remaining below ground for two winters when poor environmental conditions, such as drought, are present.[418] The Mitigation Measure for longer-term surveys must therefore account for detecting both adult and juvenile lizards, as well as the fact that adults may remain underground for two years in a row.

Deferred Mitigation

MM 4.4-9(c) says that if BNLL are found during surveys, an "avoidance plan shall be prepared." The Mitigation Measure then recommends certain minimum actions to be included in the plan, such as a Worker Awareness Program and a speed limit.[419]

But the County cannot defer creation of a mitigation measure until a problem is detected. Under the CEQA rule against improper deferred mitigation, an EIR may not outline a mitigation measure in overly general terms, leaving the details to be decided at a later time, without setting performance standards or showing how the impact can be mitigated as described in the EIR.[420] Formulation of a measure's specific requirements for biological impacts may be permissible if the measure refers to the options that will be considered and the measure identifies specific performance standards.[421] All of these required safeguards and specifics are lacking in MM 4.4-9(c).

Cumulative Analysis

The CDFW recommended in the scoping period that the County perform a "robust cumulative impact analysis" of the BNLL because of the "significant loss of habitat for the species," the fact that the Project area and surrounding lands "contain some of the highest quality remaining habitat" for the BNLL, and that any "ground disturbing activities . . . may have the potential to significantly impact" populations.[422] The Draft EIR entirely ignores this recommendation and it is not reflected either in the analysis or the mitigation measures. There is no explanation for why CDFW's recommendation was ignored. The County must take up this recommendation and adjust its analysis and mitigation measures accordingly.

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[417] *Id.*
[418] *Id.*
[419] *Id;* see also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius" until additional measures are determined).
[420] CEQA Guidelines, §15126.4(a)(1)(B); *Preserve Wild Santee v. City of Santee* (2012) 210 CA4th 260, 280 (rejected measure calling for management of species without specifying performance standards or other guidelines for that management); *San Joaquin Raptor Rescue Ctr.*, *supra*, 149 CA4th at 669 (measure specifying that future surveys for special status species be completed and undefined habitat management plan be developed in response to surveys found legally inadequate).
[421] *Clover Valley Found. v. City of Rocklin* (2011) 197 CA4th 200, 237 (requirement that permits be obtained from Department of Fish and Wildlife and Corps of Engineers served as performance standards supporting agency's determination that impact to listed species and its habitat would be mitigated); see also *Rialto Citizens for Responsible Growth v. City of Rialto* (2012) 208 CA4th 899, 945; *Cal. Native Plant Society*, *supra*, 172 CA4th at 621; *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 CA4th 777, 794; *Defend the Bay v. City of Irvine* (2004) 119 CA4th 1261, 1275.
[422] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 150.

Buffer Zones

The mitigation measures for BNLL buffer areas fail to match the analysis and evidence CDFW provided in the scoping period. CDFW sought to determine the appropriately sized buffer to create a "reasonable chance of preventing take."[423] The agency reviewed the best available scientific information on the area which individual BNLL use and the distances that individuals are known to move between points.[424] They summarized relevant findings and concluded that the buffer area would need to be 164 acres *at a minimum* to avoid take.[425]

Rather than grapple with this informed and reasoned recommendation, the mitigation measures for the BNLL are vastly under-protective. MM 4.4-9(a) provides only a 50-foot buffer where ground-disturbing activities could impact suitable burrows. MM 4.4-9(b) prescribes a 250-foot buffer if the species is detected. (Even here, it is unclear what "detected" means—the same Mitigation Measure states that no buffer is needed if no BNLL "is observed," but "observation" may not be the same as detecting signs of the lizard.)[426]

The Draft EIR's prescribed 50-foot buffer is 2% of the CDFW recommendation, and the 250-foot buffer only 10% of the CDFW recommendation. Moreover, the evidence the CDFW analyzed showed the *minimum* home range for the BNLL to be 1.1 acres (with other findings extending up to nearly 22 acres). One acre is 660 feet long—meaning the buffers in the mitigation measures are not even half of the bare minimum space needed to protect the species. These buffers simply fall far short of what is needed to meet the County's legal obligations and avoid take of the species. The Draft EIR offers no explanation for running counter to the best available scientific evidence of what might be reasonable to avoid take.

b. San Joaquin Kit Fox

There is both high likelihood of San Joaquin Kit Fox (SJKF) presence and occupation of the Project site and a need for strong mitigation measures. Per the CDFW, SJKF "may be attracted to the Project area due to the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance."[427] Mitigations must eliminate or substantially limit the likelihood of den collapse, inadvertent entrapment, reduced reproductive success, reduction in health and vigor of young, and direct mortality of individuals.[428]

The current SJKF mitigation measures are deficient and fail to align with scientific evidence and/or legal requirements in several ways. First, the CDFW was clear in its scoping comment that avoiding Project impacts to SJKF "is likely infeasible," and this Project warrants

[423] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 151.
[424] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 151.
[425] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 152–53 (going on to explain that there is "a reasonable plan for avoidance is to assume that the lizard might utilize up to 98.8 acres in any direction from where it was observed," and assuming a circular home range, the diameter would be 2340.8 feet, or a 395-acre circle as a buffer).
[426] See also MM 4.4-9(c)(3) (if BNLL are detected during construction, "construction shall cease within a 250-foot radius until additional measures are determined).
[427] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 153.
[428] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 153.

consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities.[429] This is because the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity."[430]

Second, while MM 4.4-6 provides for buffers around potential and confirmed dens, it also directs that any dens that "cannot be avoided" will be removed. Calling for den removal fails to align with evidence provided during the scoping period that kit fox relocation is complex and likely to fail.[431] The Mitigation Measure further fails to propose how exactly den "excavation" will occur, if/where relocation will happen, and how relocation will take into account critical factors such as expense, available habitat, impact on existing populations, and documentation.[432] Den removal also implicates species take which, as noted below, requires a separate ITP than what the County currently claims covers Project activities.[433] The Mitigation Measure also fails to acknowledge the USFWS's guideline that occupied natal or pupping dens will not be destroyed until the foxes have vacated, thus requiring postponement of Project activities.[434] Details such as these must be included in the mitigation measures so that all parties (including the Project developer, workers, and local regulators) are aware of their obligations and limitations.

Third, other measures to project the SJKF do not align with CDFW and USFWS recommendations. (Of note, MM 4.4-6 directs the reader to other measures "including capping pipes, covering trenches, adding exit ramps to excavated areas" at MM 4.4-15. But MM 4.4-15 concerns wetlands and waters, whereas 4.4-13 concerns additional measures to avoid adverse impacts to species, such as speed limits and covering open trenches. This drafting error should be corrected.) For example, the CDFW recommends all perimeter fencing be raised 5 to 7 inches above ground level to allow SJKF movement through the Project site and to minimize impacts to SJKF habitat connectivity.[435] MM 4.4-13(h) prescribes perimeter fencing to be 4 inches off the ground—meaning, this fencing would be too short for the SJKF to pass. The USFWS also recommends that new sightings of kit fox shall be reported to the California Natural Diversity Database.[436] The County should amend its mitigation measures to take into account these expert agency recommendations.

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[429] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[430] Draft EIR. Vol. 2, App'x A.2: Comment Letters at 154.
[431] Bremner-Harrison, S. et al., *Feasibility and Strategies for Translocating San Joaquin Kit Foxes to Vacant or Restored Habitats* (2007), https://esrp.csustan.edu/publications/pdf/esrp_2007_kitfoxreloction_w.pdf.
[432] See *id.* at 3-7.
[433] See, e.g., FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 4 (2011), https://www.fws.gov/sites/default/files/documents/survey-protocols-for-the-san-joaquin-kit-fox.pdf (emphasizing that "Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the Service" and that if "at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described [therein] should be resumed").
[434] *Id.* at 4 (2011).
[435] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[436] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.

c. Giant Kangaroo Rat, Tipton Kangaroo Rat, Short-Nosed Kangaroo Rat, and San Joaquin Antelope Squirrel

As an initial matter, the Draft EIR must correct its omission of the Tipton Kangaroo Rat from the Draft EIR. According to CDFW, the Giant Kangaroo Rat (GKR), Tipton Kangaroo Rat (TKR), and Short-Nosed Kangaroo Rat (SNKR) "have been documented to occur near the Project site (CDFW 2022), and the Project Area supports some of the best GKR habitat present in the Elk Hills oil field."[437] It is unclear why the Draft EIR's list of Special Status Animal Species that could occur onsite fails entirely to include the TKR.[438] This omission must be corrected, not just in the table but in the surveys of species at the site, analysis of impacts, and biological resources mitigation measures.

Regarding surveys, the CDFW recommended trapping surveys for the GKR, TKR, and SNKR, to be conducted according to trapping plans developed in consultation with CDFW.[439] CDFW further recommended that these surveys be conducted between April 1 and October 31, when kangaroo rats are most active and well in advance of ground- and/or vegetation-disturbing activities.[440] Once completed, they requested that all survey results be sent to CDFW.[441] Without explanation or evidence to explain why it would not have to conduct such surveys (including for the TKR), the Draft EIR does not take up any of these recommendations. Relatedly, the CDFW recommended seeking ITPs upon detection of any of the protected rat species; it does not appear the Project has done this.[442]

While the Draft EIR's 50-food den buffer aligns with the CDFW recommendation,[443] the mitigation measures ignore the CDFW's caution that buffers may not be sufficient to ensure that the species can "freely disperse to and from burrows."[444] Inhibiting the movement of these protected species could be considered "capture" and/or result in prohibited species take.[445] To address this, the CDFW recommended that no burrow be surrounded more than 180 degrees around by development activities.[446] The Draft EIR ignores this recommendation without explanation or evidence. The mitigation measures should adopt this 180-degree protection in addition to buffers around rodent dens.

The issues above are similar with the San Joaquin antelope squirrel (SJAS), which is known to occur throughout the Elk Hills oil field.[447] Like the rat species, the CDFW

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[437] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154; *see also* Draft EIR, Vol. 1 at 4.4-38 (noting that the USFWS published a recovery plan for species in the San Joaquin Valley, including the TKR, identifying it as a "keystone" species).
[438] Draft EIR, Vol. 1 at Table 4.4-4.
[439] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[440] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[441] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[442] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154–55 (stating that "the existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").
[443] Draft EIR, Vol. 1 at Table 4.4-6.
[444] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[445] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[446] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154.
[447] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 156.

recommended that no SJAS burrow be surrounded more than 180 degrees around by development activities.[448] The Draft EIR fails to adopt this measure and fails to offer explanation or evidence that omitting this protection would somehow avoid capture and/or take. The CDFW also informed the County of the need for a separate ITP permit for SJAS take.[449]

d. Swainson's Hawk

Swainson's hawks have been documented to occur in the areas bordering the Elk Hills oil field, and the habitat type present provides suitable foraging and nesting habitat.[450] Despite this, the Draft EIR lacks any mitigation measures specific to the species.

The CDFW recommended specifically for the Swainson's hawk that, upon discovery of an active nest, a minimum half-mile buffer be delineated and that such a buffer be maintained until the breeding season ends or a qualified biologist determines the birds have fledged.[451] Instead, MM 4.4-8 (which broadly covers all bird nests) provides that if a nest is detected, it will be continuously surveyed for 24 hours to establish behavior baseline prior to construction; then continuously monitored to detect any behavioral changes. Monitoring of a nest falls short of an immediate buffer and the Draft EIR does not provide evidence that simple monitoring will be sufficient to reduce adverse impacts to the species. Further, the Measure does not clarify who will do the 24-hour monitoring or the continuous behavioral monitoring; at the very least this must be a qualified biologist selected by the County.

The Draft EIR also entirely fails to address the loss of Swainson's hawk foraging habitat and tree removal, two concerns CDFW raised during the scoping period.[452] The CDFW provided reasoned and supported recommended mitigations to address these concerns that must be incorporated into the Draft EIR.

e. Burrowing Owl

Burrowing owls have been documented in the Project vicinity, per CDFW.[453] The Project has the "potential to significantly impact local [] populations" and, and as described in CDFW's "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), "excluding and/or evicting [burrowing owls] from their burrows is considered a potentially significant impact under CEQA."[454]

The CDFW's Staff Report is clear that Project-specific CEQA mitigation is important for burrowing owls and unless otherwise provided in a state, local, or regional conservation strategy, mitigation measures must incorporate the following four principles: 1) use of the precautionary principle; 2) use of mitigation effectiveness monitoring and reporting, as well as adaptive management; 3) protect and conserve owls in wild, semi-natural, and agricultural habitats; and 4)

[448] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 156.
[449] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 157.
[450] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 157.
[451] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 158.
[452] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 158.
[453] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.
[454] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.

protect and conserve natural nest burrows or surrogates.[455] The Staff Report then lists best practices for mitigation measures grounded in scientific literature.[456] These include, broadly, avoidance, pre-construction surveys, site surveillance, and buffer zones.[457]

The Draft EIR does not take the CDFW's scoping comment or Staff Report fully into account, leaving its burrowing owl mitigations insufficient to reduce adverse impacts and unsupported by any evidence.

First, accurate surveys to detect burrowing owl presence is key, and CDFW suggested during the scoping period that the Project conduct "three or more surveillance surveys" with each visit occurring at least three weeks apart during peak breeding season (April 15 to July 15).[458] Mitigation Measure 4.4-1 provides only that "any required focused/protocol surveys shall be conducted . . . with protocol survey timelines." The Draft EIR does not address the guideline for three or more surveillance surveys for owls, nor does it contain evidence or an explanation for why this approach would not be taken.

Second, MM 4.4-4 provides that burrowing owls present in the Project area or within 500 feet outside the breeding season "may be moved away . . . using passive relocation techniques." While this measure pledges to follow CDFW guidelines, the Draft EIR fails to acknowledge that according to the CDFW, "excluding birds from burrows is not a take avoidance, minimization, or mitigation method and is instead considered a potentially significant impact under CEQA."[459] The Draft EIR must therefore acknowledge that displacing owls is an impact and analyze it as such. Should MM 4.4-4 maintain the approach of displacing owls, it must also incorporate the CDFW's guideline that burrow exclusion be conducted only by qualified biologists and only during the non-breeding season, and that occupied burrows be replaced with artificial ones at a ratio of 1:1.[460]

Finally, there is no logical connection between the full suite of impacts to burrowing owls named in the Draft EIR and the mitigation measures named. The Draft EIR acknowledges that "[n]oise, vibration, and increased human activity" from construction "could alter the daily behaviors of individual owls and affect foraging success, displace owls from their burrows, or lead to nest failure."[461] The Draft EIR then claims MMs 4.4-1, -3, -4, -11, and -13 "would reduce impacts,"[462] but these Measures on their face do not fully address the impacts. MM 4.4-1 concerns surveys, MMs 4.4-3 and -4 address buffers and owl nest exclusion, MM 4.4-11 describes worker education, and MM 4.4-13 lists additional measures such as trash and dust control. The Measures listed are a start, but the Draft EIR does not fully connect how they will

[455] CDFW, *Staff Report on Burrowing Owl Mitigation, State of California* (March 7, 2012) at 3–4, https://www.sandiegocounty.gov/content/dam/sdc/pds/ceqa/JVR/AdminRecord/IBR/RTCReferences/3a%20CDFG%202012_Staff%20Reports%20on%20Burrowing%20Owl%20Mitigation.pdf.
[456] *Id.* at 8.
[457] *Id.* at 8–10.
[458] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 160.
[459] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 161 (citing the CDFW Staff Report).
[460] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 161.
[461] Draft EIR, Vol. 1 at 4.4-46.
[462] Draft EIR, Vol. 1 at 4.4-46.

address noise, vibration, and other impacts that could alter the daily behaviors of owls; the impacts are therefore left unmitigated.

f. Nocturnal Species

There are six protected nocturnal species in the Project area,[463] but the mitigation measures fail to adequately reduce impacts to these species (and other species) from the array of nighttime Project activities expected to occur.

As an initial matter, the Biological Resources section acknowledges that construction could occur at night and therefore require lighting that may affect diurnal and nocturnal wildlife.[464] But elsewhere in the document, the Draft EIR states that nighttime Project activities could include "drilling activities, vehicle and equipment activities supporting drilling, and safety and security lighting for areas, such as construction yards, work areas, vehicle and equipment parking areas, and staging and laydown areas,"[465] and that Class VI well drilling "typically run[s] continuously, 24 hours a day" for "up to 60 days."[466] The full range of nighttime activities mentioned in other parts of the Draft EIR must be incorporated, analyzed, and mitigated in the Biological Resources section.

Perhaps because of this disconnect, the only nighttime-related mitigation measure for species merely directs use of "directing lighting" and compliance "with applicable lighting mitigation measures."[467] Nighttime lighting is harmful to nocturnal species, but lighting is far from the only impact of nighttime construction and other activities that needs to be mitigated. (Moreover, the lighting mitigation is far too vague to be evaluated or measured and must be revised to include specifics and information about enforcement.) For example, the San Joaquin kit foxes "are known to sometimes rest and play near the den entrance in the afternoon, but most above-ground activities begin near sunset and continue sporadically throughout the night."[468] Accordingly, for that species, the U.S. Fish and Wildlife Service recommends that "[n]ight-time construction should be minimized" and if it does occur, "then the speed limit should be reduced to 10-mph" and "[o]ff-road traffic outside of designated project areas should be prohibited."[469]

The County must therefore develop mitigation measures to address the full array of impacts to nocturnal species from activities such as traffic, noise, vibrations, and continuous

[463] The species are the California glossy snake, Draft EIR, Vol. 1 at 4.4-44, 4.4-18; the giant kangaroo rat, *id.* at 4.4-22 (noting that "suitable burrows with diagnostic signs of kangaroo rat were observed" during surveys); the short-nosed kangaroo rat, *id.* at 4.4-22; the San Joaquin pocket mouse, *id.* at 4.4-22; the American badger, *id.* at 4.4-23 (noting that "dens displaying signs consistent with the use of a badger were observed" in the Project area); and the San Joaquin kit fox, *id.* at 4.4-23.
[464] Draft EIR, Vol. 1 at 4.4-40.
[465] Draft EIR, Vol. 1 at 4.1-24.
[466] Draft EIR, Vol. 1 at 4.1-25.
[467] Draft EIR, Vol. 1 at 4.4-13.
[468] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 3.
[469] *Id.* at 5.

drilling. The County must also develop measures to address impacts to daytime species whose rest and other behaviors might be disrupted by nighttime disturbances and continuous drilling.

g. Worker Environmental Awareness Program

Mitigation Measure 4.4-11 to create a Worker Environmental Awareness Program is a good start but, as written, falls short of the County's legal requirements and could benefit from adopting recommendations by other agencies.

For one, the Draft EIR defers development of the program, stating only in MM 4.4-11 that it "shall be developed." As noted earlier in this comment section, the County cannot defer development of a mitigation measure and instead must provide specifics prior to finalizing the Draft EIR. A worker educational program is not the type of mitigation that requires further data or inputs from operations to prescribe measures, nor is it impractical or infeasible to devise the specifics of such a program now.[470]

One template the County could consider comes from the USFWS regarding the SJKF. They recommend an employee education program that does the following:

> The program should consist of a brief presentation by persons knowledgeable in kit fox biology and legislative protection to explain endangered species concerns to contractors, their employees, and military and/or agency personnel involved in the project. The program should include the following: A description of the San Joaquin kit fox and its habitat needs; a report of the occurrence of kit fox in the project area; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of measures being taken to reduce impacts to the species during project construction and implementation. A fact sheet conveying this information should be prepared for distribution to the previously referenced people and anyone else who may enter the project site.[471]

This type of thorough education is appropriate for all protected species that are or could occur at the Project site. These materials must be developed and shared with the public and decisionmakers prior to finalizing and certifying the Draft EIR.

Similarly, MM 4.4-12 provides that "wildlife found that might have been affected by exposure to CO_2 shall immediately cause a shutdown of all injection operations." This measure is important and should therefore be incorporated into the Worker Environmental Awareness Program, along with other information about exactly *how* to identify wildlife suffering symptoms of CO_2 exposure.

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[470] See, e.g., *Defend the Bay v. City of Irvine* (2004) 119 Cal.App.4th 1261, 1275; *Preserve Wild Santee*, *supra,* 210 Cal.App.4th at 281; CEQA Guidelines, § 15126.4(a)(1)(B).

[471] FWS, *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* at 6.

h. Cumulative Impacts and Mitigations

The Draft EIR concludes that "the cumulative impacts of the project when combined with other known and unknown projects, would be significant and unavoidable" for biological resources.[472] The Draft EIR then offers no additional mitigation measures beyond the ones proposed to address direct impacts.[473]

The Draft EIR opts not to independently consider and evaluate potential cumulative impacts to biological resources because of the *Final Environmental Impact Report - Revisions to the Kern County Zoning Ordinance - 2015(C) Focused on Oil and Gas Local Permitting*, referred to in the EIR as the Oil and Gas EIR.[474] The relationship to this Draft EIR is somewhat opaque. The County uses the Oil and Gas EIR "as a source of information regarding cumulative impacts," but supposedly "does not rely" on it "for purposes of tiered review under CEQA."[475] By way of further explanation, the Oil and Gas EIR's information "provide [sic] evidence for the record of the analysis of cumulative impacts" for activities included in the Project, meaning it offers "facts and evidence for the record" on the oil field's biological resources.[476]

We agree that CEQA Guidelines section 15152 guides whether the County can tier to a previous analysis, but the County's supposed use but non-reliance on the Oil and Gas EIR is unconvincing. Per the Guidelines, "tiering" is defined as "using the analysis of general matters contained in a broader EIR" with later EIRs, incorporating by reference the general discussions from the broader EIR, and concentrating the later EIR solely on the issues specific to the later project.[477] This definition of tiering describes how the County is using the Oil and Gas EIR for this Project—meaning, the County is tiering to the challenged EIR, even if it claims not to be.

The County should not be tiering to the Oil and Gas EIR given its status in litigation. The Oil and Gas EIR "is subject to a pending court challenge."[478] This alone should prohibit the County from using the challenged EIR as a source of information. The Draft EIR, however, attempts to carve out the cumulative impacts section of the Oil and Gas EIR to use here because that section is not directly challenged in the lawsuit.[479] Such a tightrope walk is unsupported. In the court challenge, the direct impacts (such as to air, water, and biological resources) are at issue; if the court orders a remedy on those direct impacts, the cumulative impacts analysis would also have to change.[480] This casts the entire analysis of impacts (direct and cumulative) of the EIR into doubt, and the current Draft EIR should instead conduct its own cumulative impacts analysis rather than attempt to rely on a disputed and stale one.

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[472] Draft EIR, Vol. 1 at 4.4-66.
[473] Draft EIR, Vol. 1 at 4.4-66.
[474] Draft EIR, Vol. 1 at 4.4-65.
[475] Draft EIR, Vol. 1 at 4.4-65 (citing CEQA Guidelines, § 15152).
[476] Draft EIR, Vol. 1 at 4.4-65
[477] CEQA Guidelines, § 15152(a).
[478] Draft EIR, Vol. 1 at 4.4.-64.
[479] Draft EIR, Vol. 1 at 4.4.-64.
[480] CEQA Guidelines, § 15130(a)(1) (defining cumulative impact as "the combination of the project evaluated in the EIR together with other projects causing related impacts").

6. The Draft EIR's reliance on a prior conservation easement deed for Endangered Species Act coverage is improper.

It is unclear to what extent Kern County proposes to rely on previously issued plans for Endangered Species Act coverage for the Project, but reliance on existing coverage through take permits is improper. As the Draft EIR recognizes, unauthorized take of species is unlawful, and the County must have an ITP to cover any species take.[481] Yet the Draft EIR claims that California Resources Corporation has an ITP from 2012, pointing to Appendix C.2. The Draft EIR also references an "Elk Hills Habitat Conservation Plan" but does not provide the plan anywhere in the appendices.[482]

The Draft EIR's discussion of ITP coverage is problematic for several reasons. First, the document provided in Appendix C.2 is not an ITP or Habitat Conservation Plan—it is a conservation easement deed for conservation areas that largely do not overlap with the Project site.[483] The document mentions only a small number of the potentially impacted protected species.[484] And the document mentions "certain impacts of oil and gas production facilities and activities at the Elk Hills oil field," which would not encompass the CO_2 capture, compression, transportation and injection activities of this Project.[485] Although the Center for Biological Diversity is aware that a previous oil field operator prepared a Habitat Conservation Plan in 2009 as part of an ITP application necessary to extend a prior permit beyond 2014 and authorize incidental take of species associated with continued oil and gas production activities,[486] there is no publicly available information indicating that plan was finalized.[487]

The Center for Biological Diversity requested from Kern County an ITP noted in other Elk Hills oil field drilling approval documents.[488] The Center received a document in response, ITP number 2081-2014-019-04, issued to California Resources Corporation Elk Hills, LLC. We are including it with our comment submission since this permit must be part of the administrative record.

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[481] Draft EIR, Vol. 1 at 4.4-23 (take requires an ITP issued under section 2081 or a finding that an ITP issued under the federal Endangered Species Act is consistent with state requirements); *id.* at 4.4-25 (section 10 of the federal Endangered Species Act allows a permit applicant to obtain an ITP through submission of a habitat conservation plan); see also MM 4.4-2 (stating that there may be no incidental take of any protected species without a permit or approved conservation plan).

[482] Draft EIR, Vol. 1 at 4.4-36.

[483] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area at 1721 *et seq.*; Draft EIR, Vol. 2, App'x C.3: Conservation Easement Deed – Elk Hills Conservation Area Map at 1741 *et seq.*

[484] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area; Draft EIR, Vol. 1 at 4.4-36.

[485] Draft EIR, Vol. 2, App'x C.2: Conservation Easement Deed – Elk Hills Conservation Area.

[486] 71 Fed. Reg. 6883.

[487] See 78 Fed. Reg. 39836.

[488] Letter from Center for Biological Diversity to Kern County Planning & Natural Resources Department, *Elk Hills Oilfield Incidental Take Permit* (Jan. 16, 2024); CalGEM, *Notice of Determination, NOD-OG California Resources 072022-201-1* (Aug. 25, 2022).

Second, the ITP does not sufficiently include the CTV I Project as a Covered Activity. The ITP explains that the activities covered involve "continued oil and gas related activities and the exploration and development of new wells necessary to enhance recovery and processing of oil and gas reserves."[489] The CTV I Project, in contrast, proposes to capture CO_2 from existing oil field operations, but also "is dependent on the sources permitted for injection into the storage, the ability of the project year by year to obtain CO_2 and inject at the maximum 2,210,000 million tons per year."[490] As noted earlier in this comment letter, additional sources of CO_2 could include DAC, hydrogen, and waste to energy facilities. Moreover, CO_2 compressors, pipelines, injection wells, and other infrastructure are fundamentally different from oil and gas counterparts.

Third, and relatedly, the existing ITP covers only four species—the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, and Tipton kangaroo rat—not the full range of species that could suffer take from the CTV I Project.[491] Even the CDFW—the state's authoritative agency on this issue—reiterated throughout its comment during the Scoping Phase that the existing ITP is insufficient to cover the Project's impacts on protected species.[492] The CDFW issued its opinion based not only on species that the ITP fails to cover, but the deficiency of the existing ITP to address impacts to the four covered species.[493]

It should also be noted that while the current ITP covers incidental take of the Tipton Kangaroo Rat resulting from oil and gas production, the Draft EIR arbitrarily excludes this species from surveys and consideration of mitigation measures.[494] CRC must therefore obtain a new ITP to cover *all* activities that could result in take of protected species flagged as occurring or potentially occurring in the Project Area. Obtaining ITP(s) covering CTV I Project activities and other species must occur before any construction begins to avoid unlawful take. The County must therefore revise MM 4.4-2, which provides only that if CRC "elects in the future to pursue any disturbance . . . that requires additional take authorization," the Project would obtain a new ITP. [495] The Draft EIR must then be revised to analyze and account for the new ITP.

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[489] CDFW, ITP No. 2081-2014-019-04, Elk Hills Oil and Gas Field at 2–3 (hereinafter, "ITP Permit 2081"); see also *id.* at 6–10 (listing covered activities and not including CCS).
[490] Draft EIR, Vol. 1 at 4.8-24.
[491] ITP Permit 2081 at 11 ("These species and only these species are the 'Covered Species' for the purposes of this ITP.").
[492] Draft EIR, Vol. 2, App'x A.2: Comment Letters at 146–65; see also section VI.G, *supra* (noting instances in which the ITP does not cover protected species for the activities proposed).
[493] See, e.g., Draft EIR, Vol. 2, App'x A.2: Comment Letters at 154 (noting that the Project warrants consultation with CDFW and acquisition of a SJKF-specific ITP prior to ground-disturbing activities and for this species, the "existing ITP issued to OXY/CRC does not include the proposed Project as a Covered Activity").
[494] See Draft EIR, Vol. 2, App'x C.1: Biological Analysis Report at 1701; see also section VI.G, *supra* (discussing exclusion of the Tipton kangaroo rat in the Draft EIR).
[495] Draft EIR, Vol. 1 at 4.4-64 (emphasis added).

H. The Draft EIR Fails to Analyze and Mitigate Cumulatively Considerable Impacts.

Under CEQA, an EIR must discuss significant "cumulative impacts."[496] Cumulative impacts are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts."[497] A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable future projects with impacts that might compound or interrelate with those of the project at hand.[498] Such analysis is necessary because "environmental damage often occurs incrementally from a variety of small sources [that] appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact."[499] As is the case for all impact categories, a lead agency's threshold findings of significance with regard to cumulative impacts must "be supported by substantial evidence"; and, where found, cumulatively considerable impacts must be adequately mitigated.[500]

"[M]ere awareness of proposed expansion plans or other proposed development does not necessarily require the inclusion of those proposed projects in the EIR. Rather, these proposed projects must become 'probable future projects.' (CEQA Guidelines, § 15130(b)(1)(A).)"[501] "'[P]robable future projects' can be interpreted as reasonably probable future projects . . . [P]rojects that are undergoing environmental review are reasonably probable future projects. [Citation.] We conclude that any future project where the applicant has devoted significant time and financial resources to prepare for any regulatory review should be considered as probable future projects for the purposes of cumulative impact."[502]

An adequate cumulative impacts analysis and discussion requires a thorough assessment of the incremental significance of the CTV I Project's impacts over time, and in consideration of "other projects causing related impacts."[503] The Draft EIR concludes that the CTV I Project will cause potentially significant impacts for a number of impact areas, including, but not limited to, air quality, biological resources, energy, geology and soils, and GHG. For some impact areas, including air quality, biological resources, and GHG, the Draft EIR concludes the impact will be significant and unavoidable.[504] However, the Draft EIR fails to conduct an appropriate cumulative impacts analysis and support its conclusion with evidence, because it fails to consider the full range of projects that are required in a cumulative impact analysis.

The most crucial aspect of cumulative impact analysis of a carbon sequestration project is the project's sources of CO_2. An analysis of these sources is necessary not only to understand the impact of their operation together with the CTV I Project, but also in order to give the public a

[496] CEQA Guidelines, § 15130(a).
[497] CEQA Guidelines, § 15355(b).
[498] Pub. Resources Code, § 21083(b)(2); CEQA Guidelines, § 15065(a)(3).
[499] *Communities for a Better Environment*, *supra*, 103 Cal.App.4th at 114.
[500] See CEQA Guidelines, § 15064.7(b).
[501] *Gray, supra,* 167 Cal. App. 4th 1099 at 1127–28.
[502] *Id.* at 1127–28.
[503] CEQA Guidelines, § 15130(a)(1).
[504] Draft EIR, Vol. 1 at 5-3 to 5-5.

picture of whether the CTV I will facilitate and incentivize new GHG emissions, rather than reducing existing ones, and whether it will extend the life of existing fossil fuel CO_2-emitting industries. The cumulative analysis fails to include any meaningful discussion of the Project's CO_2 sources.

As described above, the project description section of the Draft EIR lists under "Cumulative Projects" several projects in the County, and provides nothing more than the name, location, type, acreage, and status of these projects.[505] In doing so, the Draft EIR ignores projects that are clearly "probable future projects" and must be analyzed in a proper cumulative impacts analysis. These projects include, at a minimum:

1. Lone Cypress Blue Hydrogen plant

The Draft EIR describes this project as a "Blue Hydrogen project" located at Elk Hills and Skyline Road and classifies the project status as "EIR in Process". It does not include any other information or analysis of its potential cumulative impacts.

Yet documents show that the project's application was deemed complete by Kern County in September 2023,[506] and a draft Notice of Preparation was already prepared for it in December 2023;[507] thus, and as the Draft EIR concedes, this project is already undergoing environmental review.

A Carbon Dioxide Management Agreement (CDMA) for the Lone Cypress Project was entered into by CRC's Carbon TerraVault JV Holdco on December 2022.[508] Moreover, CTV has announced that it is a direct partner in that project, noting in a media release that "the CTV JV has the right to take a majority equity stake in the project, as well as to provide sequestration services for all subsequent Lone Cypress hydrogen projects in California"[509] These facts, together with the fact the project is co-located in the Elk Hills oil field as the CTV I Project, make the Lone Cypress Project a clear "probable future project" that must be analyzed in the cumulative impacts analysis.

2. Golden State Hydrogen plant

The Golden State Hydrogen project, some 60 miles north of the CTV I Project, was approved on January 30, 2024, when the Tulare County Board of Supervisors issued a Notice of Exemption.[510] As discussed above, the plant operating statement contemplates sending its

[505] Draft EIR, Vol. 1 at 3-43 (Table 3-8).
[506] PLN23-00800 Project Meeting, Email from Jamal Ferguson, Kern County, to Greg Brooks, *supra*.
[507] Notice of Preparation/Initial study, Elk Hills Blue Hydrogen by Lone Cypress Energy Services, LLC (Dec. 2023).
[508] CRC, *Lone Cypress CDMA*, https://www.crc.com/carbon-terravault/projects/lone-cypress-cdma/default.aspx (last accessed Feb. 28, 2024).
[509] CRC, *California Resources Corporation Announces Carbon Dioxide Management Agreement For CTV's First Permanent Carbon Storage Project* (Dec. 7, 2022), https://www.crc.com/news/news-details/2022/California-Resources-Corporation-Announces-Carbon-Dioxide-Management-Agreement-For-CTVs-First-Permanent-Carbon-Storage-Project/.
[510] Notice of Exemption No.., CEQ 23-013 - Golden State Hydrogen Plant Pixley, *supra.*

liquified CO_2 for sequestration at the CTV I Project.[511] The Draft EIR fails to even mention this project, and as discussed above, except for an obscure mention of truck travel in the project description section, fails to discuss or analyze any impact of trucking CO_2 into the Project.

This project is clearly a "probable future project," as it is now beyond the environmental review stage. Because this project was approved using a CEQA exemption, it did not go through any meaningful environmental analysis, which makes a proper cumulative impact analysis even more crucial.

3. Projects with a CDMA for carbon sequestration at CTV I

As discussed above, the CTV I Project is dependent on CO_2-sending industries. Therefore, the most significant aspect of cumulative analysis for the Project is the facilities that will send their CO_2 for sequestration. According to CRC's website, a number of Carbon Dioxide Management Agreements (CDMAs) were already entered into with multiple corporations. All the projects that have entered into a CDMA should be included in the cumulative impact analysis.

These projects include, at a minimum: a new renewable dimethyl ether (rDME) production facility by InEnTec, Inc. (CDMA from May 2023), a renewable gasoline plant by Verde Clean Fuels (CDMA from July 2023), and a waste-to-energy production facility by NLC Energy (CDMA from November 2023). All these projects are planned to be co-located at Elk Hills.[512] Moreover, and importantly, several of these projects contemplate CRC, CTV, or affiliated companies possessing an "equity stake" in the CO_2-sending facilities.[513] As the Project proponent has noted publicly, these projects "play an important role within Carbon TerraVault's strategy" in developing the Project.[514]

The result of the Draft EIR's failure to properly account for cumulative projects is that the Draft EIR's cumulative analysis is deeply flawed. Once an agency has a set of projected projects, CEQA requires it to include a summary of the environmental impacts expected to be

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[511] Operating Statement – Golden State Hydrogen Plant Project, *supra*, at 9.
[512] CRC, *Carbon TerraVault Vaults*.
[513] CRC, *Carbon TerraVault Provides Second Quarter 2023 Update* ("CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake"); CRC, *Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA* (May 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Announces-Two-New-Storage-Only-Carbon-Dioxide-Management-Agreements-and-Submission-of-Another-Class-VI-Permit-to-the-EPA/default.aspx ("CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake").
[514] CRC, *Carbon TerraVault Provides Third Quarter 2023 Update* (Nov. 1, 2023), https://www.crc.com/news/news-details/2023/Carbon-TerraVault-Provides-Third-Quarter-2023-Update/default.aspx ("This project highlights the value proposition of our CTV Clean Energy Park and its important role within Carbon TerraVault's strategy," said Francisco Leon, CRC's President and Chief Executive Officer. "We welcome NLCE as a trusted partner in developing and furthering California's decarbonization efforts and supporting Kern county's ambitions to become the leading carbon sequestration area in the state.").

produced by those projects and an analysis of whether the impacts are cumulatively considerable.[515]

The description and analysis of cumulative impacts should reflect their severity and the likelihood of their occurrence.[516] While this analysis does not have to go into the same details as the primary analysis of the pProject's impacts, it still must be reasonable and show a good faith effort to disclose the impact.[517] As described under each impact area section in these comments, the Draft EIR does not provide any meaningful analysis of the cumulative impacts of the projects, and ignores even the projects it lists as cumulative projects in Table 3-8.

The Draft EIR must be revised to include an adequate cumulative impacts analysis that includes all the projects it lists as cumulative projects, and all the probable future projects discussed above.

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For the reasons set forth above, we urge the County to re-do its analysis, prepare and circulate a revised Draft EIR, and, ultimately, reject the CTV I Project.

We reserve the right to identify new issues, provide additional information, and propose additional mitigation measures during the County's ongoing decisionmaking process for the CTV I Project.

If you have any questions about the foregoing comments, you may reach out to any of us directly or contact the Earthjustice contacts listed below, who helped prepare this submission.

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[515] CEQA Guidelines, § 15065(a)(3).
[516] CEQA Guidelines, §15130(b); *City of Long Beach v. Los Angeles Unified Sch. Dist.* (2009) 176 Cal.App.4th 889.
[517] *Citizens for Open Gov't v. City of Lodi* (2012) 205 Cal.App.4th 296, 320.

Respectfully submitted,

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ATTACHMENT A

Comment on the Air Quality and Greenhouse Gas (GHG) Analysis Provided in the Draft Environmental Impact Report (SCH# 2022030180) for the Carbon TerraVault 1 (CTV1) Project in Kern County, California Proposed by California Resources Corporation, December 2023

by

Dr. Ranajit (Ron) Sahu[1]

I provide the following technical comments based on my review of the air quality and GHG analyses provided for the proposed CTV1 project in the DEIR. The lead agency for the EIR is Kern County's Planning and Natural Resources Department (Mr. Keith Alvidrez).

The figure below, taken from the DEIR shows the two dis-jointed parcels (at the surface) where the proposed project will be implemented.

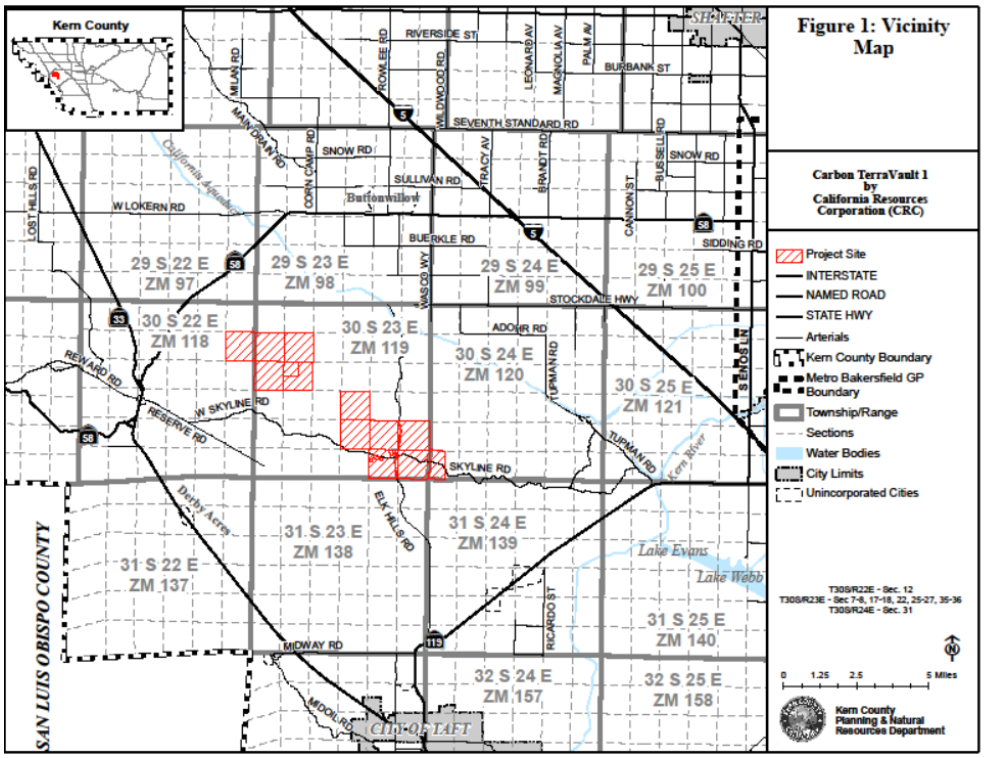

Figure 1: Regional Vicinity Map

[1] Resume provided in Attachment A.

My comments are based on information provided in the body of the DEIR (in Volume 1) and Appendix B (in Volume 2, specifically the report prepared by Trinity Consultants[2]) which contains the supporting information on the air quality and GHG analyses. My comments point out the deficiencies in the analysis, including the lack of support or rationale for critical inputs which should be addressed. Given the lack of publicly available information on the proposed project, I am unable to provide an independent, alternate set of analyses and results.

Comment 0 – Inconsistent Description of the Proposed Project

Page 1-1 (Introduction) and page 3-1 (Project Description) of the DEIR state:

> The Carbon TerraVault I (Kern County) Project (CTV I) proposed by California Resources Corporation (CRC, or project proponent) would request the approval of multiple Conditional Use Permits (CUPs)…for the construction and operation of an approximately 9,130-acre carbon capture and storage (CCS) facility with related capture facilities and pipeline for the initial source and request associated Zone Change Case (ZCC) No. 5, Map 119 and ZCC No. 4, Map 120 from A-1 (Limited Agriculture) to A (Exclusive Agriculture) on approximately 6,160 acres."[3]

Appendix B.1 of the DEIR states that:

> "…[T]he Project will involve a 5,332-acre carbon capture and sequestration field, associated sequestration injection wells and related improvements for storage of Carbon Dioxide (CO_2)."[4]

Yet, later in the same document, it states that:

> "[T]he Carbon TerraVault 1 Carbon Capture and Sequestration Project is consideration of the approval of multiple Conditional Use Permits (CUP) (CUP No. 13, Map no. 118, CUP No. 5, Map 119, CUP No. 3, Map 120) and related changes in zoning designations (ZCC No.5, Map No.118, ZCC No. 5, Map 119, ZCC No. 4, Map 120 for the construction and operation of a 7,385.67 acre carbon capture and storage (CCS) facility, with associated Class VI Underground Injection Control (UIC) wells, 13 miles of facility pipeline for capture from the pre-combustion gas and related infrastructure improvements for the capture, transfer, and storage of CO_2."[5]

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[2] DEIR, Appendix B.1. Air Quality Impact Analysis, May 2023 (revised November 2023), prepared by Trinity Consultants.

[3] DEIR, pages 1-1, 3-1.

[4] DEIR, Appendix B.1, p. 1-1. (emphasis added)

[5] DEIR, Appendix B.1, Section 2.2. (emphasis added)

Please clarify the discrepancies between the three very different acreages noted above.

Comment 1 – Missing Details and Energy/Air Quality Impacts of the Carbon Capture System

The DEIR contains no engineering information about specific design and/or details regarding the operations of the carbon capture (CC) system that is/will be implemented at the Elk Hills power plant or at the existing cryogenic and fractionation natural gas plant (CGP-1) facility (or any other sources of GHG) before those emissions are then managed, ultimately being injected into geologic formations for sequestration.

As an example, while CC systems naturally involve additional equipment such a blowers and ductwork, which incur energy penalties in order to operate, the DEIR does not provide the details supporting the approximately 31 MW per year[6] of energy it estimates that will be needed to operate the CC facilities and associated equipment.

In addition, while the DEIR notes that the energy/power needed to operate the CC facilities would be sourced from the Elk Hills Power Plant, it does not discuss how this additional power generation will change the load factor and other operating characteristics of the power plant. The DEIR, in summary fashion at Appendix B.1, simply states that "…[T]he Elk Hills Power Plant provides about one third of its power to the oilfield for operations and the remainder is distributed to the California power grid via the Pacific Gas and Electric (PG&E) substation in Buttonwillow." It does not discuss how the additional power/energy needed by the proposed CC facilities would be accommodated by the Elk Hills power plant. I note that the DEIR simply assumes that the power plant will continue to operate at an annual (and constant) capacity factor of 93%[7] for every single year of the 30 year duration of the proposed project. The justification for this capacity factor and whether or not it includes the additional energy needed for the CC system is not clear. That should be clarified.

In addition, given that the expected duration of the proposed project is 30+ years, it is presumed that the Elk Hills Power Plant will need to operate for the next three decades to support the project, whether or not the plant would have continued to run for all this additional time into the future without the project. As it stands, the Elk Hills Power Plant is approximately 20 years old already. So, that means the proposed project would require the power plant to operate till it is 50+ years old. Without significant additional investments to extend the life of the power plant, it is likely that the Elk Hills power plant would have shut down but for the proposed project. The DEIR

[6] DEIR, p. 4.6-15.

[7] DEIR, Appendix B, tables on pdf pages 310-311.

should address whether or not the proposed project enables the life extension of the Elk Hills power plant and the impacts of any such extension.

Comment 2 – Cursory and Missing Aspects of GHG Leakage

There is little to no detail on the leakage of GHGs, including but not limited to the various types of potential leakage of CO_2 from different aspects of the entire project.

While the DEIR makes a gross assumption that the GHG capture will be 95%,[8] it is not clear if, therefore, the remaining 5% uncaptured GHG is presumed to be an annual leakage level for the duration of the project. If so, what specifically is included in this 5% leakage is not discussed. That should be clarified.

It appears however, that, at best, this uncaptured GHG might include losses during capture of the power plant's exhaust as well as certain fugitive losses in processing the exhaust waste gases containing GHG to and through the amine system, followed by its conveyance to the injection wells. Importantly, three additional potential loss mechanisms and their GHG losses (and associated leakage) do not appear to have been addressed or quantified:

(i) GHG losses associated with ruptures or failures of the additional new pipelines or pipeline components proposed as part of the project. Given the large geographic extent of CTV1, including the gathering and injection infrastructure and given the assumed three decades of operation, such failures are quite likely;

(ii) GHG losses associated with the maintenance of equipment, including "blowdown" or similarly necessary emissions in order to allow for proper preventive maintenance. Pipeline maintenance typically requires evacuation of pipeline sections in order to safely effect such maintenance. Such evacuation necessitates "blowdown" of the gas contained in the pipeline sections. Unless otherwise gathered or captured – which is not discussed in the DEIR – these events can result in emissions of waste gases, containing GHG and other pollutants to the atmosphere; and

(iii) GHG losses from the geologic formation itself due to the injected GHG/CO_2.[9] While the DEIR generally admits that there could be potentially significant leakage[10], the DEIR does not provide any details including the probabilities of such leakage, the circumstances

[8] Curiously, in Section 4.11 of Appendix B.1, this 95% capture is at the amine units. Why that is the case is not clear. The DEIR should clarify.

[9] DEIR, Appendix B.1, Section 2.2 notes that annually 1.5 million metric tons of CO_2 will be injected, with an overall total project injection of 48 million metric tons. This is roughly a 32 year time period.

[10] For example, DEIR at p. 4.8-26.

under which such leakage may occur, or any quantification of the leakage.

The DEIR does include a few monitoring wells but the logic of their placement (including depths) in the various locations and how just the small number of proposed monitoring wells will provide enough assurance that GHG once injected will not migrated from the intended injected formation, is not provided and is not supported by evidence. This un-sequestered GHG migration may not just be towards the surface (i.e., vertically upwards) but also laterally and even downwards from the formation, eventually manifesting themselves as leakage to the surface. While the timing of this subsurface leakage mechanisms may not occur just during the presumed thirty or so year project period (and its GHG accounting of the benefits of sequestration), that does not mean that leakage after (or long after) the thirty or so year time period should simply be assumed to be zero, with little to no support and little to no verification.

* * * * *

The remainder of my comments address specifics about the air quality and GHG analyses presented in the DEIR. For air quality, I focus mainly on the discussion provided in Chapter 4.3 (specifically Sections 4.3.4 and 4.3.5) and Appendix B (specifically Appendix B.1 – the Trinity Consultants report, from which much of the analysis in the body of the DEIR is drawn from), including certain mitigation measured proposed in the DEIR. For GHG, I have reviewed the analysis presented in Section 4.8 of the DEIR and also in Appendix B. I have also reviewed Appendix F in Volume 2 relating to a site-specific risk assessment.

Comment 3 – Air Quality Emissions Estimates

It is crucial that an air quality analysis fully support the assumptions underlying its emissions estimates, as those assumptions and resulting emissions estimates ultimately affect the DEIR's assessment of project impacts and feasible mitigation.

This is true for all types of air pollutants (i.e., criteria pollutants, air toxics or hazardous air pollutants, and GHG) and from all potential emissions generating sources and activities of the proposed project, including both construction and operational phases.

While it is customary in conducting EIR-type air quality analyses to rely on "standard" models to develop emission estimates as has been done in this DEIR,[11] those models typically only have emission factors (i.e., mass of emissions of pollutant X from a source Y – like piece of fuel-burning

[11] DEIR, Section 4.3.4.

equipment, for example). That such standard models have been used in the present instance is confirmed by the DEIR:

> "[T]he construction and operational emissions were estimated from several emissions models and associated spreadsheet calculations, depending on the source type and data availability. The primary emissions models used included CARB's on-road vehicle emission factor model (EMFAC) version 2021 and the California Emissions Estimator Model (CalEEMod) version 2021.1.13." In addition, the DEIR states that "[T]he capture facilities (new amine unit valve) fugitive emissions have been quantified using the California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities…"[12]

The user of the model or the analyst has to input the corresponding activity factor (i.e., how many and what types of equipment, of what sizes, hours of usage, etc.) in order to run the model and obtain estimates of the mass of emissions (i.e., pounds or tons) from those activities over the desired time period (hours, days, weeks, year, etc.).

An accurate analysis and robust evaluation of impacts is especially important here given that the proposed project will be located in an area that is already non-attainment for several criteria pollutants including: ozone (Federal and State); PM_{10} (State); and $PM_{2.5}$ (Federal and State).[13] I should note also that, for $PM_{2.5}$, the EPA has now proposed to make the primary (i.e., health based) annual National Ambient Air Quality Standard (NAAQS) more stringent from its current level of 12 ug/m^3 to a range between 9 – 10 ug/m^3, reflecting the current science on adverse health impacts of this zero-threshold air pollutant.[14] The adoption of the stricter standard means that the air quality in the area is even more unhealthy than understood previously and even further from attaining the health-based NAAQS than acknowledged in the DEIR.

Comment 3.1 – Emission Factors and Errors

I should note for the record that just because the "standard" models incorporate emission factors for various pollutants and for various types of equipment and activities, that does not mean that those emission factors do, in fact, accurately or conservatively represent the emissions of the respective pollutants from specific equipment and specific activities that are part of the project.

[12] *Id.*

[13] DEIR, Table 4.3-2.

[14] https://www.epa.gov/newsreleases/epa-proposes-strengthen-air-quality-standards-protect-public-harmful-effects-soot

First, there are issues of representativeness of the emission factors, especially as they apply to not just new equipment but also to older equipment and the inevitable deterioration of their emissions (including deterioration of any air pollution controls) over time. This specifically applies to the emission factors that are included as part of the "standard" models used to develop emission estimates as noted prior.

Second, there are always issues of precision and error in emission factors (and activity factors, which I discuss later) and the resultant emissions estimates. The emissions estimates in the DEIR in many instances provide values to many significant digits (i.e., implying greater – and false – precision than warranted), thereby misleading the reader as to the accuracy of the air quality emissions estimated. The DEIR contains no estimates of the errors in any of the calculations. In fact, a proper analysis should provide some guidance of the error (or the range) of the emissions as opposed to misleadingly precise estimates for the reader. The DEIR fails completely on this score. To meaningfully inform the public and decision makers, the DEIR should quantify and disclose uncertainties in the emissions estimates.

Comment 3.2 – "Existing" Air Quality Information is Dated And May Not Be Representative

Section 3.2 of Appendix B.1 summarizes "existing" air quality – i.e., ambient monitoring concentrations of several pollutants. Yet, even though the report in Appendix B.1 was revised in November 2023, this "existing" ambient data is only provided for the years 2019 through 2021. Further, the description misleadingly states that these are "the last three years." Clearly that is not the case since no data is provided for 2022. There is also no mention of why 2022 data could not have been reported. That should be fixed. Notably, quality-assured data from 2022 is readily available.[15]

I also note that this "existing" three-year time period of 2019-2021 was substantially impacted by COVID-19 for the years 2020 and 2021. As such, due to changes in economic activities including transportation patterns, and many other factors, it is not assumable, without further discussion, that this impacted three-year period is representative of "existing" air quality. I suggest that a broader time period, say, 5 or even more years, including 2022, be included to describe existing air quality, with comments, as necessary, on any patterns in the data.

Comment 3.3 – None of the Assumptions Made For Estimating Project-Related Emissions Are Supported by Any Justification and/or Rationale

[15] See, https://www.arb.ca.gov/aqmis2/display.php?param=OZONE&units=007&statistic=DAVG&year=2022&mon=12&day=31&county_name=15-Kern&basin=--AIR+BASIN--&latitude=--PART+OF+STATE--&report=7DAY&order=basin%2Ccounty_name%2Cs.name&submit=Retrieve+Data&ptype=aqd&std15=

I will provide examples of these unsupported assumptions in this comment. I also note, that in each instance, there is no verification of any of these assumptions proposed in the DEIR either.

(i) for short-term construction emissions, it is assumed that the construction schedule will be 11 days per well pad, 18 days per well, 2 years for the capture facilities, and 1 year for the pipelines (later noted as 220 days). None of these timelines are supported.

Specifically, Table 4-12 in Appendix B.1 shows the details of the wells to be constructed/repurposed as part of the project. It is excerpted below for easy reference.

Table 4-12. Total Emissions on a Per Well Basis

Well Name	Description	Depth (ft)	Emissions (Tons)
26R Reservoir			
363C-27R	Injector	6290	4.55
353XC-35R (new)	Injector	6390	4.55
373-35R (new)	Injector	7010	5.36
345C-35R (new)	Injector	5690	3.98
341-27R	Plume monitoring	6981	4.55
328-25R	Plume monitoring	5268	3.98
376-36R	Plume monitoring	5832	3.98
355X-26R	Above-zone monitoring	4063	2.35
USDW Monitoring (new)	USDW monitoring	400	1.28
A1/A2 Reservoir			
355-7R	Injector	8387	6.17
357-7R	Injector	8420	6.17
353A-7R	Plume monitoring	8773	6.17
335X-7R	Plume monitoring	8737	6.17
327-7R-RD1	Above-Zone monitoring	3782	2.03
345-7R	A3+ Monitoring	8904	6.17
388X-7R	A3+ Monitoring	8800	6.17
342-17R	A3+ Monitoring	8844	6.17
USDW Monitoring (new)	USDW monitoring	740	1.28
Total			**81.08**

I note that the well depths, excluding the groundwater monitoring wells, in Table 4.12 range from as low as 3782 ft to as high as 8904 feet. Given this wide range of well depths and many other depths noted in Table 4-12, it makes no sense to presume that there will be 18 days required to construct each well. If the intent is to presume that 18 days is the "average" for all wells/various depths noted above, that should be justified. Clearly, the wells in the A1/A2 reservoir will be drilled to deeper depths as compared to the wells in the 26R reservoir. Since they are not expected to be drilled all at once, the construction schedule for the wells should be provided in greater detail, along with supported construction durations.

In addition, it is not clear how the well depths in Table 4-12 were so precisely estimated, right down to the last foot (for example, 6981 feet, 4063 feet, etc.). Please provide the rationale since the depths will affect construction timelines.

(ii) Section 4.2.1 of Appendix B.1 contains a number of mobile source activity assumptions. These include: a 40-mile trip distance; 160 average daily trips (ADTs) for workers during construction; 32 ADTs by 1-ton trucks and 20 ADTs using 5-ton trucks, in addition to 8 water trucks; 16 ADTs by workers and 2 ADTs by vendors during well pad construction; and 12 ADTs by workers and 10 ADTs by vendors during well construction. There is no justification provided for any of these assumptions. Thus, the emission estimation approach is nothing more than an algebraic exercise. As a simple example, it is not clear why there should be a 40-mile trip distance for both workers and vendors. Also, since there is no description of the work that will be done during construction of the well pad and the well, there is no context for understanding if the assumed numbers of workers/vendors, as well as equipment proposed, makes any sense.

These types of assumptions should be supported by actual data that is undoubtedly available to the project proponent since these are not the first well pads nor first wells that are going to be drilled in this area.

(iii) Similarly, there are numerous assumptions about the types, numbers, and operating hours of various construction equipment that will be used in developing the construction emissions. These are inputs to the emissions calculations in the standard models used to develop those estimated. I have excerpted Tables 4-3 through 4-6 from Appendix B.1 below that contain these assumptions.

Table 4-3. Facilities Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Hydro Crane	Cranes	5	1968.75	3.8
ForkLift	Forklifts	7	1968.75	3.8
Excavator	Excavators	1	1968.75	3.8
Backhoe	Tractors/Loaders/Backhoes	4	1968.75	3.8
Air Compressor	Air Compressors	20	246.09	0.5
Crane	Cranes	3	246.09	0.5
Loader	Rubber Tired Loader	3	246.09	0.5
Dozer	Rubber Tired Dozers	1	1968.75	3.8
Dump Truck	Off-Highway Trucks	2	1968.75	3.8
Welding Truck	Welders	8	1968.75	3.8

Table 4-4. Pipeline Construction Equipment

Equipment	CalEEMod Equipment Designation	Quantity	Average Daily Operating Hours
Crane	Cranes	3	5.0
Boom Truck	Other Construction Equipment	3	5.0
Crane	Cranes	3	2.5
Side Boom	Other Construction Equipment	6	5.0
Bending Machine	Other Material Handling Equipment	1	2.5
Air Compressor	Air Compressors	4	5.0
Air Compressor	Air Compressors	1	2.5
Welding Machines	Welders	8	5.0
DitchWitch	Off-Highway Trucks	1	2.5
Vacuum Truck	Other Construction Equipment	2	2.5

Table 4-5. Well Pad Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Grader	Graders	1	16	1.5
Front Loader	Tractors/Loaders/Backhoes	1	40	3.6
Excavator	Excavators	1	32	2.9
Water Truck	Other Construction Equipment	1	40	3.6

Table 4-6. Well Drilling Construction Equipment (Per Well)

Equipment	CalEEMod Equipment Designation	Quantity	Total Operating Hours per	Average Daily Operating Hours
Forklift	Forklifts	1	72.0	4.0
Drilling Rig Motor	Bore/Drill Rigs	1	275.4	15.3
Drilling Rig Motor	Bore/Drill Rigs	1	322.2	17.9
Drilling Rig Motor	Bore/Drill Rigs	1	216.0	12.0
Small Generator	Generator Sets	1	8.0	0.4
Light Tower	Generator Sets	2	216.0	12.0
Water Truck	Other Construction Equipment	1	144.0	8.0
Vacuum Truck	Other Construction Equipment	1	432.0	24.0

The DEIR/Appendix B.1 should provide justifications for the equipment type, the numbers of each equipment, and the expected operating hours in each instance. It is also clear that the operating hours are provided with a high degree of precision, with no rationale. For example, 3.8 hours of operation per day for several types of equipment (along with the equally precise annual operating hours (246.09, 1968.75), in Table 4-3. What is the basis of such precision? Similar comments also apply to the other tables above.

(iv) Long-term, i.e., operational emissions are discussed in Section 4.2.2 of the Appendix B.1 for fugitive (dust) emissions (Section 4.2.2.1) and mobile sources (Section 4.2.2.2). However, fugitive dust emissions are simply not quantified. Instead it is noted that these are "…not expected to present a substantial source of fugitive dust (PM_{10}) emissions…" What is the basis for this conclusionary assertion, with no supporting data or calculations?

In addition, the DEIR presumes that the main source of PM_{10} emissions would be from vehicular traffic associated with the project.[16] While this is true, PM_{10} also results from soil disturbance associated with land grading, including stockpiling of soils and also from the storage of other erodible construction materials.

Further, the DEIR does not address fugitive $PM_{2.5}$, for which the area is non-attainment at present and likely to be even more so when the NAAQS for $PM_{2.5}$ is revised downward per EPA's current proposed, as noted prior.

(v) As for mobile source exhaust emissions during operations, like in the case of construction, the DEIR/Appendix B.1 makes numerous unsupported assumptions, with the exception of a reference to a traffic study estimating 20 ADTs from workers. However, other assumptions such as: the 40-mile trip distance; the assumption for 10 additional workers; the complete lack of any vendor-related trips or emissions are not justified or

[16] DEIR, p. 4.3-65.

supported at all. The DEIR should provide that support or revise as needed. The DEIR should provide the justification for why no vendor support would be needed as operational support for the various injection and monitoring wells.

(vi) In addition to the fugitive and mobile source emissions during operations, the only stationary source emissions included in the analysis are from fugitives from component leaks from the two new amine units that will be installed are estimated (in Table 4-11 of Appendix B.1) using the previously mentioned Implelentation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities. However, the applicability of these estimates for "petroleum facilities" to the amine units is not clear. Please provide the justification. Also, please clarify what fractions of the components of each type are expected to be "leakers" at different levels of assumed leakage, i.e., 50 ppm, 100 ppm, 250 ppm, 500 ppm, 1000 ppm, 10,000 ppm, etc. And, how these leakers have been included (or not) in the current calculations.

(vii) Previously, I have excerpted Table 4-12 showing the depths of the 18 new wells that will be drilled, for the various purposes shown in that table. In connection with the drilling schedule, I have also provided a comment about the precisions of the well depths noted in Table 4-12. In addition, I have additional comments/questions:

- First, I note that the DEIR provided no justification provided for the well depths for just/only the two above-zone monitoring wells (i.e., one for each reservoir) noted in that table.
- Second, the DEIR provides no justification (geologic or otherwise) for the depths of these two monitoring wells, that are approximately 2000 feet or higher than the reservoirs themselves.
- Third, the DEIR does not state how such a single monitoring well will be placed exactly where some leakage might manifest itself, given the vast area/acreages in each reservoir.
- Finally, the DEIR does not discuss or address potential leakages that may occur from the formation in directions other than vertically, such as initially laterally or even downward from the formations, later finding their way to the surface. The DEIR does not address how these potential leakage paths will be monitored.

In sum, it appears that, at least as far as the monitoring of the injection/sequestration at each reservoir is concerned, there are too few wells. Of course including additional wells, at justified and proper depths, will increase construction (and operational) emissions that have not been properly included in the DEIR.

Comment 4 – Mitigation Measures

As an overall comment, none of the mitigation measures for air quality and GHG have verification or monitoring requirements that would provide even reasonable confidence that: (i) the proposed measures are, in fact, being implemented as promised in the DEIR; and (ii) that even if they are being implemented, their effectiveness is similar to that claimed. This includes, for example, monitoring to quantify GHG leakages via the various pathways and sources previously discussed as well as monitoring to address emissions of criteria and air toxic air pollutants from the facilities that are part of the proposed project.

Comment 4.1 – Emission Reduction Agreements and Their Limitations As Proposed Mitigation

The DEIR states repeatedly that, as mitigation, the proposed project will avail itself of a Development Mitigation Contract (DMC) or Voluntary Emission Reduction Agreement (VERA) to address the project's criteria pollutant emissions of NO_x, reactive organic compounds (ROGs) and particulate matter (PM). The goal is to "fully mitigate the project's air quality impacts such that development of the project could be considered to result in no net increase in the designated criteria pollutant emissions over the criteria pollutant emissions that would otherwise exist without the development of the project, all to be verified by the SJVAPCD." In addition, Section 4.10 of Appendix B.1 also makes a similar claim, justifying the lack of any air quality impact (or modeling).

First, this entire construct does not work if the emissions from the project are not properly estimated and/or verifiably and accurately measured. Without such accurate measurements, the amount of mitigation, to achieve "no net increase" using the DMC or similar mechanism is meaningless. Yet, there is nothing in the DEIR that provides any assurance of actual measurements of even these criteria pollutants from each of the project's activities.

Second, as noted in the DEIR, the DMC does not extend to other pollutants, including additional criteria pollutants such as carbon monoxide (CO) or sulfur dioxide (SO_2).

The DMC also does not extend to any of the air toxic compounds that will be emitted as a result of combustion sources and the amine system used for CO_2 concentration. This is true for such air toxics emissions during construction and operations.

Since none of the mitigations identified contain any verifiable measures of their effectiveness and the emissions estimates are simply not verifiable since no monitoring is required, there is a significant uncertainty as to the actual emissions and their impacts (mitigated or otherwise) of air toxic compounds.

Comment 4.2 – Lack of Verification and Effectiveness of PM_{10} Reduction Measures

These are listed in Mitigation Measure 4.3-2. I will not repeat all/both of them for the sake of brevity. But every single item on these lists is simply a promise, with no recordkeeping or

verification. At a minimum, such record-keeping and verification should be included in as part of an enforceable mitigation monitoring plan for PM_{10} (and $PM_{2.5}$) reduction.

Comment 4.3 – The 4,000-foot Setback in MM 4.3-5 Should Be Expanded, as Needed

A reasonable setback distance from any injection well to sensitive receptors is necessary. The DEIR proposes that the setback be 4,000 feet but provides no explanation for this distance.

However, while MM 4.3-5 addresses the setback from injection wells, it is not clear why similar setback distances are not also proposed for other physical infrastructure like pipelines, from which ruptures can cause CO_2 to also escape and could result in adverse impacts to humans and wildlife. For example, if any pipeline passes through a topographically low area, any CO_2 that might escape can accumulate locally and cause adverse impacts. For these reasons, setbacks should be provided from all physical infrastructure associated with the proposed project, based on a site-specific factors such as the locations of such infrastructure and nearby receptors in order to meet CEQA's requirement to provide all feasible mitigation for significant impacts.

Comment 4.4 – MM 4.3-7 and Additional Details of Fence Line Monitoring

While I agree with the goal of MM 4.3-7 that an Air Monitoring program for fence line monitoring of all air constituents generated by the CCS project – including but not limited to criteria pollutants, CO_2, and H_2S – should be developed and implemented, MM 4.3-7 provides no details of how such fence line monitoring will occur. Even basic details of whether this will consist of periodic sampling at specific locations along the fence line (of, say, a well pad; or near the amine units, etc.) or continuous open-path measurements along the entire perimeter of such locations, is not provided in the DEIR. Without this, and additional detail, the efficacy of MM 4.3-7 is not clear. The DEIR should provide additional details, like, for example: (i) specific monitoring parameters (e.g., spacing of monitors, equipment sensitivity, frequency of monitoring) and/or performance standards to be used to select monitoring parameters; (ii) requirements for reporting monitoring results to the County and responsible agencies and for public disclosure of monitoring data and/or performance standards to be used to develop reporting and public disclosure requirements; (iii) any threshold levels (by pollutant) that, if detected at the fence line, will trigger mitigation and/or performance standards to be used to select appropriate thresholds for mitigation; and (iv) mitigation measures to be implemented if monitoring thresholds are exceeded and/or performance standards to be used to select effective mitigation measures.

Attachment A
to Technical Comments of Dr. Ranajit (Ron) Sahu:
Qualifications and Experience

RANAJIT (RON) SAHU, PH.D, CEM (NEVADA)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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EXPERIENCE SUMMARY

Dr. Sahu has over thirty two years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over thirty years of project management experience and has successfully managed and executed hundreds of projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past three decades include various trade associations as well as individual companies such as steel mills, petroleum refineries, chemical plants, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, land development companies, and various entities in the public sector including EPA, the US Dept. of Justice, several states (including New York, New Jersey, Connecticut, Kansas, Oregon, New Mexico, Pennsylvania, and others), various agencies such as the California DTSC, and various cities and municipalities. Dr. Sahu has executed projects in all 50 US states, numerous local jurisdictions and internationally.

In addition to consulting, for approximately two decades, Dr. Sahu taught numerous courses in several Southern California universities as adjunct faculty, including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management). He also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental and engineering areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.), public sector (such as the US Department of Justice), and public interest group clients with project management, environmental

consulting, project management, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena, CA.

Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

“Thermodynamics and Heat Transfer,” Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-mid-1990s.

Air and Waste Management Association, West Coast Section, 1989-mid-2000s.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, 2000 - 2021.

CEM, State of Nevada (#EM-1699).

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

“From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada,” with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled "Hitting the Ethanol Blend Wall – Examining the Science on E15."

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.,* C2-99-1181 (Southern District of Ohio).

4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).

6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).

7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc*., 5:04-cv-00034-KSF (Eastern District of Kentucky).

9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc*., 1:06 CVA 0143 (Southern District of Ohio, Western Division) .

19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings))/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).

22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).

23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us

24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.

25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas.

26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*

27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina).

28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions*, No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.

35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).

36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).

38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).

41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant*

Generation Company LLC, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).

44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority*, Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).

48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.*, Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).

51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.*, Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).

52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et. al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).

53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association*, Case No. 11-417-MJP (Western District of Washington).

54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency*, Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).

56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).

57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality,* Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).

58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.*, Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).

59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.

60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.

61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.

63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.

65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.

67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v Environmental Protection Agency et al. (Resppondents),* Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).

69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.

71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.

72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.

73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.

75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et. al*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).

76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.,* Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).

78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).

79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).

80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).

81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).

82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*

85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.

86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et. al., (Petitioners) v. EPA et. al., Utility Air Regulatory Group (Petitioners) v. EPA et. al., National Mining Association et. al., (Petitioner) v. EPA et. al.,* (Supreme Court of the United States).

87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.

89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).

90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of "Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation's Emergency Motion;" Declaration (September 2015, Docket No. 1574820) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;" Declaration (October 2015) in support of "Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners' Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).

92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.

93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.

95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.*, ERAC Case No. 14-256814.

96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.

97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.

100. Declaration (December 2016) relating to EPA's refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180.* (D.C. Circuit Court of Appeals).

101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).

107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant), Case No. 4:16-CV-1544-BYP*, (US District Court for the Northern District of Ohio, Eastern Division).

108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant),* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.

111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.

113. Expert Report (Harm Phase) (January 2018), Rebuttal Expert Report (Harm Phase) (May 2018) and Supplemental Expert Report (Harm Phase) (April 2019) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).

115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

117. Direct Pre-filed Testimony and Affidavit (December 2018) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

118. Expert Report (February 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

119. Declaration (March 2019) on behalf of Earthjustice in the matter of comments on the renewal of the Title V Federal Operating Permit for Valero Houston refinery.

120. Expert Report (March 2019) on behalf of Plaintiffs for Class Certification in the matter of *Resendez et al v Precision Castparts Corporation* in the Circuit Court for the State of Oregon, County of Multnomah, Case No. 16cv16164.

121. Expert Report (June 2019), Affidavit (July 2019) and Rebuttal Expert Report (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

122. Affidavit/Expert Report (August 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

123. Expert Report (October 2019) relating to the appeal of air permit (Plan Approval) on behalf of Appellants in the matter of *Clean Air Council and Environmental Integrity Project (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection and Sunoco Partners Marketing and Terminals L.P.*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-057-L.

124. Expert Report (December 2019), Affidavit (March 2020), Supplemental Expert Report (July 2020), and Declaration (February 2021) on behalf of Earthjustice in the matter of *Objection to the*

Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

125. Affidavit (December 2019) on behalf of Plaintiff-Intervenor (Surfrider Foundation) in the matter of *United States and the State of Indiana (Plaintiffs), Surfrider Foundation (Plaintiff-Intervenor), and City of Chicago (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant),* Civil Action No. 2:18-cv-00127 (US District Court for the Northern District of Indiana, Hammond Division).

126. Declarations (January 2020, February 2020, May 2020, July 2020, and August 2020) and Pre-filed Testimony (April 2021) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE),* before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

127. Expert Report (April 2020) on behalf of the plaintiff in the matter of Orion Engineered Carbons, GmbH (Plaintiff) vs. Evonik Operations, GmbH (formerly Evonik Degussa GmbH) (Respondent), before the German Arbitration Institute, Case No. DIS-SV-2019-00216.

128. Expert Independent Evaluation Report (June 2020) for *PacifiCorp's Decommissioning Costs Study Reports dated January 15, 2020 and March 13, 2020 relating to the closures of the Hunter, Huntington, Dave Johnston, Jim Bridger, Naughton, Wyodak, Hayden, and Colstrip (Units 3&4) plants*, prepared for the Oregon Public Utility Commission (Oregon PUC).

129. Direct Pre-filed Testimony (July 2020) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

130. Expert Report (August 2020) and Rebuttal Expert Report (September 2020) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

131. Expert Report (July 2020) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

132. Expert Report (August 2020) and Supplemental Expert Report (February 2021) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

133. Expert Report (August 2020) and Supplemental Expert Report (December 2020) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

134. Pre-filed Direct Testimony (October 2020) and Sur-rebuttal Testimony (November 2020) on behalf of petitioners (Ten Persons Group, including citizens, the Town of Braintree, the Town of Hingham, and the City of Quincy) in the matter of Algonquin Gas Transmission LLC, Weymouth MA, No. X266786 Air Quality Plan Approval, before the Commonwealth of Massachusetts, Department of Environmental Protection, the Office of Appeals and Dispute Resolution, OADR Docket Nos. 2019-008, 2019-009, 2019010, 2019-011, 2019-012 and 2019-013.

135. Expert Report (November 2020) on behalf of Protect PT in the matter of *Protect PT v. Commonwealth of Pennsylvania Department of Environmental Protection and Apex Energy (PA) LLC*, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2018-080-R (consolidated with 2019-101-R)(the "Drakulic Appeal").

136. Expert Report (December 2020) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

137. Pre-filed Testimony (January 2021) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

138. Expert Reports (March 2021 and May 2021) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, Central Planning Board, City of Newark, New Jersey.

139. Expert Report (April 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana, New Orleans Division).

140. Affidavit (April 2021) for *Clayton Faerber et.al., (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 20-CV-00328 01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

141. Expert Report (April 2021, June 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

142. Expert Report (April 2021) and Sur-Rebuttal Report (June 2021) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

143. Expert Report (May 2021) for *Clifford Osmer (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)* related to No. 18-CV-12557 (US District Court for the Eastern District of Louisiana).

144. Expert Report (May 2021) and Rebuttal Expert Report (January 2022) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

145. Expert Report (June 2021) and Declarations (May 2021 and June 2021) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division.)

146. Expert Witness Disclosure (June 2021) on behalf of the Plaintiffs in the matter of *Jay Burdick, et. al., (Plaintiffs) v. Tanoga Inc. (d/b/a Taconic) (Defendant)*, Index No. 253835, (State of New York Supreme Court, County of Rensselaer).

147. Expert Report (June 2021) on behalf of Appellants in the matter of *PennEnvironment and Earthworks (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection (Appellee) and MarkWest Liberty Midstream and resource, LLC (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2020-002-R.

148. Expert Report (June 2021) for *Antonia Saavedra-Vargas (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:18-CV-11461 (US District Court for the Eastern District of Louisiana, New Orleans Division).

149. Affidavit (June 2021) for Lourdes Rubi in the matter of *Lourdes Rubi (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)*, related to 12-968 BELO in MDL No. 2179 (US District Court for the Eastern District of Louisiana, New Orleans Division).

150. Expert Report (June 2021) for *Wallace Smith (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:19-CV-12880 (US District Court for the Eastern District of Louisiana, New Orleans Division).

151. Declaration (July 2021) on behalf of Plaintiffs in the matter of *Stephanie Mackey and Nick Migliore, on behalf* of *themselves and all others similarly situated (Plaintiffs) v. Chemtool Inc. and Lubrizol Corporation (Defendants)*, Case No. 2021-L-0000165, State of Illinois, Circuit Court of the 17th Judicial Circuit, Winnebago County.

152. Declaration (July 2021, August 2021) on behalf of Petitioners in the matter of the Petition for a Hearing on the Merits Regarding Air Quality Permit No. 3340-RMD issued to New Mexico Terminal Services, LLC by *Mountain View Neighborhood Association et. al., (Petitioners) v. City of Albuquerque Environmental Health Department*, AQCB Petition No. 2020-1 before the Albuquerque-Bernalillo County Air Quality Control Board.

153. Expert Disclosure (September 2021) and Affidavit (May 2023) on behalf of the Plaintiffs in the matter of *State of New York, Town of Hempstead, Town of Brookhaven, Incorporated Village of Garden City and Long Island Power Authority et. al., (Plaintiffs) v. Covanta Hempstead Company et. al., (Defendants)*, Index No. 7549/2013 before the Supreme Court of the State of New York, County of Nassau.

154. Expert Report (October 2021) for *John A. Battiste (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:21-CV-00118 (US District Court for the Southern District of Alabama, Mobile Division)

155. Declaration/Expert Report (October 2021) for *Charles K. Grasley et. al., (Plaintiffs) v. Chemtool Incorporated (Defendant)*, Case No. 2021-L-0000162 (State of Illinois, In the Circuit Court of the 17th Judicial Circuit, Winnebago County).

156. Declaration (October 2021) and Expert Report (November 2021) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

157. Expert Report (November 2021) and Declaration (September 2022) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

158. Declaration (November 2021) for the *United States of America and the State of Kansas, Department of Health and Environment (Plaintiffs) v. Coffeyville Resources Refining & Marketing, LLC (Defendant)*, Civ. No. 6:04-cv-01064-JAR-KGG (US District Court for the District of Kansas).

159. Expert Report/Affidavit (December 2021) on behalf of the City of Detroit in the matter of Marathon Petroleum Company (Claimant) v. City of Detroit Building Safety Engineering and Environmental Department, BSEED Case No. MCR 2018-2525, DAH Appeal No. 21-SWA-01, before the State of Michigan, City of Detroit Department of Appeals and Hearings.

160. Expert Report (December 2021) for *John Pabst (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 21-CV-00290 (US District Court for the Eastern District of Louisiana).

161. Expert Report (December 2021) for *Audrey Annette Tillery-Perdue individually and as person representative of the estate of Eddie Lewis Perdue (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendant)*, Civil Action No. 5:19-cv-00052-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

162. Expert Report (February 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant),* Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

163. Expert Report (February 2022) and Rebuttal Expert Report (June 2022, in preparation) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

164. Expert Report (February 2022) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant),* No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

165. Expert Report (March 2022), Affidavit (June 2022), Supplemental Expert Report (April 2023) in the matter of *Clean Air Council et. al., (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection (Appellee) and Renovo Energy Center (Permittee)* EHB Docket No. 2021-055-R before the Commonwealth of Pennsylvania Environmental Hearing Board.

166. Declaration (March 2022) in the matter of Max Midstream Texas LLC Air Quality Permit No. 162941 for the Seahawk Crude Condensate Terminal in Calhoun County Texas, TCEQ Docket No. 2022-0157-AIR, before the Texas Commission on Environmental Quality.

167. Expert Pre-filed Testimony (April 2022) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

168. Expert Report (April 2022) and Rebuttal Report (August 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

169. Rule 26 Disclosure (May 2022) in the matter of the *Water Works and Sewer Board of the City of Gadsden (*Plaintiff*) v. 3M Company, et. al., (Defendants),* Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

170. Expert Report (June 2022) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant),* Case No. 2018-L-011939 (Circuit Court of Cook County, Illinois.)

171. Expert Report (June 2022), Rebuttal Reports (August 2022, September 2022) for Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

172. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the 2019 South Africa Integrated Resource Plan in *African Climate Alliance et. al. v. The Minister of Mineral Resources and Energy et. al.,* in the High Court of South Africa, Gauteng Division, Pretoria.

173. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the Limpopo Mine (Lephalale Coal Mines Ltd.) in *Earthlife Africa v. The Minister of Forestry, Fisheries and Environment et. al.,* in the High Court of South Africa, Gauteng Division, Pretoria, Case No. 9149/2022.

174. Pre-filed Testimony (July 2022) and Rebuttal Testimony (September 2020) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

175. Expert Report (September 2022) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain Watershed Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor*, Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

176. Expert Affidavit (October 2022) for *Concerned Citizens of Cook County GA (Petitioner) v. Georgia Department of Natural Resources (Respondent) and Spectrum Energy Georgia, LLC (Respondent Intervenor)* before the Office of State Administrative Hearings, State of Georgia, Docket No: 2303405-OSAH-BNR-AQ-37-Barnes.

177. Expert Rebuttal Report (January 2023), Supplemental Rebuttal Expert Report (March 2023, May 2023, November 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

178. Expert Report (January 2023) and Rebuttal Expert Report (April 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant)*, Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

179. Affidavit (January 2023) for *Richard Dufour (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-cv-00591-HSO-BWR (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Southern District of Mississippi).

180. Expert Report (January 2023) and Supplemental Expert Report (July 2023) on behalf of Plaintiffs in the matter of *Stephanie* Mackey *et. al., (Plaintiffs) v. Chemtool Inc. et. al., (Defendants) and Holian Insulation Company Inc. (Third-party Defendant)*, Case No.: 3:21-cv-50283, U.S. District Court, Northern District of Ilinois, Western Division.

181. Expert Report (February 2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

182. Expert Report (February 2023) for *Carol Davis (Plaintiff) v. Lockheed Martin Corporation (*Defendant*)*, Case No. 6:22-cv-81-RBD-EJK, U.S. District Court, Middle District of Florida, Orlando Division.

183. Expert Report (February 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

184. Affidavit (March 2023) on behalf of plaintiffs in the matter of the *State of New Mexico, ex rel. Raul Torrez, Attorney General (Plaintiffs) v. Sterigenics US LLC, Sotera Health Holdings, LLC, Sotera Health LLC and Sotera Health Company (Defendants)*, Case No.: D-307-CV-2020-02629, State of New Mexico, Third Judicial District Court, County of Dona Ana

185. Pre-filed Direct Testimony (March 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

186. Declaration (April 2023) in the matter of Sierra Club (Plaintiff) v. Tennessee Valley Authority in the matter of the Johnsonville Aeroderivative Combustion Turbines Project, Case No.: 3:22-cv-1054, U.S>, District Court, Middle District of Tennessee, Nashville Division.

187. Expert Report (May 2023/June 2023), Affidavit (April 2023) and Declaration (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

188. Affidavit (May 2023) for *Lawrence Tucei (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00078-HSO-BWR (US District Court for the Southern District of Mississippi).

189. Expert Report (May 2023/June 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

190. Expert Report (June 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

191. Declaration (June 2023) in support of public commenters relating to the Michigan Department of Environment Great Lakes and Energy (EGLE)'s Annual Network Monitoring Plan 2024.

192. Expert Report (July 2023) and Rebuttal Expert Report (September 2023) relating to Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

193. Pre-filed Direct Testimony (July 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

194. Declaration (August 2023) in support of comments by Environmental Defense Fund in connection with the "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards, published at 88 Fed. Reg. 36,654 (June 5, 2023) ("Final Rule"), Docket ID No. EPA-HQ-OAR-2021-0668.

195. Expert Report (August 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

196. Pre-filed Testimony (September 2023) and Cross Answering Testimony (October 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

197. Expert Report (December 2023) on behalf of plaintiffs in the matter of *PennEnvironment and Sierra Club (Plaintiffs) v. PPG Industries, Inc. (Defendant).* Case No.: Civil Action Nos. 2:12-cv-00342, 2:12-cv-00527, 2:13-cv-01395, 1:13-cv-01396, 2:14cv-00229 (consolidated). U.S. District Court Western District of Pennsylvania.

C. Occasions where Dr. Sahu has provided oral testimony <u>in depositions, at trial or in similar proceedings</u> include the following:

198. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.

199. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

200. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).

201. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).

202. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).

203. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.

204. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.

205. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.

206. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.

207. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.

208. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

209. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al*.

210. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

211. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

212. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

213. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

214. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

215. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

216. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

217. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

218. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.,* 2:05cv0885 (Western District of Pennsylvania).

219. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

220. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions,* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

221. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

222. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

223. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

224. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

225. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

226. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

227. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).

228. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.

229. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

230. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).

231. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

232. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.

233. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

234. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation*

Company LLC, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).

235. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

236. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).

237. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).

238. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).

239. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and Pacificorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).

240. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).

241. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).

242. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.

243. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

244. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

245. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).

246. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.

247. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.

248. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).

249. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

250. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

251. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

252. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.

253. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).

254. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

255. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).

256. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.

257. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).

258. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington.

259. Deposition (June 2018) (harm Phase) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).

260. Trial Testimony (July 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.

261. Deposition (January 2019) and Trial Testimony (January 2019) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

262. Deposition (February 2019) and Trial Testimony (March 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric

Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.

263. Deposition (June 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.

264. Deposition (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.

265. Deposition (December 2019) on behalf of the Plaintiffs in the matter of David Kovac, individually and on behalf of wrongful death class of Irene Kovac v. BP Corporation North America Inc., Circuit Court of Jackson County, Missouri (Independence), Case No. 1816-CV12417.

266. Deposition (February 2020, virtual) and testimony at Hearing (August 2020, virtual) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.

267. Hearing (July 14-15, 2020, virtual) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.

268. Hearing (September 2020, virtual) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware* Operating – *NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A)*, before the State of New Mexico, Environmental Improvement Board.

269. Deposition (December 2020, March 4-5, 2021, all virtual) and Hearing (April 2021, virtual) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE)*, before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.

270. Hearing (September 2020, virtual) on the *Initial Economic Impact Analysis (EIA) for A Proposal To* Regulate *NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

271. Deposition (December 2020, virtual and Hearing February 2021, virtual) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.

272. Deposition (January 2021, virtual) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)

273. Deposition (February 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (*Defendants*)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)

274. Deposition (April 2021, virtual) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the* Conservation *Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)

275. Deposition (June 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division).

276. Deposition (June 2021, virtual) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

277. Testimony (June 2021, virtual) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, (Central Planning Board, City of Newark, New Jersey).

278. Testimony at Hearing (October 2021) on behalf of Evraz Rocky Mountain Steel in the matter of Colorado's Proposed Revisions to Regulation 22, the Greenhouse Gas Emissions and Energy Management for the Manufacturing Sector in Colorado (GEMM Rule), before the Colorado Air Quality Control Commission.

279. Deposition (November 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana).

280. Testimony at Hearing (November 2021) on behalf of *National Parks Conservation Association, et. al*., in the matter of the Proposed Revisions to Colorado's Regional Haze State Implementation Plan (SIP) and Colorado Regulation 23, before the Colorado Air Quality Control Commission.

281. Deposition (December 2021) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).

282. Deposition (December 2021) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).

283. Testimony at Hearing (February 2022, virtual) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant)*, No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.

284. Deposition (March 2022) and Rebuttal Deposition (July 2022) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois.)

285. Deposition (April 2022, virtual) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.

286. Deposition (May 2022, virtual) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (*Defendants*)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)

287. Deposition (June 2022 and September 2022, both virtual) for *Teresa* Fornek *(Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

288. Deposition (June 2022, virtual) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.

289. Deposition (July 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).

290. Trial (August 2022) on behalf of the Plaintiffs in the matter of Modern *Holdings, LLC, et al. (Plaintiffs) v. Phillips (Defendants),* Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

291. Trial (August 2022, in person) for *Susan Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

292. Deposition (September 2022, virtual) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)

293. Deposition (September 2022) on behalf of Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant),* Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)

294. Deposition (September 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

295. Hearing (October 2022) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).

296. Trial (October 2022, in person) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

297. Depositions (March 2023, June 2023) for *Ann Jordan et. al., and Blake Darnell (Plaintiffs) v. Terumo BCT et. al., (Defendants)* before District Court, Jefferson County, Colorado Case Numbers: 2020CV031457, 2021CV030474 (consolidated with 2020CV031457) and 2020CV03148.

298. Depositions (March 2023, April 2023, May 2023) for Quinn Buczek (Plaintiff) v. Sterigenics US, LLC, Sotera Health, LLC, Prologis First US Properties, LP, et. al., (Defendants) before State Court of Gwinnett County, State of Georgia, Case No. Civil Action File No. 20-C-05918-S1.

299. Deposition (May 2023) for *Potomac Riverkeeper and Sierra Club (Plaintiffs) v. Virginia Electric and Power Company (Defendant),* Civil Action No. 2:21-CV-23 (Kleeh) (US District Court for the Northern District of West Virginia, Elkins Division).

300. Deposition (May 2023) for Mark Letart (Plaintiff), et al. v. Union Carbide Corporation, et al. (Defendants), Case No. 2:19-cv-877, U.S. District Court, Southern District of West Virginia, Charleston Division.

301. Testimony at Hearing on behalf of Evraz North America In the Matter of Colorado Air Quality Regulation Proposed Revisions to Regulation Number 3 to establish enhanced Modeling, monitoring and permitting requirements for Stationary sources in disproportionately impacted communities 5 CCR 1001-5, before the Air Quality Control Commission, State of Colorado.

302. Deposition (2023) for *Vervicia Henderson, et al. (Plaintiff) v. Lockheed Martin Corporation (Defendant)*, Case No. 6:21-cv-01363, U.S. District Court, Middle District of Florida, Orlando Division.

303. Testimony at Hearing (July 2023) *Clean Air Council, Citizens for Pennsylvania's Future, Mountain* Watershed *Association (Appellants) v. Allegheny County Health Department (Appellee) and Allegheny Energy Center (*Intervenor, *Permittee),* Case No. 21-043 before the Hearing Officer of the Allegheny County Health Department.

304. Deposition (July 2023) for *Ezequiel Caraballo-Pache (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 8:20-cv-00263-SCB-JSS (US District Court for the Middle District of Florida, Tampa Division).

305. Deposition (August 2023) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).

306. Deposition (August 2023) on behalf of petitioners in *Doreen Carey et; al., (Petitioners) v. Fulcrum Centerpoint LLC. (Permittee/Respondent) and Indiana Department of Environmental Management (Respondent)*, Permit Number 089-44042-00660, before the Indiana Office of Environmental Adjudication.

307. Deposition (August 2023) on behalf of the Plaintiff in the *Water Works and Sewer Board of the Town of Centre, Alabama v. 3M Company, et. al.*, Civil Action No.: CV-2017-900049. Circuit Court of Cherokee County, State of Georgia.

308. Deposition (August 2023) for *Matthew Williams (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:22-cv-00278-LG-BWR (US District Court for the Southern District of Mississippi).

309. Deposition (September 2023) for *Vincent Culliver (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 3:21-cv-4942-MCR/HTC (US District Court for the Northern District of Florida).

310. Testimony at Hearing for Greenhouse Gas and Energy Management (GEMM2) for Manufacturing in Colorado (September 2023) on behalf of Environmental Defense Fund.

311. Testimony at Hearing (October 2023) in the matter of *Algonquin Gas Transmission LLC., on behalf of Community Residents (*Petitioners*)*, Commonwealth of Massachusetts Department of Environmental Protection, Office of Appeals and Dispute Resolution, OADR Docket Nos. 2017-011 and 012, Waterways Application License No. W16-4600, Weymouth Mass.

312. Testimony at Hearing (August 2023) on behalf of Citizens for Environmental Justice in the matter of the permit Application of Valero Refining-Texas, LP for Modification to State and Prevention of Significant Deterioration Air Quality Permits No. 38754 and PSDTX324M15 before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-23-14975, TCEQ Docket No. 2023-0203-AIR.

313. Testimony at Hearing (September 2023) on behalf of Appellants in the matter of *PennEnvironment and Sierra Club (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection, (Appellee), and PPG Industries, Inc. (Permittee)*, EHB Docket No. 2022-032-B. Environmental Hearing Board, Department of Environmental Protection, State of Pennsylvania.

314. Testimony at Hearing (November 2023) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)*, Docket: UG-230393. Before the Washington Utilities and Transportation Commission.

ATTACHMENT B

Evaluation of Draft Environmental Impact Report on Geological Storage of Carbon Dioxide at the Carbon TerraVault I Facility in Kern County, California

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Center for Applied Environmental Science

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About the Author: Dr. DiGiulio is a retired geoscientist from the U.S. Environmental Protection Agency's Office of Research and Development. He has conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. He assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide (Tier II Committee). He has served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. His consulting services to non-government organizations have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

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Background

A Draft Environmental Impact Report (DEIR) was prepared by Kern County as the Lead Agency under the California Environmental Quality Act (CEQA). In volume 1 of the DEIR, it is stated that Carbon TerraVault 1 LLC (CTV), a wholly owned subsidiary of the California Resources Corporation, proposes to inject supercritical carbon dioxide (CO_2) at two locations (26R and A1-A2 reservoirs) in the Monterey Formation at the Elk Hills Oil Field in Kern County, California (DEIR, 2024a). The source of CO_2 for injection is pre-combustion Elk Hills Oil Field gas, from which CO_2 is captured and processed at the existing cryogenic and fractionation natural gas plant facility and the Elk Hills Power Plant within the Elk Hills Oil Field (DEIR, 2024a). Currently, the Elk Hills Power Plant provides electricity for both oilfield operations and the California wide power system (DEIR, 2024a). The project would consist of six injection wells - four (one converted Class II well, three new) within the 26R reservoir and two converted Class II wells within the A1 – A2 reservoir.

At the 26R reservoir, the Monterey Formation is approximately 6,000 feet deep with oil and gas production from turbidite sands (DEIR, 2024a). Turbidite deposited sands are interbedded with siliceous shale. Sand porosity and permeability averages 25% and 45 millidarcy (mD), respectively (DEIR, 2024b). At the A1 – A2 reservoir, the Monterey Formation is approximately 8,500 feet deep with oil and gas production also from turbidite sands. Turbidite deposited sands are interbedded with and bound above and below by siliceous shale. Sand porosity and permeability averages 16% and 60 mD, respectively (DEIR, 2024b).

The 26R reservoir was discovered in the 1940s while the A1-A2 reservoir was discovered in the 1970s (DEIR, 2024b). In addition to primary extraction, oil and gas wells have been used for enhanced recovery using water and gas injection over the past 40 years (DEIR, 2024b).

The Reef Ridge Shale is present over the southern San Joaquin Basin and serves as the primary confining layer for both the 26R and A1-A2 reservoirs (DEIR, 2024a). The Reef Ridge Shale is dominated by gray to grayish-black silty or sandy shale with rare silty and clay beds. The Reef Ridge Shale is continuous and ranges from 750 to 1,600 feet thick and has a permeability of less than 0.01 mD and 7% porosity (DEIR, 2024b). To date, over 7,500 wells have been drilled to various depths within the Elk Hills Oil Field (DEIR, 2024b). There are numerous well penetrations in the Monterey Formation outside the 26R and A1 – A2 storage areas as illustrated in figures in Volume 2 of the DEIR. The DEIR fails to specify the exact number of well penetrations.

At full operation, the project is designed to inject up to 1.46 million tons of CO_2 per year into the 26R reservoir (up to 26 years) and up to 0.75 million tons per year in the A1-A2 reservoir, for a total capacity of 2.21 million tons per year (DEIR, 2024a). Additionally, 10 existing wells will be converted to monitoring wells, and six existing wells would be converted into seismic monitoring wells (DEIR, 2024a).

Setbacks and Encroachment

Leakage of CO_2 from wellbores is widely considered to be one of the most significant leakage pathways for geologic storage of CO_2 (Jordan and Benson, 2009, Zhang and Bachu, 2011). There is interest in using depleted oil and gas reservoirs for geological storage of CO_2 due to extensive preexisting geological

characterization and infrastructure but the presence of a large number of well penetrations increases the possibility of leakage (Celia et al., 2005).

From a health and safety perspective, if large-scale leakage were to occur at the surface, asphyxiation and suffocation are of concern. Continued exposure to CO_2 concentrations above 20–30% is associated with suffocation to humans and most air-breathing animals (Damen et al., 2006). Since CO_2 is denser than air, topography and prevailing meteorologic conditions would largely govern risk from a large-scale release with gas buildup being greater in valleys and low-lying areas.

As discussed in Volume 2 of the DEIR (DEIR, 2024b), in 2008 in Mönchengladbach, Germany, over 100 residents suffered from respiratory problems due to a CO_2 release, of which 19 were hospitalized. The incident involved the release of about 15 metric tons of fire suppression CO_2 inside a factory, which leaked out of the building. At the time there was no wind, so the dense CO_2 cloud drifted down hill to the lowest lying region where there was a village about 1,500 feet away (DEIR, 2024b).

Probably the best-known anthropogenic release of CO_2 occurred in February 2020 from a CO_2 pipeline rupture in proximity to Satartia, MS. The rupture followed heavy rains that resulted in a landslide, creating excessive axial strain on a pipeline weld (DEIR, 2024b). Pipeline operators are required to establish atmospheric models to prepare for emergencies. Denbury's model did not contemplate a release that could affect the Village of Satartia (DEIR, 2024b). Local emergency responders were not informed by Denbury of the rupture and the nature of the unique safety risks of the CO_2 pipeline. As a result, responders had to guess the nature of the risk, in part making assumptions based on reports of a "green gas" and "rotten egg smell" and had to contemplate appropriate mitigative actions (DEIR, 2024b). Fortunately, responders decided to quickly isolate the affected area by shutting down local highways and evacuating people in proximity to the release (DEIR, 2024b). Denbury reported that 200 residents surrounding the rupture location were evacuated, and forty-five people were taken to the hospital. No fatalities were reported (PHMSA, 2022).

Following this incident, a large release of CO_2 to the atmosphere occurred later in 2020 in Yazoo County, Mississippi due to a blowdown valve freezing open (DEIR, 2024b). Work was being conducted to reconnect the pipeline that had ruptured near Satartia. An 8-inch valve froze in the open position due to internal dry-ice formation as CO_2 flashed across the valve (DEIR, 2024b). A total of approximately 5,299 metric tons of CO_2 were released over about 24 hours until the pipeline segment pressure had reduced enough to allow the valve to thaw and be closed. A large CO_2 cloud formed, and the nearby highway closed. Air monitoring was conducted in the surrounding area (DEIR, 2024b).

A clearly unacceptable release from a wellbore would be a CO_2 well blowout. A CO_2 well blowout is considered a low probability high consequence incident (Oldenburg and Budnitz, 2016) that could cause an immediate danger to public health in the vicinity of an abandoned well. The Sheep Mountain CO_2 blowout in March 1982 is a well-documented case in the literature (GEM Wiki, 2024). The leakage rate was estimated to be 13,000 metric tons CO_2 per day (GEM Wiki, 2024). 100% CO_2 flow was observed in the well with chunks of dry ice occasionally ejected hundreds of feet into the air. Other examples of CO_2 well blowouts include the Travale geothermal field, Italy in 1972 having a CO_2 release rate of 113 kg/s and the Torre Alfina geothermal field, Italy in 1973 (Lewicki et al., 2007) having a CO_2 leakage release rate of 76 kg/s (Lewicki et al., 2007; Aines et al., 2009).

Another example of CO_2 release via a wellbore is Crystal Geyser in Utah (the largest cold geyser in the world). The geyser was unintentionally created in the 1930s after a prospective oil well was drilled about 2,600-foot-deep into a fault zone above a natural CO_2 reservoir (DEIR, 2024b). Shortly after drilling, the well was improperly abandoned allowing CO_2 to be released through the well (DEIR, 2024b). Crystal Geyser eruptions last from 7 to 98 minutes with a release rate between 2.5 and 6 kg/s. Downwind CO_2 concentrations have been measured during eruptions, averaging about 4,000 parts per million (ppm) (0.4 percent) at 160 feet, and 800 ppm at 330 feet (DEIR, 2024b).

In 2011, an improperly plugged and abandoned well failed at the Tinsley Field, Mississippi during CO_2 enhanced oil recovery (EOR) (DEIR, 2024b). There were incomplete records of abandoned wells at the site (DEIR, 2024b). A 2,000-foot-deep well failed when the reservoir pressure increased on injection of CO_2. The blowout took 37 days to bring under control, sickened one worker and suffocated deer and other animals (DEIR, 2024b). In 2013, an underground CO_2 blowout occurred at the CO_2-EOR Delhi field in Louisiana, when two or more plugged and abandoned wells failed underground (DEIR, 2024b). Methane, CO_2, oil, water, brine and sands migrated to the surface in a sparsely populated, marshy area. The release lasted for more than six weeks and contaminated the air with CO_2 and methane (DEIR, 2024b).

Comment: As evidenced in the Satartia, MS CO_2 pipeline release and other documented incidences of CO_2 release, including those from wellbores, release of CO_2 from an injection well or failed plugged or unplugged wellbores could be catastrophic depending on surface topography and meteorologic conditions. The closest sensitive receptor to the project site is McKittrick Elementary School, which is 2.5 miles southwest of the facility pipeline and 4.46 miles from injection well 357-7R. The nearest residence is approximately 4.5 miles southeast of the injection line and 4.4 miles from injection well 345-36R. Buttonwillow Recreation and Park District is approximately 7 miles northeast of injection well 355-7R and 6.9 miles from the injection pipeline (DEIR, 2024a). Based on project-specific and site-specific considerations, the County should determine safe distance(s) for injection wells, wellbores, and pipelines from human receptors and adopt setback(s) that prohibit development at unsafe distance(s).

Comment: Another issue of concern is future development encroaching near land used for CO_2 storage. The land area containing wellbores and vicinity of this land area (e.g., within 1 mile) could conceivably not be suitable for public use for hundreds of years. The DEIR does not address whether or how land uses on surrounding properties might change (soon or in the long term) in ways that would increase the dangers posed by the project.

Mineralization of Injected CO_2

CTV states that full mineralization of CO_2 is expected to occur in two to five years (DEIR, 2024a) - a gross misstatement. If this were true, there would be little concern with geological storage of CO_2 at the CTV facility. Research is ongoing in formations having high divalent cation concentrations (iron, calcium, magnesium) (e.g., basalt) where mineralization is much more rapid. As correctly stated in the Class VI permit applications (EPA, 2024), based on previous studies on reactive transport modeling and geochemical reactions during geological storage, the amount of CO_2 predicted to be trapped by mineralization reactions at the TerraVault 1 Project is extremely small over a 100-year post injection time frame. For this reason, CO_2 mineralization was not included as a part of the compositional simulation modeling for Terravault (EPA, 2024).

Computational modeling indicates that CO_2 injected into the Monterey Formation 26R reservoir will be soluble in both water and oil. Due to remaining saturation of oil and water in the depleted reservoir, total dissolved CO_2 in oil and water is estimated to be 20% and 8% of the CO_2 injected respectively (EPA, 2024). Hence, 72% of injected CO_2 is expected to remain in a supercritical state for an extended period of time (e.g., thousands of years). In the A1 - A2 storage area, CTV states that because of low water saturation within the Monterey Formation A1 - A2 storage reservoir results in greater than 98% of the CO_2 injectate remaining supercritical phase, minimizing the quantity of CO_2 dissolving in formation water through time (DEIR, 2024b). The phase (supercritical fluid, dissolved in water or oil) and form (mineralization) of CO_2 is important because storage as a supercritical fluid is the least secure phase of storage while formation of carbonates during mineralization is by far the most secure form of storage.

Comment: Assessment of mineralization of injected CO_2 in Volume 1 of the DEIR is incorrect and contradicts Volume 2 of the DEIR and the Class VI permit applications. Mineralization of CO_2 is not expected to occur to any appreciable degree during storage in the 26R and A1 – A2 storage reservoirs. The DEIR must be updated to reflect an accurate assessment of mineralization and the additional potential impacts of CO_2 storage in a supercritical state. Also, less storage in water and oil than expected would result in a more rapid pressure increase than expected and necessitate updating computational modeling before the mandatory five-year reevaluation period.

Lateral Confinement to Storage Areas

The Elk Hills Oil Field is a large WNW-ESE trending anticlinal structure, approximately 17 miles long and over seven miles wide (DEIR, 2024b). With increasing depth, the structure subdivides into three distinct anticlines, separated at depth by inactive high-angle reverse faults (DEIR, 2024b). The project would be developed in two phases. In Phase 1, three new wells and one modified existing well used for enhanced oil recovery will be used to inject CO_2 into the Monterey Formation in the 26R reservoir portion of 31S anticline (DEIR, 2024a). In Phase 2, two modified wells used for enhanced oil recovery would be used to inject CO_2 into the Monterey Formation in the A1 - A2 reservoir portion of the Northwest Stevens anticline (DEIR, 2024a). CTV states that it plans to maintain the reservoir pressure at or beneath the discovery pressure of the reservoir to ensure that CO_2 does not migrate beyond the edges of the anticline structure (DEIR, 2024a).

Comment: CTV states that the Monterey Formation in the A1-A2 storage reservoir has "*minimal*" connection outside the Area of Review (DEIR, 2024b). The DEIR is vague about what this means for the project. Do anticlinal structures provide full containment or not? The Monterey Formation A1-A2 CO_2 sequestration reservoir is located in the Northwest Stevens anticline. As discussed by Zumberge et al. (2005), the Northwest Stevens anticline and the western 29R structure share some of the same turbidite sand bodies. Sandstone reservoirs on the two structures also share the same oil family. After filling of the Northwest Stevens anticline reservoirs, oil appears to have spilled into and filled the 24Z trap. This same oil family may also have reached the 2B trap on the east nose of the 29R anticline and the 26R reservoir at the west end of the 31S anticline, again moving within turbidite sand bodies from the Northwest Stevens structure. It appears then that there is hydraulic communication between the Monterey Formation inside and outside of the 26R and A1 - A2 storage areas and injection must be carefully managed to avoid migration of injected CO_2 outside of these storage areas (exceedance of spill point). From schematics provided by CTV (DEIR, 2024b), there are a large number of wellbores screened in the Monterey

Formation outside of storage areas. At least some of these wellbores should be converted to monitoring wells to monitor for both pressure perturbation and CO_2 leakage during injection.

Comment: CTV states that confinement of the Reef Ridge Shale has been demonstrated in the 26R reservoir by the injection of 841 billion cubic feet of gas and 114 million barrels of water with no leakage (DEIR, 2024a). CTV states that confinement of the Reef Ridge Shale has been demonstrated in the A1 – A2 reservoir by the injection of 175 billion cubic feet of gas and five million barrels of water with no leakage. Referring to the work by Zumberge et al. (2005), CTV further states that geochemical analysis of reservoirs confirms compartmentalization through several million years and effectiveness of the Reef Ridge Shale to contain the CO_2 injectate (DEIR, 2024b). However, as discussed in the previous comment, this geochemical analysis also confirmed migration of oil between anticlinal traps, which the DEIR does not disclose. More importantly, there is no discussion of how leakage was monitored. It does not appear that CRC used monitoring wells in the Monterey Formation outside the 26R and A1- A2 reservoir areas to evaluate migration of injected fluids beyond anticlinal structures associated with these formations. It also does not appear that CRC monitored oil and gas wells for gas leakage during enhanced oil recovery operations. Hence, until CRC or CTV provides sufficient documentation, the veracity of these claims cannot be independently evaluated. CTV should provide evidence for claims of full confinement during injection. As previously discussed, CTV should convert several existing oil and gas wells screened in the Monterey Formation outside storage reservoirs into additional monitoring wells.

Permanence Criteria and Monitoring Plan

The primary purpose of geological storage of CO_2 is mitigation of climate change. Leakage of CO_2 from a storage formation through wellbores will occur to at least some extent (Celia and Bachu, 2003). Hence, the important question is not whether there will be leakage, but whether the extent of leakage is acceptable (Celia and Bachu, 2003) and how leakage will be monitored and quantitated.

A leakage rate of less than 1% per thousand years is necessary for geological storage of CO_2 to achieve the same climate benefits as renewable energy sources (Shaffer, 2010). In a Special Report on Carbon Dioxide Capture and Storage, the Intergovernmental Panel on Climate Change (IPCC, 2005) stated that for a well selected, designed, operated and appropriately monitored system, the balance of available evidence suggests that it is very likely the fraction of stored CO_2 retained is more than 99% over the first 100 years and it is likely the fraction of stored CO_2 retained is more than 99% over the first 1000 years. Leak rates of 0.01% per year, equivalent to 99% retention of the stored CO2 after 100 years, may be adequate to ensure the effectiveness of CO_2 storage (Hepple and Benson, 2005). As part of an application for Sequestration Site Certification, the California Air Resources Board (CARB) requires a greater than 90% probability of occurrence that 99% of CO_2 will be retained in the storage complex over 100 years post-injection to be eligible to receive Permanence Certification required for operation in California (CARB, 2018). There are no storage effectiveness criteria in the Class VI federal regulations. This is a major regulatory deficiency that now must be resolved on a state-by-state level.

To assess the risk of leakage of CO_2 through wellbores, Callas et al. (2022) used a storage security calculator developed by Alcalde et al. (2018) to estimate the percent of CO_2 leaked for different densities of wells per square kilometer (km) in a well-regulated environment. Callas et al. (2022) determined that a well density greater than 8 wells/km^2 would result in more than 1% cumulative CO_2 leaked in 1,000 years in a well-regulated environment. They state that well densities of 8 wells/km^2 are of concern. They

categorize the density of existing or abandoned wells as >8 wells/km^2, 6–7 wells/km^2, 4–5 wells/km^2, 2–3 wells/km^2, and <1 well/km^2 as worst to best for wellbore leakage concerns. Given the presence of 354 well penetrations through the confining layer and a storage area of 5332 acres (21.58 km^2), a well penetration density of 16.4 wells/km^2 represents a worst-case scenario for permanence for geologic storage of CO_2. The presence of a large number of well penetrations necessitates a robust evaluation of wellbore integrity of both plugged and unplugged wells prior to injection.

Comment: Information presented in the DEIR and Class VI permit applications does not support a finding that the project will retain 99% of stored CO_2 in excess of 100 years at cessation of injection, as required by the California Air Resources Board. Such a retention finding is not credible because: (1) the large number of wellbores (354) penetrating the Reef Ridge Shale serving as primary pathways for leakage, (2) the high pressure (~4,000 psi) (the driving force for leakage) of storage, (3) storage occurring primarily as a separate phase supercritical fluid resulting in direct contact of supercritical CO_2 with all 354 well penetrations, and (4) the high probability of elevated magnitude seismic activity in the vicinity of the project area capable of inducing levels of peak ground acceleration that would likely induce wellbore damage after plugging.

Comment: In Impact statement 4.8-1 - Generate Greenhouse Gas Emissions, Either Directly or Indirectly, that may have a Significant Impact on the Environment, the level of significance before mitigation is categorized as potentially significant (DEIR, 2024a). In mitigation measure MM 4.8-1 it is stated that, "*Prior to any injection of CO2 the owner/operator shall submit a monitoring plan that complies with all requirements of the EPA UIC permit issued for the project to demonstrate the retention of CO_2 in the injection/hydrocarbon reservoir zone. The plan shall be submitted to the Kern County Planning and Natural Resources Department concurrent with submittal to the EPA for review. A copy of the final approved plan from the EPA shall be provided to the Kern County Planning and Natural Resources Department"* (DEIR, 2024a). The monitoring plan submitted in the Class VI permit applications and attached in Volume 2 of the DEIR does not directly consider leakage from well penetrations – the most likely source of loss of retention of CO_2. Hence, MM 4.8-1 is deficient and should be rejected. It will be necessary to combine continuous areal monitoring of leakage with periodic monitoring of individual well penetrations to ensure retention of CO_2 and to quantify leakage.

Use of 10% per Year Pressure Loss as a Leakage Verification Criterion

CTV states that in the 26R reservoir, starting in 1998, pressure maintenance ceased, and the gas cap reservoir was "blown-down", depleting reservoir pressure. Since blow-down, reservoir gas pressure has remained at 150-300 psig. At the 26R Reservoir, maximum allowable downhole pressure will vary from 3847 to 4294 psig with planned bottomhole injection pressure between 3558 to 4060 psig. The initial discovery pressure was 3,250 psig (DEIR, 2024b).

Comment: CTV states that computational modeling results calibrated with monitoring data (e.g., pressure) will be used to support that the plume has stabilized and that the pressure change is negligible (less than 10 psi per year) and poses no risk for potential vertical migration after cessation of injection (DEIR, 2024b). In the A1 - A2 Storage Area, CTV states that pressure at the injection wells are expected to stabilize within one year after injection ceases and that final pressure will target the initial reservoir pressure at the time of discovery (DEIR, 2024b). Again, CTV states that monitoring data will be reviewed to ensure that the CO_2 plume has stabilized post-injection and that the reservoir pressure change is

negligible (less than 10 psi per year) (DEIR, 2024b). CTV states that pressure stabilization will be used for non-endangerment assessment (DEIR, 2024b). There does not appear to be any corresponding discussion of a 10% per year pressure loss criterion for leakage verification in the Class VI permit applications. A simple back of the envelope calculation indicates that a pressure loss of 10 psi per year results in a decrease in pressure from 3250 psi (initial reservoir and final target pressure) to 2250 psi in 100 years resulting in appreciable CO_2 loss. In reality, the rate of pressure loss will decrease somewhat as pressure decreases in the formation (i.e., reduction in driving force). Nevertheless, this metric of leakage verification is not sufficiently sensitive to be of practical use and should be reexamined if not rejected for both the 26R and A1 - A2 storage areas.

Wellbore Abandonment Evaluation to Support Plugging

DiGiulio et al. (2023) found that approximately 9 of 27 (33%) of plugged oil and gas wells were leaking gas through vent pipes at the surface and 3 of 26 (10%) of plugged wells examined were leaking gas through soil at the surface in western Pennsylvania, clearly demonstrating that oil and gas wells can continue to leak gas after plugging. Kang et al. (2016, 2017) and DiGiulio et al. (2023) found mean emission rates of leakage of methane from plugged wells in western Pennsylvania were 360 and 390 g/d, respectively. However, the computation of the mean emission rate from plugged wells in the dataset from DiGiulio et al. (2023) excluded an outlier, a plugged well leaking at a rate of 83 kg/d. It is important to realize that these rates are from depleted oil and gas fields. Higher emission rates of gas (in this case CO_2) would be expected if reservoirs were repressurized as is the case for geological storage of CO_2 in depleted oil and gas fields such as at the TerraVault I Project. Emission rates from both unplugged and plugged oil and gas wells follow a distribution whereby leakage from a relatively small number of wells accounts for the majority of total leakage. It is plausible that leakage of CO_2 from abandoned wells would follow a similar distribution.

Wellbore integrity failure is not uncommon. Rates of wellbore integrity failure range from 2 to 75% (Davies et al., 2014). Recent analysis of state and provincial databases show that wellbore integrity issues are widespread in oil and gas well populations in Canada and the U.S. and are likely under-reported or not reported at all depending on the jurisdiction (Wisen et al., 2020; Lackey et al., 2021; Ingraffea et al., 2014, 2020; Abboud et al., 2021).

Wellbore integrity failures are not necessarily addressed through well plugging and can persist after the well is “properly” plugged (Bowman et al., 2023; Kang et al., 2021; Wisen et al., 2020). Surface casing vent flow or sustained casing pressure in an oil or gas well may be due to annular gas flow which may not have been properly addressed during plugging. Gas migration and surface casing vent flows require wellbore treatments such as cement squeezes and casing repair (Hachem et al., 2023; Ingraffea et al., 2014; Yousuf et al., 2021). The process of remediating subsurface leakage is typically more complex and expensive than the average plugging procedure (Raimi et al., 2021) but must be addressed prior to plugging. Once plugged, subsurface leakage via the annulus may go unchecked leading to persistent groundwater impacts and emissions to the atmosphere.

As stated in the Class VI permit applications, the permittee shall not construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of injection, annulus or formation fluids into underground sources of drinking water (USDWs) or any unauthorized zones. The objective of this permit is to prevent the movement of fluids into or between USDWs or into

any unauthorized zones consistent with the requirements at 40 CFR 146.86(a) (EPA, 2024). Hence, even in the absence of a USDW in the 26R Reservoir, as a result of an aquifer exemption, the permittee cannot allow migration of CO_2 or other fluids (brine, oil) into overlying or underlying formations or to the surface.

Within the Area of Review the owners or operators must identify all potential conduits for fluid movement out of the injection zone, including both geologic features and artificial penetrations (40 CFR 146.84(c)(1)(iii)). The owner or operator must then evaluate artificial penetrations that may penetrate the confining layer(s) of the injection project for the quality of casing and cementing, and in the case of abandoned wells, for the quality of plugging and abandonment, and perform corrective action on any identified artificial penetrations that could serve as a conduit for fluid movement (40 CFR 146.84(c)(2), 146.84(c)(3), and 146.84(d)).

In its guidance document on Area of Review and Corrective Action, EPA emphasizes the need for a robust evaluation of both plugged and unplugged wellbores that penetrate the primary confining layer (EPA, 2013). EPA provides an extensive set of recommendations and guidelines for evaluation of artificial penetrations (EPA, 2013). Evaluation commences with review of available information including drilling logs, well completion and plugging reports, casing and cementing records, records on internal and external mechanical integrity tests, cement bond/variable density logs, information on well deviation, and wellbore diagrams (EPA, 2013). Information should also include testing for sustained casing pressure and surface casing vent flows which are indicators of wellbore integrity failures and increase the potential for gas emissions and groundwater contamination (Ingraffea et al., 2014, 2020; Lackey and Rajaram, 2019; Soares et al., 2021). Leak testing using procedures developed by Kang et al. (2016) could also be utilized to evaluate well integrity.

EPA states that if available records cannot establish wellbore integrity prior to plugging (e.g., corrosion in well casing and competent cement outside casing at critical locations such as at the interface of the injection zone and confining layer) additional testing is required (EPA, 2013). Additional testing could include multi-finger caliper logging, cement evaluation logging, internal and external mechanical integrity testing similar to that conducted on injection wells, and sidewall coring (EPA, 2013).

EPA also states that after all the available records have been reviewed, any wells located within the Area of Review that cannot be proven to have plugs adequate to prevent migration of carbon dioxide or formation fluids out of the injection zone must be evaluated by field tests in order to determine the quality of plugging, as required in the Class VI Rule (40 CFR 146.84(c)(3)) (EPA, 2013).

Comment: In the Class VI permit applications for the 26R Reservoir Area, CTV identified 204 wellbores that penetrate the Reef Ridge Shale. CTV states that three wells will be repurposed as monitoring wells, and one well, 373-35R, will be repurposed as a CO_2 injection well. CRC states that it has identified 157 wellbores that require plugging because the wellbores will not be used for injection or monitoring. Of the remaining 200 wellbores, 35 wellbores have been plugged back for sidetrack and have API-12 status for plugging and abandonment. No wellbores in the 26R Reservoir area have been permanently plugged back to surface. The disposition of the other 8 wellbores is unclear. It is also unclear why all 200 unused wellbores will not be plugged back to the surface prior to injection. In the DEIR, CRC states that 36 wellbores have been plugged back for sidetrack, leaving 164 wellbores that require standard plugging

procedures. Discrepancies in the number of wellbores requiring plugging between the Class VI permit applications and the DEIR need to be resolved.

Comment: In the DEIR, CTV states that 33 wells in the A1-A2 have been identified for abandonment. The DEIR must disclose the disposition of the other 78 unplugged wellbores, and the plan to plug back to the surface those wells that will not be used for injection or monitoring.

Comment: In Attachment B of Volume 2 of the DEIR, CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1 - A2 reservoirs that penetrate the Reef Ridge Shale - the primary confining layer in both storage areas. For the 26R Reservoir area, CTV states that "*Appendix 1*" lists the wells individually and provides information including well name, API-12, well type, status, spud date, surface coordinates, and pre-operational requirements. Despite several references throughout the DEIR, the DEIR fails to include Appendix 1 itself. In addition, there is no mention of preparation of the same type of Appendix for the A1 – A2 Reservoir area. A detailed wellbore-by-wellbore evaluation for both reservoirs will be necessary to assess wellbore integrity issues prior to plugging to plug wells in a manner to minimize leakage to the extent possible.

Comment: Class VI permit applications require "A tabulation of all wells within the area of review which penetrate the injection or confining zone(s). Such data must include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Director may require" (§146.82(a)(4)). In the Class VI permit applications, CTV states that an appendix entitled "*Well Table with Corrective Action Assessment*" lists the wells individually and provides a description of each well's type, construction, date drilled, location, depth, and record of plugging and/or completion. This table also purportedly identifies pre-operational requirements and the corrective action assessment for each wellbore. Despite explicitly being required in the Class VI permit applications, the appendix with tabulation of wells with the Area of Review was not added to EPA's Class VI docket until 2/7/2024. In addition, the provided appendix is still missing critical information and riddled with vague and indefinite terms. For example, in its tabulation, records of plugging and/or completion only consist of dates. Records of plugging and/or completion should at least include wellbore schematics including actual details of plugging and completion. The table also repeatedly evaluates the annular isolation within the upper confining later as "*adequate*" which fails to provide any meaningful criteria or performance standards. Information submitted in this regard by CTV is insufficient and does not appear to be in compliance with §146.82(a)(4).

Moreover, inclusion of what appears to be part of the DEIR's missing Appendix 1 in EPA's Class VI docket does not absolve Kern County from its own obligation to include the full Appendix with the DEIR for public review and comment, and to use it to inform its own analysis of impacts and appropriate mitigation for the CTV 1 project. The failure of the DEIR to include the Appendix means the DEIR must be recirculated with the missing information included. CTV should submit all information associated with wellbores relevant to wellbore integrity (e.g., internal and external mechanical integrity tests, drilling and cementing records, cement bond/variable density logs, cement squeeze operations, etc.).

Comment: In the Class VI permit application for the 26R Reservoir, CTV states that it accessed internal databases as well as California Geologic Energy Management Division information to identify and confirm wells within the Area of Review (EPA, 2024). CTV states that the corrective action assessment included the generation and detailed review of wellbore/casing diagrams for each well in the Area of

Review (EPA, 2024). Information used in the review included depths and dimensions of all hole sections, casing strings, cement plugs, and other wellbore equipment that isolates portions of the wellbore or otherwise establishes plugback depth (EPA, 2024). Perforated intervals are described with depth and status of perforations. Top of cement determination supported the review for annular isolation. Depths to relevant geologic features such as formation tops and injection zone were reviewed for both measured and true vertical depths (EPA, 2024). The depth of the confining zone in each of the wells penetrating the Reef Ridge shale was determined through open-hole well logs and utilized the deviation survey to convert measured depth along the borehole to true vertical depth from surface (EPA, 2024). All of this information is missing in the DEIR. This information (wellbore diagrams, cement evaluation logs, internal and external mechanical integrity tests, etc.) should immediately be made available to the public. This information is critical in determining the retention of CO_2 in storage reservoirs. A detailed wellbore-by-wellbore evaluation is necessary to assess wellbore integrity issues prior to plugging in order to plug wells in a manner that minimizes leakage to the extent possible.

Comment: In the DEIR, CTV identified 204 wellbores in the 26R reservoir and 150 wellbores in the A1-A1 reservoirs (DEIR, 2024b). No wellbores were deemed deficient in either reservoir and none require corrective action. This is a 0.0% wellbore barrier failure rate for 354 wellbores, at odds with the published rates of wellbore failure rates ranging from 2-75% in the literature. Since no information (sustained casing pressure, surface casing vent flow, gas migration in soil, internal and external mechanical integrity testing, cement evaluation logs, wellbore diagrams, drilling logs, etc.) was provided, it is impossible to verify the accuracy of this statement, which should be regarded with a degree of skepticism. It does not appear that EPA conducted an independent evaluation of wellbore integrity of well penetrations. It is both inappropriate and negligent to simply accept a statement of no wellbore barrier failure without supporting information. Again, all supporting information (wellbore diagrams, cement evaluation logs, internal and external mechanical integrity tests, etc.) should immediately be made available to the public to enable an independent evaluation of wellbore integrity.

Comment: In the Corrective Action Plan (EPA 2024), CTV states that all wellbores within the Area of Review will, "*if necessary"*, be pressure tested prior to abandonment and monitored and/or have a technical demonstration of adequate zonal confinement prior to the commencement of CO_2 injection or based on an agreed upon phased schedule after CO_2 injection commences, "*if conditions allow"*. It is unclear as to what conditions would preclude pressure testing. What is a demonstration of adequate zonal confinement? These statements are far too vague to be of any use. Hence, this Corrective Action Plan is unacceptable. Under CEQA, all feasible mitigation is required. The terms of the Corrective Action Plan do not constitute all feasible mitigation. Since all wellbores penetrating the confining layer will be in direct contact with supercritical CO_2 at high pressure, internal (pressure) and external (e.g., temperature, noise, oxygen-activation logging) mechanical integrity tests should logically be conducted on these wellbores prior to plugging and abandonment, similar to regulatory requirements for plugging injection wells.

Comment: In the A1-A2 area, CTV states that it assessed USDW protection using the following criteria: (1) surface or intermediate casing over the USDW; (2) if the well is abandoned, a cement plug across base of USDW; and (3) cement in the annulus in intermediate casing above the surface casing shoe and "*sufficient*" annular cement within the confining Reef Ridge Shale. Since all wellbores will be exposed to supercritical CO_2 for presumably thousands of years at high pressure in both the 26R and A1-A2 reservoirs, it is critical that existing wellbores not being used for injection or monitoring be plugged in a

manner consistent with regulatory requirements for plugging injection wells (4 plugs). As per Class VI regulations, all well penetrations should include a cement plug through the primary confining zone, and/or across the injection zone/confining zone contact, with sufficient integrity to contain separate-phase carbon dioxide and elevated pressures. Cement plugs should also be located across the bottom of any casings and at the base of the lowermost USDW. A surface plug would also typically be required by local well abandonment regulations to ensure that there is no risk of anyone physically falling into the well bore. Materials that are compatible with CO_2 must be used where appropriate (40 CFR 146.84(d)). A wall-to-wall barrier throughout the confining layer is critical to zonal isolation of CO_2. If well casing is not removed prior to plugging, the integrity of annular cement must be verified through the use of external mechanical tests and recent cement evaluation logs.

Comment: As stated in the Class VI applications, the Etchegoin Formation is between the Reef Ridge confining zone and the Upper Tulare Formation, is continuous across the Area of Review, and will dissipate CO_2 injectate that may migrate upward from the injection zone. The Etchegoin will be monitored continuously for pressure and temperature changes at one monitoring well in the 26R Reservoir. The DEIR does not adequately explain why there is only one monitoring well in Etchegoin. What is the minimum magnitude of leakage that would be detected from pressure perturbation from the injection well located at the greatest distance from the monitoring well? The permittee needs to evaluate this to justify the existence of only one monitoring well in the Etchegoin Formation.

Comment: In the Class VI permit applications, CTV states that surface air monitoring, including broad aerial monitoring and targeted monitoring at wells and pipelines, will be conducted using eddy covariance towers (DEIR, 2024b). In regard to leakage to the atmosphere, under 40 CFR Part 98 Subpart RR, an operator must submit a proposed monitoring, reporting, and verification (MRV) plan to EPA within 180 days of receiving a final Class VI permit (§98.448(b)(2)). As part of the MRV plan, the operator must: (1) "identify potential surface leakage pathways for CO_2 in the maximum monitoring area and the likelihood, magnitude, and timing, of surface leakage of CO_2 through these pathways" (§98.448(b)(2)); (2) develop "a strategy for detecting and quantifying any surface leakage of CO_2" (§98.448(b)(3)); and (3) develop "a strategy for establishing the expected baselines for monitoring CO_2 surface leakage" (§98.448(b)(4)). Hence, leakage to the atmosphere will be considered at some point. However, a monitoring program should be specific to evaluating leakage from plugged well penetrations as general air monitoring may not be sufficiently sensitive to determine leakage. MM 4.8-1 needs to include specific monitoring for leakage from plugged and unplugged well penetrations. Methods employed by Kang et al. (2016) can be used for CO_2 monitoring at both plugged and unplugged wells.

Seismic Risk Evaluation

Of particular concern at the TerraVault I project is the effect of natural or induced seismicity on wellbores. After a well is permanently plugged and abandoned, natural or induced seismicity can damage wellbores. For example, hundreds of oil well casings were sheared in the Wilmington oil field in Los Angeles during five or six earthquakes of relatively low seismic moment magnitude (**M** 2 to **M** 4) during a period of maximum subsidence in the 1950s (Dusseault et al., 2001). The seismic moment magnitude is the product of the area of rupture, the average displacement on the fault (a fracture or zone of fracture between two blocks of rock), and the shear modulus, a parameter related to the rigidity of rocks in the fault zone measured on a logarithmic scale (GWPC, 2021). Recently, Pozzobon et al. (2023) documented increased

leakage of gas from plugged oil and gas wells resulting from seismic activity due to injection of produced water into disposal wells and hydraulic fracturing.

Impacts of earthquakes on buildings and pipelines, including those that are buried, have long been an active area of civil engineering research. There are empirical estimates of pipeline damage that relate the number of repairs to peak ground acceleration, peak ground velocity, maximum ground strain, and other factors. There is a need to extend this existing body of research to subsurface wellbore leakage caused by earthquakes (Kang et al., 2019). Hence, seismic monitoring and hazard assessment should be based not only on the magnitude of seismic event but on ground motion.

USEPA's Class VI regulations require permit applicants to provide a determination that seismic activity will not compromise subsurface containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)). The Class VI rule provisions do not address potential damage to buildings and infrastructure (including wellbore cement sheaths of active and abandoned wells) associated with geologic storage of CO_2. However, as part of its permanence requirements for geologic sequestration, the California Air Resources Board (CARB) has developed requirements which include consideration of natural and induced seismicity (CARB, 2018). In the California Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard (CARB, 2018), if an earthquake of $\mathbf{M} \geq 2.7$ is detected within a radius of one mile of CO_2 injection operations, a determination must be made whether the mechanical integrity of any well, facility, or pipeline within this radius has been compromised. This protocol however does not consider a naturally occurring major seismic event at distance from an injection well which could induce ground movement damaging wellbores. In addition, the California Energy Commission has developed guidelines to evaluate the potential for induced seismicity during geological storage of CO_2 (CEC, 2017).

Given uncertainty in potential impact due to natural and induced seismicity during geological storage of CO_2, protocols developed by U.S. Department of Energy's (DOE) Recommended Practices for Managing Induced Seismicity Risk Associated with Geologic Carbon Storage (Templeton et al., 2021, 2023) should be used when permitting a facility for geological storage of CO_2. This integrated and risk-based protocol is a product of the DOE's National Risk Assessment Partnership, a multi-year collaborative research effort of Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, National Energy Technology Laboratory, and Pacific Northwest National Laboratory. This protocol specifically addresses the risk of seismicity at a geologic carbon storage facility and is relevant to CO_2 injection at Carbon TerraVault I. Recommendations by Templeton et al. (2021, 2023) and regulatory requirements and guidelines by EPA and the State of California are used here as the basis of evaluation for the seismicity portion of the permit application.

Review of Applicable Local, State, and Federal Laws and Requirements on Seismicity

Relevant local, state, and federal laws and regulations should be reviewed to determine how induced seismicity, however minor or unlikely, is regulated and its effects prevented or mitigated (Templeton et al., 2021). In California, the Alquist-Priolo Earthquake Fault Zoning Act (1972) and the Seismic Hazards Mapping Act (1990) direct the State Geologist to delineate regulatory "Zones of Required Investigation" to reduce the threat to public health and safety and to minimize the loss of life and property posed by earthquake-triggered ground failures and other hazards. Cities and counties affected by the zones must regulate certain development projects within them, based on the CA CGS Information Warehouse: Regulatory Map Portal (https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymaps/). As

stated in the DEIR, the Carbon TerraVault I project does not appear to be within a Zone of Required Investigation. In the DEIR, Kern County reviewed compliance with other applicable laws and regulations for this project.

Review of Naturally Occurring Seismic Events and Delineation of a Region of Concern

To support a Class VI rule application, an owner/operator is required to submit a narrative description and information on the seismic history of the area, including the presence and depths of seismic sources, and a determination that seismicity will not interfere with containment of injected carbon dioxide (40 CFR 146.82(a)(3)(v)).

CARB requires an evaluation of the seismic history of the proposed sequestration site, including the date, magnitude, depth, and location of the epicenter of seismic sources and a determination that the seismicity would not cause a catastrophic loss of containment, either by breaching the integrity of the well or the sequestration formation (CARB 2018).

To evaluate the impact of a major naturally occurring seismic event distant from a site on a site, it is necessary to define a Region of Concern (ROC). The ROC is defined as the area in which a ground motion threshold over the lifetime of a project could be exceeded causing impact to infrastructure (Templeton et al., 2021), which in this case includes wellbores. An assessment or literature search should identify any tectonic events that may have occurred in the region and a map and catalog should be created for seismic events which have occurred within at least 200 km from the reservoir (Templeton et al., 2021).

Previous seismic activity should be characterized within a region of at least 200 km radius around planned injection operations to ensure that wider regional trends are considered in the seismic hazard assessment (Templeton et al., 2021, 2023). This consideration reduces the possibility of overlooking infrequent but possibly large events that could impact the local hazard. Elements of the seismicity characterization should include:

- Catalogs of instrumentally recorded earthquakes from national, state, or regional agencies.
- Historical records of earthquakes and observed fault ruptures, including but not limited to, historical earthquake catalogs, and newspaper and other contemporary records, and published reports of field geological investigations. Historic reports of significant earthquakes can provide important information on time periods that predate instrumental recording. For rare events that occur once every few hundred to thousands of years, this may be the only evidence of seismic activity.
- Fault maps and fault characterizations, including but not limited to, scientific maps and publications.
- Paleoseismic fault displacement data, including but not limited to, published trenching studies.
- Previous induced earthquake activity, including but not limited to, earthquake catalogs and scientific publications investigating possible induced activity. If the targeted region has a history of induced seismicity, this would be a strong indication of a critically stressed crust.

In Volume II of the DEIR, Soils Engineering Inc. conducted a review of naturally occurring seismic events since 1852. Their identified Region of Concern however was limited to 100 km from the Carbon

TerraVault I project. Major faults within this area are illustrated in Figure 1. From 1852 through 2020, southern California has experienced at least 20 major earthquakes with estimated Richter scale magnitudes ranging from 5.9 to 8.0. As Soils Engineering Inc. discuss, the nearest major active faults in the western portion of the CTV Project are the San Andreas Fault located approximately 23.0 to 23.3 km to the southwest, the Kern Front Fault located approximately 39.7 to 39.9 km to the northeast, the Pleito Fault located approximately 48.3 to 48.7 km to the southeast, the White Fault located approximately 48.6 to 48.9 km to the east-southeast, and the Buena Vista Fault (minor active fault) located approximately 15.42 km to the southeast. The nearest major active faults in the eastern portion of the CTV Project are the San Andreas Fault located approximately 23.9 to 24.6 km to the southwest, the Kern Front Fault located approximately 35.5 to 36.8 km to the northeast, the White Fault located approximately 39.2 to 42.5 km to the east-southeast, the Pleito Fault located approximately 40.0 to 42.9 km southeast, and the Buena Vista Fault located approximately 9.41 km to the southeast.

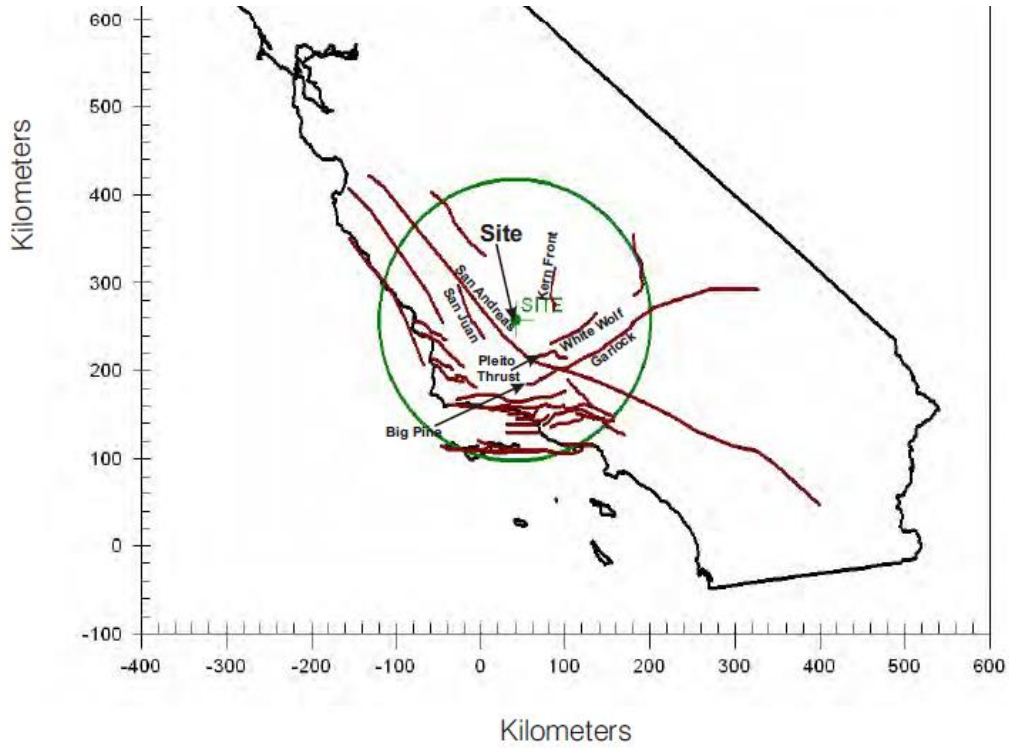

Figure 1. Identification of major faults in the vicinity of the TerraVault 1 Project. Figure from Soils Engineering, Inc. in Vol 2. of DEIR.

Some of these faults have produced earthquakes in excess of seismic moment magnitude **M** 7 (Figure 2). The San Andreas fault is a strike-slip fault (two blocks slide horizontally past each other). The 1857 **M** 7.9 Fort Tejon earthquake along the San Andreas fault, with an epicenter (the surface location directly above the depth or hypocenter where rupture is initiated) in Parkfield, CA (Figure 3) was one of the greatest earthquakes ever recorded in the United States. The San Andreas fault broke the surface continuously for at least 350 km (220 miles), possibly as much as 400 km (250 miles). In Figure 3, the estimated earthquake intensity using the Modified Mercalli (MM) scale (Table 1) is estimated with distance from the epicenter. Intensity is a qualitative measure of the strength of shaking at a specific place

and is characterized in terms of impact of shaking on individuals as well as on objects and structures. It is not a measure of the size of the earthquake.

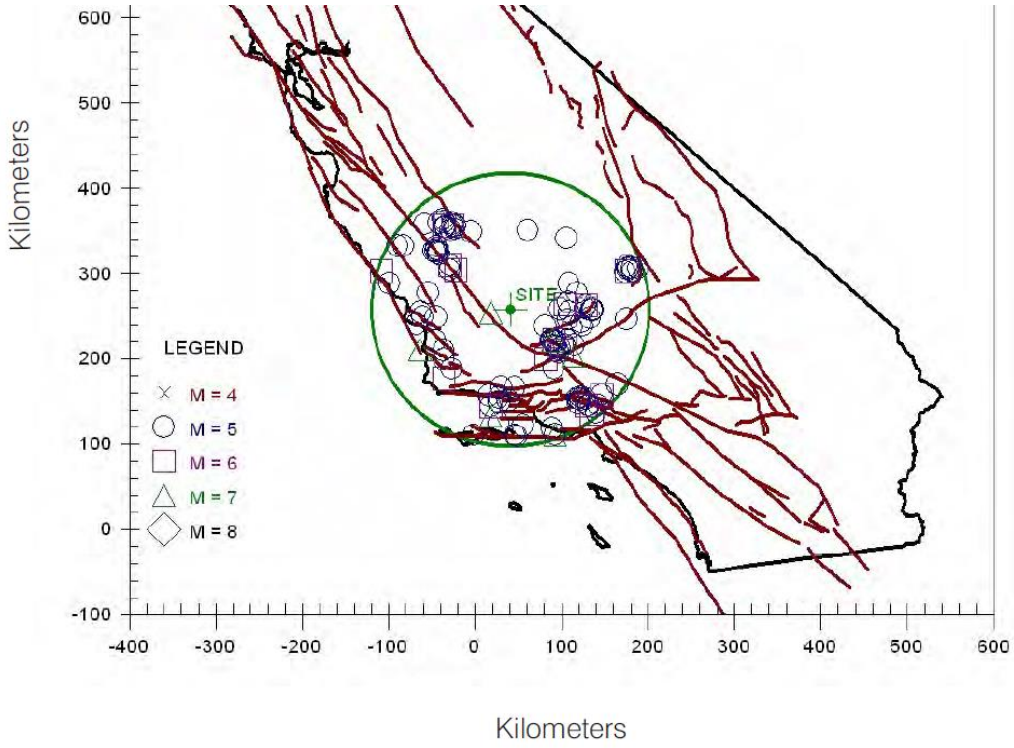

Figure 2. Magnitude of earthquakes along major faults in the vicinity of the CTV project. Figure from Soils Engineering, Inc. in Vol 2. of DEIR.

During the Fort Tejon earthquake, horizontal displacement as much as 9 meters was observed on the Carrizo Plain. As a result of the shaking, the current of the Kern River was turned upstream, and water ran four feet deep over its banks. The waters of Tulare Lake were thrown upon its shores, stranding fish miles from the original lake bed. The waters of the Mokelumne River were thrown upon its banks, reportedly leaving the bed dry in places. The Los Angeles River was reportedly flung out of its bed, too. Some of the artesian wells in Santa Clara Valley ceased to flow, and others increased in output. New springs were formed near Santa Barbara and San Fernando (USGS, 2023).

At the time of the earthquake, California was sparsely populated, especially in the regions of strongest shaking. Were the Fort Tejon shock to happen today, the damage would easily run into billions of dollars, and the loss of life would likely be substantial (USGS, 2023). Strong shaking was reported to have lasted for at least one minute but possibly lasted two or three minutes. The portion of the fault that ruptured in 1857 has settled into a period of dormancy and this has given rise to suggestions that future slip along that zone may be characterized by a very large 1857-type event followed by another period of inactivity (Sieh, 1978).

The Elkhorn Thrust, a thrust fault (reverse fault having a shallow or low angle dip) near the San Andreas fault, may have slipped simultaneously in the 1857 Fort Tejon quake indicating that future movements along the San Andreas fault zone might produce simultaneous rupture on thrust faults causing a "double

earthquake" (Southern California Earthquake Center). Reverse faults (hanging wall moves up and over the foot wall) are common in southern California and other areas experiencing tectonic compression (GWPC, 2021).

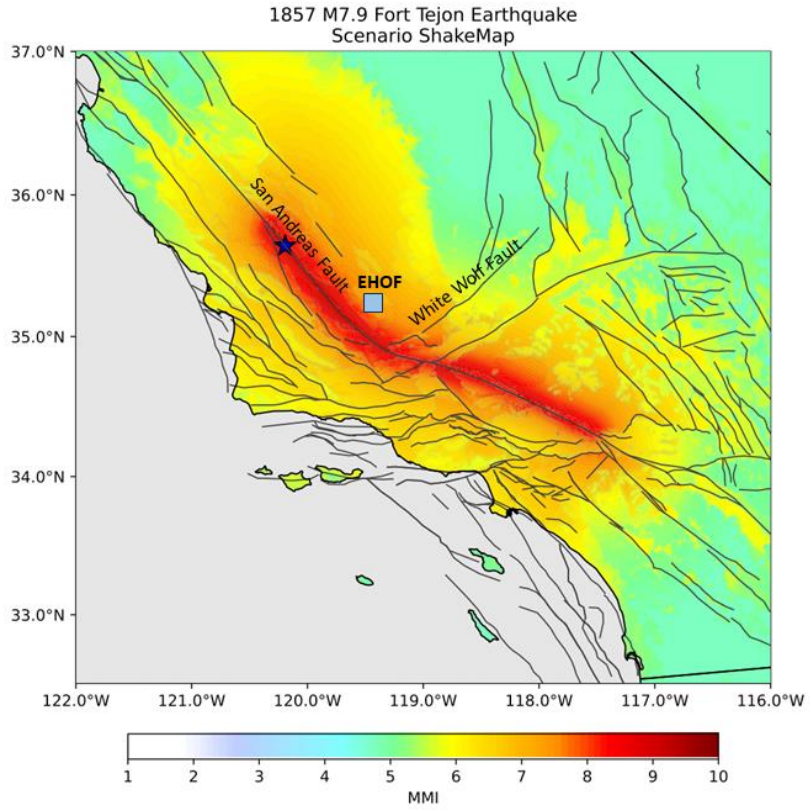

Figure 3. Location of faults in southern California and of the 1857 Tejon earthquake on the San Andreas Fault and estimated Modified Mercalli Intensity. The Epicenter illustrated by dark blue star. Approximate location of Elk Hills Oil Field (EHOF) illustrated by light blue box. San Andreas and White Wolf Faults identified. Figure modified from Southern California Earthquake Data Center.

As discussed by Soils Engineering, Inc. in Volume 2 of the DEIR, an earthquake of **M** 8.0 has been estimated for this segment of the San Andreas Fault having a conditional probability of occurrence of 0.1 (10%) over the 30-year period of 1988 to 2018. Other segments of the San Andreas fault include the Cholame (north) and Mojave (south) segments. Their respective distances from the site and characteristic magnitudes are 58 miles and **M** 7.3 (Cholame) and 78 miles and **M** 7.8 (Mojave). The associated conditional probabilities of occurrence, for the 30-year period of 1988 to 2018 were 0.3 (30%) for both segments.

The White Wolf Fault is a high-angle reverse fault with a small component of left-lateral slip. Movement along this fault was the cause of the **M** 7.5 1952 Bakersfield Earthquake, which most consider to be the third largest historic quake in California, after the 1857 Tejon and 1906 San Francisco quakes. The White Wolf fault is traceable for only about 48 km (34 miles), much less than the fault length typically thought necessary to produce such a major earthquake. The earthquake caused severe damage as far away as Las Vegas. In addition, there were at least 20 aftershocks of **M** 5 or greater associated with the initial **M** 7.5 event (San Joaquin Valley Geology).

Table 1. Modified Mercalli Intensity, peak ground acceleration (PGA), and peak ground velocity (PGV) for the central United States. Source: GWPC (2021).

MMI	Description	PGA (g)	PGV (cm/sec)	Observations (Richter 1958)
I	Not felt	< 0.00007	< 0.003	Not felt except by a few under especially favorable circumstances.
II to III	Weak	0.0008	0.04	Felt by only a few people, often indoors. Hanging objects swing. May not be recognized as an earthquake.
IV	Light	0.01	0.5	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frames creak.
V	Moderate	0.05	3.0	Felt outdoors; direction estimated. Sleepers awakened, liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI	Strong	0.09	6.5	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken.
VII	Very strong	0.15	14	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices, un-braced parapets, and architectural ornaments. Some cracks in masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII	Severe	0.27	30	Steering of motor cars affected. Damage to masonry; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

Ground motion can cause structural and nonstructural damage to buildings as well as to civil structures, such as dams, bridges, highways, railroads, tunnels, pipelines, tanks, and airport runways. It is commonly accepted that structural damage to modern engineered structures generally happens for earthquakes larger than **M** 5.0 (GWPC, 2021). For example, for the National Seismic Hazard Maps, which are the basis for the building code in the U.S. (International Building Code), the USGS uses a minimum magnitude of **M** 5.0 in the western U.S. and **M** 4.75 in the central and eastern U.S. in their hazard calculations (Petersen et al. 2014). Poorly designed or constructed buildings, such as unreinforced masonry, for example, brick and adobe, and buildings built before modern building codes can be subject to nonstructural damage at magnitudes as low as **M** 4.0 and, in some rare cases, as low as **M** 3.0 (GWPC, 2021). It is unclear what magnitude seismic event would be sufficient to cause damage to wellbores. However, as previously stated, seismic events below **M** 3 or 4 can damage wellbores. Hence, the California Carbon Capture and Sequestration Protocol requiring a determination of integrity of any well, facility, or pipeline when an earthquake of **M** ≥ 2.7 has been detected within a radius of one mile of CO_2 injection operations is reasonable.

Comment: CTV states that during the 1952 Kern County earthquake, there were no reservoir containment issues associated with oil and gas operations at the Elk Hills Oil Field. While the 26R reservoir was discovered in the 1940s, it is stated in Volume 2 of the DEIR that the Monterey Formation reservoir in the

26R anticline was not developed until 1970's. Also, the A1-A2 reservoir was not discovered until the 1970s. Hence, CTV's statement in this regard is misleading and should be removed from the DEIR.

Hazard Evaluation of Natural Seismic Events

Comment: Seismic risk is calculated from four main contributing factors. The first factor is seismic hazard, which is the probability of exceedance of a specified ground motion intensity. The second factor is exposure, which is the infrastructure or population potentially affected by seismicity. The third factor is fragility, which is the susceptibility of each element of exposure to damage from ground motion intensity. The fourth factor is consequence, which is the metric chosen to quantify the risk (e.g., economic impact, loss of CO_2 containment) (Mitchell and Green, 2017). The seismic risk analysis conducted in the DEIR is deficient because it fails to consider all four factors, especially for legacy wells which were not considered at all. In the DEIR, hazard curves were generated, however, legacy wells were not identified as part of exposure to seismicity. Fragility functions were not identified for any infrastructure including legacy wells and the consequences of leakage through legacy wells were not quantified. Hence, a comprehensive seismic risk analysis was not conducted in the DEIR.

Hazard curves can be generated to evaluate a given percent probability of exceedance of a peak ground acceleration or spectral acceleration level over a period of time (e.g., 10% probability of exceedance in 50 years). Peak ground acceleration is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake. It is an index to hazard for short stiff structures. Spectral acceleration is a measure of the maximum force experienced by a mass on top of a rod having a particular natural vibration period. Short buildings (e.g., less than 7 stories) have short natural periods (e.g., 0.2-0.6 sec). Tall buildings have long natural periods (e.g., 0.7 sec or longer) (USGS). Peak ground acceleration appears to be the appropriate metric to evaluate potential to wellbores.

Templeton et al. (2021) state that a site-specific probabilistic seismic hazard analysis should be conducted in accordance with current practice of earthquake hazard estimation to evaluate the baseline hazard from natural tectonic seismicity. Input into the site-specific probabilistic seismic hazard analysis should include the following:

- A database of potentially damaging earthquake sources that may impact the ROC, that experienced activity during the Quaternary Period (past 1.6 million years), including fault-specific sources and areal sources where appropriate. Areal seismic sources are distinct volumes within the Earth's crust that encompass concentrated zones of seismicity,
- Spatial, temporal, and frequency-magnitude distribution models for each seismic source.
- Region appropriate ground motion models for tectonic earthquakes as a function of at least earthquake magnitude and travel path. A ground motion model relates a ground motion parameter such as peak ground acceleration or peak ground velocity to magnitude, distance, and site condition. There are numerous models for tectonically active regions, such as the western U.S. (GWPC, 2021). The models for the western U.S. rely on empirical motion data obtained from instrumental records of earthquakes or numerical modeling in the absence of adequate strong motion data. Empirical models are often developed by performing a statistical regression on a ground motion parameter from the recorded data to find the best fitting model. Current ground motion models do not extend below **M** 3.0 (GWPC, 2021). Common inputs into a ground motion model include magnitude, distance, and site condition. For small earthquakes generally less than

M 4, hypocentral distance is an adequate distance metric. For larger events, a distance metric that accounts for the finite dimensions of the fault rupture area is desirable. For most models, rupture distance (the shortest distance to the fault plane) is used (GWPC, 2021). Site condition inputs also are required to accurately predict ground shaking, particularly at a soil site (GWPC, 2021).

- Information from geological, geophysical, and topographical studies within the ROC should be included to incorporate local site responses.

Templeton et al. (2021) state a seismic hazard report should be prepared by a licensed professional having demonstrated competence in the field of seismic hazard assessment. The seismic hazard report should contain site-specific assessments of the seismic hazard affecting the project and relevant sites within the ROC. The report should identify any known seismic hazards that could adversely affect relevant sites within the ROC in the event of an earthquake. Results from the probabilistic seismic hazard analysis should include multiple hazard curves and hazard maps to report the results from the baseline seismic hazard analysis due to natural seismicity before injection operations commence. Federal and state permitting agencies should then independently review the seismic hazard report to determine the adequacy of the hazard evaluation. The reviews should be conducted by licensed professionals having demonstrated competence in the field of seismic hazard assessment.

Volume 2 of the DEIR contains a report entitled "Preliminary Soil and Geologic Evaluation Terra Vault 1 Carbon Capture Project Elk Hills" completed by Soil Engineering Inc. that contains a probabilistic seismic hazard analysis for the facility. Soils Engineering Inc. used the computer modeling program EQSEARCHWIN version 3.0 (Thomas Blake) to evaluate historical earthquakes in the area of the site over the last 200 years. The largest estimated site accelerations are 0.221g (Section 36) to 0.295g (Section 7/18) from a 7.9 magnitude earthquake on January 9, 1857.

A number of active faults are located within a 50-mile radius of the subject site. Soils Engineering Inc. used the computer modeling program EQFaultwin vers. 3.0 (Thomas Blake) to evaluate the effect that a major earthquake within a 50-mile radius might have on the site. The program computed the maximum peak site ground accelerations resulting from an earthquake. Results of this analysis are presented in Table 2.

This analysis estimates that a maximum peak ground acceleration of up to 0.258g would be felt at the site as a result of a maximum earthquake of magnitude 8.0 on the San Andreas Fault approximately 23 to 24.6 kilometers away. A maximum probable earthquake of magnitude 7.3 on the White Wolf Fault approximately 39.2 to 39.9 kilometers away would create a peak site ground acceleration of up to 0.146g at the site.

Soils Engineering Inc. then utilized USGS's Unified Hazard Tool (USGS, 2024) to generate hazard curves for the site which was re-produced for this report in Figure 4. The USGS program calculates peak ground and spectral acceleration at a site for all the earthquake locations and magnitudes believed possible in the vicinity of the site. Each of these magnitude-location pairs is believed to happen at some average probability per year. Small ground motions are relatively likely, large ground motions are very unlikely. Beginning with the largest ground motions and proceeding to smaller, probabilities are summed to calculate a total probability for a particular period of time (USGS).

Table 2. Identification of faults near the site and associated maximum earthquake magnitude, estimated maximum peak ground acceleration at the site, and associated site intensity. Table from Soils Engineering, Inc. in Vol 2. of DEIR.

FAULT	Approximate Distance (Km)	Maximum Earthquake Magnitude (Mw)	Maximum Peak Ground Acceleration	Estimated Site Intensity (MM)
San Andreas (Other Segments)	**23 to 24.6**	7.4 to **8.0**	0.128 to **0.258**	VIII to **IX**
Kern Front	35.5 to 39.9	6.3	0.085 to 0.093	VII
White Wolf	39.2 to 48.9	7.3	0.123 to 0.146	VIII
Pleito Thrust	40.0 to 48.7	7.0	0.105 to 0.122	VII
San Juan	42.6 to 47.6	7.1	0.093 to 0.101	VII
San Luis Range	72.8 to 76.2	7.2	0.083 to 0.086	VII
Big Pine	64.9 to 73.4	6.9	0.060 to 0.066	VI
Great Valley 14	79.6 to 85.7	6.4	0.050 to 0.052	VI
Garlock (west)	70.3 to 73.6	7.3	0.069 to 0.076	VI to VII

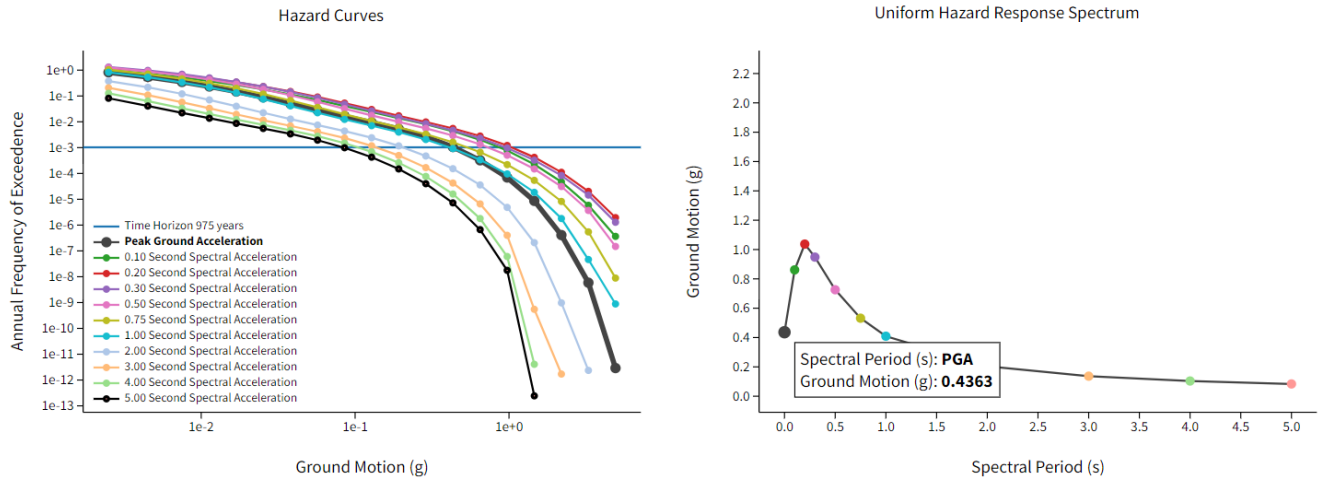

Figure 4. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 5% in 50 years. For an annual frequency of exceedance of 1.025E-03 or return period (inverse of frequency of exceedance) of 975 years, peak ground acceleration = 0.4363g (43.63% of the gravitational constant).

For the project location, a peak ground acceleration rate of 0.4363g was estimated having a 5% probability of exceedance in 50 years with an annual rate of exceedance = 1.025E-03 or a return period of 475 years (DEIR, 2024b). The return period or time horizon is the inverse of the annual rate of

exceedance. Using the USGS "rule of thumb" for calculating return period, this is approximately equivalent to a 9.8% probability of exceedance in 100 years, a 42% probability of exceedance in 500 years, and a 69% probability of exceedance in 900 years. A further examination of the hazard curves (Figure 5) (not included in the DEIR) indicates a peak ground acceleration of 0.3175g having a 10% probability of exceedance in 50 years, 19% probability in 100 years and a 64% probability of exceedance in 400 years. Care was taken in these calculations to ensure that $r^* \leq 1$ where $r^* = r(1+0.5r)$ and r = probability as recommended by USGS (USGS, 2024).

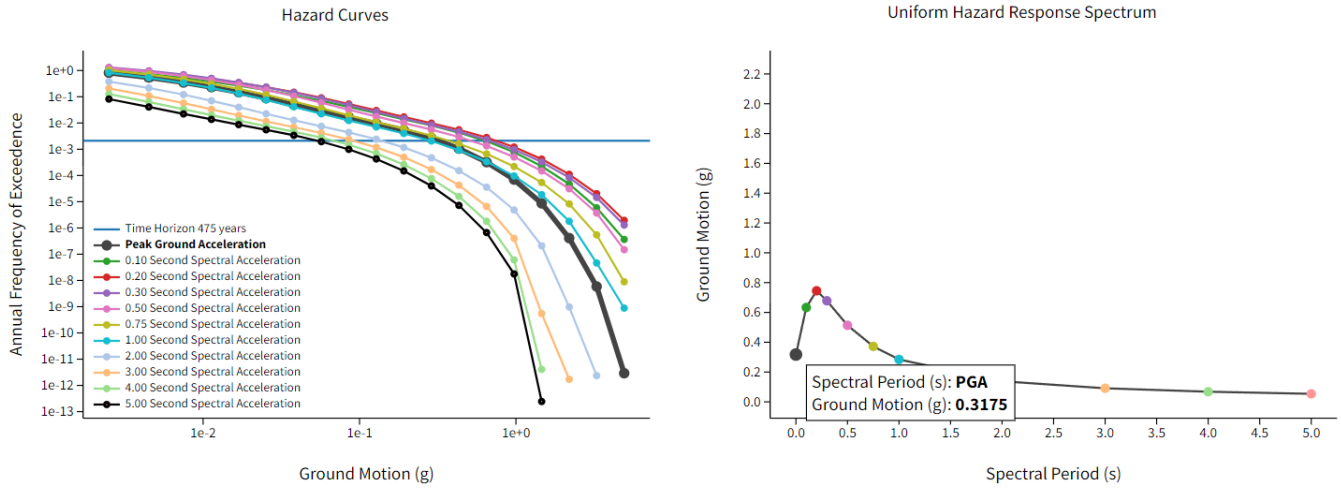

Figure 5. Generation of hazard curves for the site location (latitude 35.325027, longitude, -119.544935) using the USGS Unified Hazard Tool for a probability of exceedance of 10% in 50 years. For an annual frequency of exceedance of 2.105E-03 or return period (inverse of frequency of exceedance) of 475 years, peak ground acceleration = 0.3175g (31.75% of the gravitational constant).

Comment: In Volume 1 of the DEIR, in Impact 4.7-1, it is stated, *"an earthquake may disturb surface and/or subsurface facilities, possibly resulting in loss, injury, or death. Impacts from seismic hazards are considered potentially significant without mitigation and MM 4.7-1 would be required to reduce these potential impacts to a less-than-significant level for this individual project impacts."* Mitigation measure 4.7-1 consists of preparing *"a comprehensive seismic activity monitoring plan that includes, but is not limited to, connection to the Statewide seismic monitoring program of California Seismic Network (CISN)…The final plan shall be approved by the California Air Resources Board and include all requirements of State law including but not limited to: Appropriate subsurface monitoring to ensure geologic sequestration of injected carbon dioxide; Identification of hazards and conditions that may require the suspension of carbon dioxide injections; notification protocols for all applicable agencies and emergency procedures. All requirements for seismic monitoring adopted by the California Air Resources Board – Carbon Capture, Removal, Utilization and Storage Program shall be implemented."*

While a seismic monitoring plan would be able to detect an earthquake, a seismic monitoring program would not reduce damage to surface and subsurface facilities (e.g., wellbores). Unlike induced seismicity as a result of injection of CO_2, monitoring of natural seismicity is not mitigation. Cement used outside of well casing is a brittle material susceptible to damage from ground motion. Hence, a seismic monitoring program would not mitigate damage from a natural major earthquake within 100 km of the Carbon TerraVault I project to a less-than-significant level. In the presence of moderate seismic activity at the

project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores. The Level of Significance for Impact 4.7-1 should be changed from Less than Significant to Significant and Unavoidable.

Comment: In Volume 2 of the DEIR, Soils Engineering Inc. states, *"Project proponent will design structures in accordance with state and county code requirements for seismic ground shaking and geotechnical and geohazard constraints. Designs shall comply with seismic, soil response at the site, and structural dynamic characteristics contained in the Kern County Code of Building Regulations and the California Building Code and State of California design standards Chapter 16 and 18. These design standards are required by law for all new structures in Kern County and were established to reduce the potential impact to structures from strong seismic shaking to a less than significant level."*

These regulations do not address wellbore integrity, however. It is not clear whether wellbores can withstand a peak ground acceleration of 0.258g, let alone peak ground accelerations of 0.3175g or 0.4363g. A peak ground acceleration of 0.27 g is associated with a Modified Mercalli Intensity of VIII with observations including: steering of motor cars affected; damage to masonry and some masonry walls; twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks; frame houses moved on foundations if not bolted down; loose panel walls thrown out; changes in flow or temperature of springs and wells; and cracks in wet ground and on steep slopes. Hence, this mitigation measure is not appropriate, at least for wellbores like those that would be impacted at Elk Hills. Also, Templeton et al. (2021) state that an evaluation of the anticipated losses as a function of ground motion intensity can be achieved either directly by using vulnerability functions or indirectly through the use of fragility functions. Vulnerability functions directly relate ground motion intensity to anticipated losses. Fragility functions relate ground motion intensity to the probability of damage and are often expressed as either loss ratio curves, damage probability matrices, or fragility curves (Templeton et al., 2021). There does not appear to be vulnerability and fragility functions associated with oil and gas wellbores. However, based on a Modified Mercalli Intensity of at least VIII, wellbore damage would reasonably be expected from a major seismic event within 100 km of the Carbon TerraVault I project. The Level of Significance for Impact 4.7-2 should be changed from Less than Significant to Significant and Unavoidable. In the presence of moderate seismic activity at the project area (e.g., MMI ≥ 5, PGA ≥ 0.05g, PGV ≥ 3.0 cm/s), mitigation should include assessment of leakage at wellbores and reentry and replugging of wellbores in the event of increased leakage from wellbores.

Comment: CARB requires that an operator use appropriate tools to characterize potential risks of adverse impacts on the environment, health, or safety, by combining the assessment of the probability of occurrence and the magnitude of the adverse impacts of identified project risk scenarios. Risk scenarios identified as part of this assessment must be classified high risk, medium risk, or low risk, according to the combination of probability of occurrence during a 100-year period and the severity of potential consequences (Table 3). Given an approximately 10% and 20% probability of a of a major seismic event inducing a peak ground acceleration of 0.44 g and 0.32 g, respectively, at the TerraVault I Project area, it is difficult to understand how CTV categorized risk as low to medium (Table 4). Risk in assigned scenarios should be classified as high. At a minimum, this high risk classification should mandate robust evaluation and monitoring of wellbore integrity.

Table 3. CARB Risk scenario classification.

	Insubstantial[2]	**Substantial**[2]	**Catastrophic**[2]
> 5%[1]	Medium risk	High risk	High risk
1-5%[1]	Low risk	Medium risk	High risk
< 1%[1]	Low risk	Medium risk	Medium risk

1 Probability of occurrence over 100 years
2 Severity of potential consequences

Table 4. Risk Assessment Results from Volume 2 of DEIR

Scenario	Consequence	Probability	Risk
Injection or Monitoring Well Failure	Insubstantial	<1%	Low
Equipment failure	Insubstantial	<1%	Low
Natural Disaster	Insubstantial to Catastrophic	<1%	Low/ Medium
Fluid Leakage to Shallow Groundwater	Insubstantial	<1%	Low
CO_2 leakage to Atmosphere	Insubstantial to Catastrophic	<1%	Low/ Medium
Induced Seismic Event	Insubstantial	<1%	Low
Well Operations (drilling/workover)	Insubstantial to Catastrophic	<1%	Low/ Medium

Additional Hazard from Induced Seismicity

Induced seismicity is of concern for faults that are optimally oriented, critically stressed, and of sufficient size to cause damage sufficient to induce leakage of sequestered CO_2. Leakage of CO_2 could occur through a damaged confining layer, from activation of faults penetrating a confining layer, or through wellbore damage.

Induced seismicity considerations in the Class VI regulations are largely limited to CO_2 migration through faults penetrating the confining layer. EPA (2013) states that use of seismic hazard maps to demonstrate the reasonable expectation that no induced seismic events would occur during the course of a CCS project may fulfill the requirements at 40 CFR 146.82(a)(3)(v). However, if such maps indicate a substantial likelihood of seismic activity, other required geologic information, such as geomechanical data, depth to confining zones, and fault stability analysis may be needed to demonstrate that seismic activity will not compromise subsurface containment (EPA, 2013) An owner/operator is required to determine the "location, orientation, and properties of known or suspected faults and fractures that may transect the confining zone(s) in the Area of Review, along with a determination that they will not interfere with containment" (40 CFR 146.82(a)(3)(ii)). The owner/operator is also required to demonstrate the presence of a "confining zone(s) free of transmissive faults or fractures and of sufficient areal extent and integrity to contain the injected carbon dioxide stream and displaced fluids" (40 CFR 146.83(a)(2)).

It is stated in the Class VI permit applications that in 2019 three-dimensional (3D) seismic survey data was re-processed to allow a more focused structural image around tight folds and faults (EPA, 2024). Offsetting the 31S anticline are high-angle reverse faults that are oriented NW-SE. It is stated that these inactive faults penetrate the lowest portions of the Monterey Formation but not the lower Reef Ridge Shale above the Monterey Formation in the 26R reservoir. It is also stated the 26R reservoir is continuous across the Area of Review and the sands pinch-out up-dip and on the channel edges. As such, the 26R reservoir has minimal connection outside the Area of Review creating a reservoir with no connection to regional saline aquifers (EPA, 2024). The emphasis of EPA regulations are on upward migration of brine and CO_2 as opposed to downward propagation of pressure. The concern with faults in the Monterey Formation may be uncertainty associated with potential propagation of pressure below the storage formation, such as has occurred during disposal of produced water in Class II disposal wells and during hydraulic fracturing.

Increased subsurface fluid injection activity has led to increased seismicity at some sites, including near oil and gas wastewater (produced water) disposal sites, hydraulic fracturing sites, and engineered geothermal systems (Ellsworth, 2013; Keranen and Weingarten, 2018; Templeton et al., 2020). Induced seismicity has raised concerns about the scalability of geologic storage of CO_2 considering the seismic hazard and risk associated with far-reaching subsurface pressurization and adjacent basement rocks (Zoback and Gorelick, 2012; White and Foxall, 2016). Even in areas of low to moderate natural seismic activity, fluid injection may induce earthquakes in excess of **M** 4 (Templeton et al., 2023).

Seismogenic response to fluid injection may vary strongly from site to site and between different injection intervals (Templeton et al., 2023). Weingarten et al. (2015) and Schultz et al. (2018) show that the potential for inducing earthquakes in wastewater disposal and hydraulic fracturing, respectively, correlates positively with the total injected fluid volume and the rate of injection. However, the causative mechanisms of induced seismicity and geomechanical conditions at injection sites are diverse and involve many poorly constrained or unknown parameters. Significant uncertainties on the likelihood of inducing seismicity can persist even after careful characterization. It is not fully understood why some operations can cause significant induced seismicity while others do not (Templeton et al., 2021).

Before 2011, the **M** 4.8 event in 1967 near Denver, Colorado, was the largest event widely accepted in the scientific community as having been induced by fluid injection. The Rocky Mountain Arsenal earthquakes demonstrated how the diffusion of pore pressure within an ancient fault system can initiate earthquakes many kilometers from the injection point, delayed by months or even years after injection ceased (Hermann et al. 1981). The **M** 5.7 event in November 2011 in central Oklahoma is now the largest known induced seismic event (Kerenan et al., 2013). This earthquake damaged homes and unreinforced masonry buildings in the epicentral area and was felt as far as 1000 km away in Chicago, Illinois.

Seismicity may be induced tens of kilometers away from large-scale injection. The occurrence of seismicity farther away from injection implies that stress changes much smaller than 1 MPa may be sufficient to trigger seismicity even in naturally quiescent areas. Recent studies indicate that effective stress changes on the order of 100 kPa (14.5 psig) or less can found near earthquake hypocenters (Keranen et al., 2014; Barbour et al., 2017; Norbeck and Rubinstein, 2018; Zhai et al., 2020).

Even faults capable of **M** 5 earthquakes may be previously unknown. In many of the induced seismicity cases, faults that hosted even the largest events > **M** 5 were not known beforehand (Templeton et al.,

2023). Even natural events, such as the 2014 Napa, California earthquake, often occur on blind faults (Brocher et al., 2015). This can be related to the difficulty of imaging faults in basement rocks or the lack of vertical offset in the sedimentary overburden from subvertical strike-slip faults.

The largest injection-induced events have all involved faulting that is considerably deeper than the injection interval (Horton, 2012), suggesting that transmission of increased pressure into the basement elevates the potential for inducing earthquakes. Hence, during geologic storage of CO_2, it is important that pressure perturbation from injection not be transmitted below depths of injection.

Few commercial scale geologic CO_2 storage sites exist that can be used as prototypes to study induced seismic response. The Cogdell CO_2 enhanced oil recovery project has been associated with felt earthquakes. The seismicity in the Cogdell project has been attributed to the very high injection rates and the presence of faults in the reservoir (Gan and Frohlich 2013). At the Illinois basin–Decatur project and the associated Illinois Industrial Carbon Capture and Sequestration Sources project, as of 2022, 2.8 million metric tons of CO_2 have been injected into the Mt. Simon saline sandstone reservoir with detection of nearly 20,000 seismic events with **M** up to 1.2, although none have been felt at the surface (Williams-Stroud et al., 2020). As a result of seismic activity, injection was moved to a shallower zone within the Mt. Simon sandstone resulting in fewer seismic events (Williams-Stroud et al., 2020).

Dvory and Zoback (2021) state that since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

One study of particular relevance to the Carbon TerraVault I project is a potentially injection-induced earthquake swarm in 2005 associated with the WhiteWolf Fault (Goebel et al., 2016). It was comprised of a **M** 4.5 event on 22 September, followed by two **M** 4.7 and **M** 4.3 events the same day. The White Wolf swarm is suspected to be connected to fluid-injection activity at the Tejon Oil Field based on a statistical assessment of injection and seismicity rate changes (Goebel et al., 2015). Injection wells at the Tejon Oil Field targeted a 25–30 m thin, highly permeable stratigraphic zone within the Monterey formation composed of turbiditic sand lenses with maximum lateral extents of 1 to 2 km (Goebel et al., 2016). Recall that turbiditic sand lenses are targeted for CO_2 storage at the Carbon TerraVault I project.

Based on geological mapping, seismicity, and well-log data, Goebel et al. (2016) identified a seismically active normal fault referred to as "Tejon Fault" in proximity to the Tejon Oil Field which deepened (7.7 km) toward the northwest below the Wheeler Ridge fault before intersecting with the White Wolf Fault 8 km from injection wells (Figure 6). Pressure diffusion was likely influenced by a 11 km high permeability pathway along the seismically active part of the Tejon fault (Goebel et al., 2016). Numerical modeling indicated that for a fault zone permeability above ~300 mD and fault width below ~800 m, a pressure increase of just 0.01 MPa (1.5 psi) was sufficient to induce seismicity on a fault favorably oriented to slip (Goebel et al., 2016) as also observed by Keranen et al. (2014) and Hornbach et al. (2015). Given the discussion here, the primary concern at the Carbon TerraVault I project is pressure transmission below the Monterey Formation, not above it. Investigative studies have demonstrated that pressure propagation can occur over large distances and depths during injection of fluids and that a very small pressure differential

can induce seismicity. Hence, analysis conducted by CTV in the DEIR and Class VI permit applications does not eliminate the potential for inducted seismicity at the Carbon TerraVault I project.

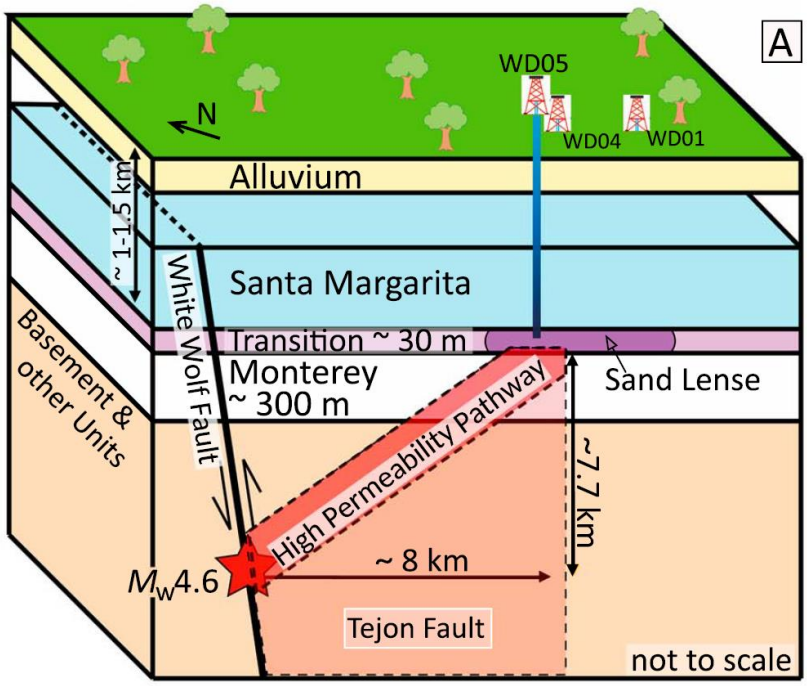

Figure 6. Schematic representation of pressure migration along a high-permeability fault between the Tejon Oil Field and a M 4.6 seismic event along the White Wolf Fault.

Comment: For induced seismicity, the primary concern here is pressure transmission below the Monterey Formation, not above it. In the Class VI regulations, the primary concern is leakage through faults in the confining layer, not transmission of pressure and induced seismicity below the storage formation. Hence, neither EPA regulations nor the DEIR adequately consider induced seismicity. Callas et al. (2022) state that lack of a lower confining seal (permeability > 100 nD) (nD = nanodarcy) is a disqualifying threshold for geologic storage of CO_2 because of potential pressure propagation to basement rock capable of producing seismic activity. According to schematics provided in Volume 2 of the DEIR, the Reef Ridge Shale bounds both the upper lower Monterey Formation and has an average permeability of 0.01 mD (mD=millidarcy) or 10,000 nD. As discussed, in the 26R and A1 - A2 Storage Areas, CTV states that final pressure will target the initial reservoir pressure at the time of discovery. Hence, this would decrease but not eliminate the possibility of induced seismicity.

Seismic Monitoring Network Design

The Class VI regulations do not include an explicit requirement for a seismic monitoring plan. However, in its Class VI Implementation manual for UIC Program Directors, EPA states that concerns about seismicity or uncertainties about the seismic history of the site raised during site characterization may necessitate the inclusion of passive seismic monitoring (EPA, 2013).

Seismic data needs to be gathered, analyzed, and archived during the lifetime of a project for geologic storage of CO_2. These data are needed to accurately assess and periodically reassess the natural and

induced seismic hazard and risk associated with the project and to aid in the rapid and effective detection and characterization of the seismicity at the site. This data is especially needed as input into induced seismicity mitigation plan protocols (e.g., traffic light systems). In general, the National Earthquake Information Center (NEIC) and other national or state monitoring systems are not sufficient for monitoring induced seismicity at a facility for geologic storage of CO_2 (Templeton et al., 2021). Routine detection of small events in the immediate vicinity of the injection site is necessary to detect problematic developments as early as possible.

The California Carbon Capture and Storage Review Panel recommended that seismic risks be considered during the operation and monitoring of CO_2 storage projects and stated that specialized seismic monitoring may be warranted (California Institute for Energy and Environment, 2010). The CARB protocol for CO_2 sequestration requires that the operator deploy and maintain a permanent, downhole seismic monitoring system to determine the presence or absence of any induced micro-seismic activity associated with all wells and near any discontinuities, faults, or fractures in the subsurface (CARB, 2018). Templeton et al. (2023) state that to record seismicity within the ROC, it is expected that the footprint of the seismic network would need to extend beyond the ROC. In the 26R Reservoir and A1 - A2 Area of Review areas, CTV will monitor seismicity with a network of surface and shallow borehole seismometers. Specifically, CTV will deploy 6 sensor locations (borehole and near surface) most of which are outside the Area of Review. CTV states that this data will help establish historical natural seismic event depth, magnitude, and frequency in order to distinguish between naturally occurring seismicity and induced seismicity resulting from CO_2 injection.

The Technical Advisory Committee to the California Carbon Capture and Storage Review Panel recommended that monitoring for induced seismicity should begin during the site selection and assessment phase to establish a baseline record of the natural background seismicity in the region encompassed by the project using the state's existing seismometer network augmented by a local network. Templeton et al. (2023) recommend that prior to commencing injection operations, a seismic monitoring network should be operated for at least 6 months but preferably 1 year or longer and be designed to detect and characterize seismicity occurring in the ROC down to at least **M** 1. CTV states in the Class VI permit application that a seismic monitoring network will establish an understanding of baseline seismic activity within the area of the project and that historical seismicity data from the Southern California Seismic Network will be reviewed to assist in establishing the baseline.

Comment: Templeton et al. (2023) state that a local seismic monitoring network should include a combination of high-gain sensors, which can optimally record weak ground motions from small local earthquakes, and low-gain accelerometers, which can optimally record strong ground motions from nearby larger earthquakes. Templeton et al. (2023) also state that each seismic station should measure ground motion in three orthogonal directions (e.g., up-down, north-south, and east-west) to fully capture the movement of the seismic waves as they travel through the earth. CTV states that high-sensitivity 3-component geophones will be utilized for seismic monitoring (DEIR, 2024b). CTV also states that CTV will monitor data from nearby (~5-8mi) existing broadband seismometers and strong motion accelerometers of the Southern California Seismic Network. It is unclear whether the seismic monitoring network is of sufficient robustness. CTV should provide additional information on specification of geophones to be used for seismic monitoring.

Comment: Information on the resolution of the CTV I seismic network is lacking and should be provided in the DEIR and Class VI permit applications. Templeton et al. (2023) state that the network should be able to record and locate seismicity in the ROC with at least a 2-sigma location accuracy of 0.5 km in the horizontal direction and 1.0 km in the vertical direction.

Comment: Templeton et al. (2023) state that seismic monitoring networks should be designed, and stations located such that ground velocities of 600 nm/s can be recorded with a signal-to-noise ratio of at least 6 in the frequency range 5–40 Hz within the ROC. Information on the signal-to-noise ratio in the seismic network is lacking and should be provided in the DEIR and Class VI permit applications.

Comment: Templeton et al. (2023) state that the data should be recorded using at least a 24-bit digital data acquisition system and a global positioning system-based field timing system to achieve the required timing accuracy of at least 1 ms. CTV states that waveform data is to be transmitted near real-time via cellular modem or other wireless means and archived in a database (DEIR, 2024b). Timing accuracy was not specified in the DEIR and the Class VI permit applications.

Seismicity Mitigation Plan

If the project operator obtains evidence that an earthquake has caused a failure of the mechanical integrity of wells, facilities, or pipelines, which may cause potential CO_2 emissions to the atmosphere, the project operator must implement an Emergency Remedial Response Plan (CARB, 2018). The operator should create a site-specific induced seismicity mitigation plan for the DEIR based on a Traffic Light System (TLS) framework (Templeton et al., 2023). Templeton et al. (2023) state that the TLS framework should include at least three response levels, indicating operation as usual (green), heightened awareness and reassessing and modifying as appropriate of injection operations (yellow), and stopping injection (red). In the Class VI permit application, CTV created a five-response level (green, yellow, orange, magenta, red) seismicity mitigation plan.

Comment: CTV established response levels based on the magnitude of a seismic event. For an induced seismic event having **M** > 2.0, in the Class VI permit application, CTV states that it will initiate gradual shutdown of the injection wells if it is determined "*appropriate*". Words like "*appropriate*" are vague and don't provide measurable performance criteria, per CEQA requirements. CTV also states that it will monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure, and identify and implement appropriate remedial actions in consultation with the UIC Program Director (DEIR, 2024b). There is no mention of evaluation of any other wellbores, which is a critical oversight.

The CARB protocol for CO_2 sequestration requires that the operator continuously monitor for indication of an earthquake of **M** 2.7 or greater occurring within a radius of one-mile of injection operations. If an earthquake of **M** 2.7 or greater is identified, CARB, in consultation with the project operator and the California Geological Survey, or local geological survey or equivalent, must conduct an evaluation of the following: (a) whether there is indication of a causal connection between the injection activity and the earthquake; (b) whether there is a pattern of seismic activity in the area that correlates with nearby

injection activity; and (c) whether the mechanical integrity of any well, facility, or pipeline within the radius specified in subsection C.4.3.2.3(b) has been compromised (CARB, 2018). Hence, if induced seismicity having a magnitude of **M** 2.7 or larger occurs, the operator must conduct an evaluation of the integrity of *all* wellbores including those plugged and abandoned.

Comment: The preliminary results of the seismic evaluation must be reported to CARB within 30 days following the earthquake, with a final report submitted within 120 days (CARB, 2018). The report must include, at a minimum: (1) the date, time, and magnitude of the earthquake; (2) the location and distance of the epicenter from the CCS project; (3) the results of the investigation into the link between the injection activity and the earthquake or pattern of seismicity; (4) any emergency and remedial actions taken; (5) a description of any investigations and tests conducted to assess the mechanical integrity of wells and other surface equipment, and a demonstration that the well and equipment were either not damaged by the earthquake or that mechanical integrity was restored prior to the re-initiation of injection; and (6) any identified changes necessary to the CCS project Testing and Monitoring Plan (CARB, 2018). There is no mention of reporting of seismic events to CARB anywhere in the seismicity mitigation plan.

Comment: Templeton et al. (2023) state that the seismicity mitigation plan should provide a clear description of mandatory and optional actions and procedures at each of the response levels. CTV repeatedly used the term *"if appropriate"* for initiation of injection well shutdown. The term appropriate is not defined and hence is ambiguous. Words like "*appropriate*" are vague and don't provide measurable performance criteria, per CEQA requirements. It is unclear precisely under what conditions initiation of shutdown would commence for yellow, orange and magenta operating states.

Comment: Of perhaps greater concern are naturally occurring seismic events at distance from the facility. In these cases, a seismic mitigation plan specified in terms of peak ground velocity or ground acceleration would be more useful in the DEIR and Class VI permit application.

Conclusions and Recommendations

There is interest in using depleted oil and gas reservoirs, such as the Carbon TerraVault I project for geological storage of CO_2 due to extensive preexisting geological characterization and infrastructure. Also, since depleted oil and gas fields have decreased pore pressure compared to initial conditions, it is plausible that the risk of induced seismicity in depleted oil and gas fields may be less than that associated with other storage configurations (e.g., saline aquifers) because increased pore pressure beyond initial conditions is one of the main causes of injection-induced seismic events.

However, well penetrations are widely recognized as a primary pathway for leakage during geologic storage of CO_2. There are an extraordinarily large number of wellbores (354) penetrating the primary confining layer (Reef Ridge Shale) at the Carbon TerraVault I project. Leakage through wellbores will be facilitated by the high pressure of storage (~4,000 psi) and storage occurring primarily as a separate phase supercritical fluid. All 354 wellbores will eventually be in direct contact with highly pressurized supercritical CO_2 – a highly corrosive medium.

Complicating matters further is the fact that that the Carbon TerraVault I project is located in an area of high natural seismicity. The probability of a natural seismic event capable of causing wellbore damage in the project area is quite high (~20% within 100 years). Given the large number of well penetrations, high

pressure during storage, storage primarily as a supercritical fluid, and natural seismicity, leakage through well penetrations is a major concern. The success or failure of geologic storage of CO_2 at the Carbon TerraVault I project will largely depend on minimizing leakage from well penetrations.

The importance of properly evaluating wellbores prior to plugging to determine the need for corrective action and evaluating wellbores that have been plugged sometime in the past cannot be stressed enough. Unfortunately, only a table identifying well penetrations was provided in the Class VI permit applications. No identification of well penetrations was provided in the Draft Environmental Impact Report. CTV claims that no wellbores require corrective action – a claim that must be viewed with considerable skepticism since wellbore integrity failure rates published from oil and gas sites in the literature range from 2 to 75%.

In one column of the table provided in the Class VI permit applications, annular isolation of wellbores within the upper confining later is subjectively described as "*adequate.*" No proof of adequacy of any wellbore beyond those used for injection was provided in the DEIR or Class VI permit applications. CTV should immediately submit all supporting information (drilling logs, well completion and plugging reports, casing and cementing records, records on internal and external mechanical integrity testing, cement bond/variable density logs, and wellbore diagrams) to the public record. Also, EPA should conduct an evaluation of each well penetration – something that the agency should have done but does not appear to have done so. Simply accepting CTV's claim of adequacy is unacceptable.

In the absence of a robust investigation of wellbore integrity at the Carbon TerraVault I project, neither the DEIR nor the Class VI permit applications should be approved.

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Draft Environmental Impact Report (DEIR, 2024b), SCH# 2022030180, Volume 2, Appendices A – K, Carbon TerraVault I (Kern County), by California Resources Corporation (PP22405), Kern County Planning and Natural Resources Department, Bakersfield, California, December 2023.

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Attachment A
to Technical Comments of Dominic DiGiulio, PhD:
Qualifications and Experience

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Background

I am a retired geoscientist from the U.S. Environmental Protection Agency. I have conducted research on: emissions of volatile organic compounds from abandoned wells, leakage of produced water, condensate, and drilling fluids from impoundments to groundwater, contamination of groundwater from hydraulic fracturing, subsurface methane and carbon dioxide migration (stray gas), intrusion of subsurface vapors into indoor air (vapor intrusion), gas flow-based subsurface remediation (soil vacuum extraction, bioventing), groundwater sampling methodology, soil-gas sampling methodology, gas permeability testing, and solute transport of contaminants in soil. I assisted in the development of EPA's original guidance on vapor intrusion and the EPA's Class VI Rule on geologic sequestration of carbon dioxide. I have served as an expert witness in litigation relevant to oil and gas development, testified before State oil and gas commissions on proposed regulation, and testified before Congress on the impact of oil and gas development on water resources. My consulting services have included reports on: stray methane gas migration, geological carbon storage in Louisiana, storage of natural gas liquids in solution mined caverns, proposed oil and gas regulations in Colorado, impact to groundwater resources from Class II disposal wells in Ohio, Idaho, and Florida, produced water transport in barges along the Ohio River, proposed EPA regulation on discharge of produced water to surface water, and Bureau of Land Management leases in Wyoming, Montana, and Colorado.

Education

B.S., Environmental Engineering, Temple University, Philadelphia, PA (1982)
M.S., Environmental Science, Drexel University, Philadelphia, PA (1988)
Ph.D., Soil, Water, and Environmental Science, University of Arizona, Tucson, AZ (2000)

Employment

Independent Consultant: Feb 2023 - present

Research Affiliate: University of Colorado, Boulder, CO: October 2020 - present. I conduct research on the impact of abandoned wells on air, surface water, and groundwater quality.

Senior Research Scientist: PSE Healthy Energy, Oakland, CA: Jan 2017 – Feb 2023. My research focused on evaluating the impact of oil and gas development on water resources and air quality. In addition to publishing findings of my research in peer-reviewed journals and reports, I provided testimony on oil and gas development rule-making, served as an expert witness in litigation against oil and gas corporations, and have testified before Congress on the impact of oil and gas development on water resources.

Research Associate: Stanford University, Stanford, CA: Apr 2014 – May 2019. I conducted research on the impact of oil and gas development to groundwater.

Environmental Engineer: U.S. Environmental Protection Agency, Office of Research and Development, Ada, OK: Sep 1988 – Mar 2014 (retired). Duties included providing regulatory oversight assistance to

EPA remedial project managers and conducting research related to subsurface gas flow and vapor transport. Research included: (1) Development of methods to improve the effectiveness of soil vapor extraction, bioventing, and air sparging subsurface remediation systems including lead authorship of EPA's primary technical resource document in these areas; (2) Co-development of analytical solutions and associated codes for estimation of gas permeability and gas flow in soil; (3) Development of analytical solutions to simulate combined solute and vapor transport in soil including lead authorship of the model *VFLUX;* (4) Development of field methods to improve active soil-gas sampling especially pertaining to leak and purge testing; (5) Development of forensic techniques (use of hydrocarbon degradation products and radon) and assistance in development of EPA guidance to evaluate vapor intrusion (migration of organic compounds from ground water to indoor air); (6) Development of ground water and soil gas monitoring strategies including assistance in development of EPA's Class VI rule on geologic sequestration of carbon dioxide; (7) Development of methods to evaluate impact to Underground Sources of Drinking Water (USDWs) under the Safe Drinking Water Act and stray gas migration due to hydraulic fracturing. Research activities included conducting seminars, workshops, and short courses to States.

Environmental Engineer (Remedial Project Manager: U.S. Environmental Protection Agency, Region III, Philadelphia, PA: Jun 1980 – Dec. 1981 and Sep 1982 – Jan 1988. Duties included: conducting investigations (e.g., remedial investigations, risk assessments, feasibility studies, sample collection) under the Comprehensive Environmental Response and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA), federal contractor oversight, preparation of consent orders and initiation of enforcement actions.

Military Service: U.S. Marine Corps: Active duty 1975-1978, Camp Pendleton, CA, Honorable Discharge in 1981.

Scientific Awards

5 EPA Bronze Medals: (1) Development of EPA Guidance Document on Soil Vacuum Extraction, (2) Technical Support to EPA's Program and Regional offices on Subsurface Gas Flow and Vapor Transport, (3) Development of EPA Guidance on Vapor Intrusion, (4) Research on Vapor Intrusion, (5) Development of Class VI Rule on Geologic Sequestration of Carbon Dioxide

3 EPA Honor Awards: (1) Development of a National Risk Management Research Laboratory Strategic Research Plan, (2) Development of a Protocol to Assess Vapor Intrusion; (3) Technical support at Leaking Underground Storage Tank Sites

3 EPA Scientific and Technological Achievement Awards: (1) Innovative Design of Soil Vacuum Extraction Systems, (2) Development of Analytical Model to Simulate Transient Flux of Volatile Organic Compounds in Soil to Ground Water and the Atmosphere, (3) Simulation of Geochemical Impacts to Ground Water from Leakage of Carbon Dioxide

Peer-Reviewed Journal Publications, Reports, and Book Chapters

Tisherman, R.; Rossi, R.J.; Shonkoff, S.B.C., DiGiulio, D.C. **2023**. Groundwater Uranium Contamination from Produced Water Disposal to Unlined Ponds in the San Joaquin Valley. *Science of the Total Environment*, Vol. 904, 15 December 2023, 166937

Kang, M.; Boutot, J.; McVay, R.; Roberts, K.; Jasechko, S.; Perrone, D.; Tao T.; Lackey, G.; Raimi, D.; DiGiulio, D.C.; Shonkoff, S.B.C.; Carey, J.W.; Elliott, E.G.; Vorhees, D.J.; Peltz, A.S. **2023.** Environmental risks and opportunities of orphaned oil and gas wells in the United States. *Environmental Research Letters*, 18, 7, 074012.

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ATTACHMENT C

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February 26, 2024

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Re: Observations concerning Kern County's Draft Environmental Impact Report ("DEIR") on the TerraVault I Carbon Capture and Storage Project ("Project").

A. Summary of DEIR.

The above referenced DEIR makes many statements that are confusing or misleading, lacking critical information to allow decision makers, including the public, to make an informed evaluation and decision about the proposed Project from this document. It appears that many of these statements relate to safety jurisdiction of various agencies, which based on my extensive experience, are confusing, if not misleading. It appears that the Project is getting ahead of badly needed safety regulatory efforts, either at the state or federal level before prudent safety regulations can be developed and implemented. Section 3 below identifies eight areas where the DEIR needs to be supplemented with important details before this Project is allowed to proceed. Lack of such detail has served to be a recurring problem across the U.S. as states and local governments wrestle with serious gaps in pipeline safety regulations for CO_2 pipelines as a result of an onslaught of multibillion dollar proposals incentivized by recent federal tax credits. A 2022 paper identifies at least eight serious deficiencies in current federal minimum pipeline safety regulations concerning liquid CO_2 pipelines summarized as follows:[1]

1. The definition of carbon dioxide needs to be updated.
2. Scientifically based regulation on impact areas for CO_2 pipeline ruptures needs to be promulgated.
3. Regulatory reference to industry recommended practices should be avoided.
4. Fracture propagation protection on CO_2 pipelines needs to be codified.
5. The use of odorant in CO_2 pipelines should be mandated.
6. Pipeline operations and maintenance manuals should require specific coordination with local emergency response personnel.
7. Maximum contaminant impurities for CO_2 pipelines should be specified.
8. Regulations for conversion of existing pipelines to CO_2 service should be developed.

[1] Richard B. Kuprewicz, President of Accufacts Inc., prepared for the Pipeline Safety Trust, "Accufacts' Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.," March 23, 2022, pp. 12 &13.

B. The TerraVault 1 Carbon Capture and Storage Project DEIR - a simple synopsis.

The TerraVault 1 Project proposes to capture CO_2 from the existing Elk Hills oil field, produced by separating a portion of the pre-combustion field gas production into "high-purity" CO_2 streams at two existing or relocated cryogenic and fractionation natural gas plant facilities identified as "CGP-1." The term high purity is not defined in the DEIR, but is a critical parameter given that existing federal minimum pipeline safety jurisdiction currently establishes a CO_2 purity of more than 90% in a poorly worded definition of carbon dioxide.[2]

The high-purity CO_2 streams will then be transported from the two CGP-1 processing/treating locations by "Facility Pipelines" which will be newly constructed pipelines.[3] The DEIR also uses the term Injection Pipelines. The definition of both Facility Pipelines and Injection Pipelines needs to be clarified as well as their transition boundaries as these terms have specific meaning in the industry and affect regulatory safety jurisdictions, if any, of various federal and state agencies that might become involved.

The DEIR indicates that new pipelines of up to 16-inches in diameter, approximately 5.61 miles long for phase 1, and approximately 7.59 miles long for phase 2, will transport CO_2 to six injection wells at two sequestration reservoir sites within the site plan (to 26R Monterey Formation Reservoir at an approximate depth of 6,000 feet for phase 1's four injection well sites, and to A1-A2 Monterey Formation Reservoir, approximately 8,500 feet deep for phase 2's two injector well sites).[4]

C. Critically important and needed pipeline information is missing in the DEIR.

Important pipeline information is missing in the DEIR that will not permit decisionmakers to make an informed decision about this Project. For example, some of the many major shortcomings in the DEIR related to pipeline issues are:

1. The purity of the claimed "high-purity" CO_2 stream has not been provided.

The CO_2 purity sets a simple bar as to whether the Pipeline and Hazardous Materials Safety Administration, or PHMSA, the federal agency chartered with transportation pipeline safety regulations, or for that matter the California Office of the State Fire Marshal, or OSFM, the state agency chartered with intrastate liquid transportation pipeline safety oversight in California, has any pipeline safety jurisdiction under current transportation pipeline safety regulations. The DEIR needs to provide the minimum purity of the CO_2 stream for reinjection and how this minimum will be controlled/maintained and assured. If the CO_2 purity is not above 90 %, the pipeline facilities are not regulated as transportation pipelines under current federal pipeline safety regulations.

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[2] 49CFR§195.2 Definitions - *Carbon Dioxide*.
[3] DEIR, Volume 1, pp. 3-18 & 3-19.
[4] DEIR, Volume 1, pp. 3-21 & 3-22.

Since the CO_2 will be produced from the oil/gas field, the DEIR also needs to present how possible impurities in the CO_2 stream will be limited and controlled. This is especially important for water as water in CO_2 pipelines is not tolerated well in carbon steel pipeline systems. Water in such CO_2 systems can experience extremely unpredictable and high corrosion rates that can quickly result in pipeline rupture failure.

2. **The DEIR discussion of Facility Pipelines and Injection Pipelines is not clear.**

   Facility Pipelines and Injection Pipelines usually have special meaning/distinction within the industry and whether any pipeline safety agency has any jurisdiction. The DEIR is very confusing on this important issue, labeling for example Injection Pipelines under the heading Facility Pipelines in the figures' legends.[5] PHMSA, or for that matter the OSFM, may not have any jurisdiction on this Project or parts of this Project.

3. **The DEIR indicates that the Facility Pipelines will operate at pressures roughly 1,700 to 2,100 psig for "dense phase" transport.[6]**

   Psig, or pounds per square inch gauge, is a pressure measurement used in the industry. The pressure range for this system, while higher than conventional liquid transportation pipelines, is not unusual for dense phase CO_2 pipelines. Dense phase is a term used to mean either liquid **or** supercritical CO_2 phase for a liquid pipeline, and is not defined in either Federal or California pipeline safety regulations.[7] What phase a specific CO_2 liquid pipeline segment is in (liquid or supercritical) at the time of a pipeline rupture can have a significant impact on rupture release dynamics, the tonnage of pipeline inventory that will be vented even after mainline valves are closed, and associated attempts to model possible rupture impact zones and attempts at establishing realistic safety buffer zones.

4. **The DEIR does not provide important pipeline parameters.**

   At this stage of the Project, the pipeline operator should be able to provide the pipeline specifics such as: pipe grade, thickness, diameter, and maximum operating pressure, or MOP, a term defined in federal pipeline safety regulation having a specific meaning related to pipeline safety. As previously mentioned, the DEIR should also clearly delineate the general pipeline route, possible pipeline safety jurisdictional boundaries, and approximate location of main equipment such as pump/compressor stations. The lack of such basic information makes it difficult to determine a simple process flow scheme for the Project. This lack of such basic information also prevents decisionmakers from assessing impacts and to develop feasible mitigations for the Project. Not only does the DEIR lack such critical basic pipeline information, what information is supplied is also confusing. It appears the Project is being rushed and

[5] DEIR, Volume 1, p. 3-20, Figures 3-8 and 3-9, Location of Phase 1 Wells: 373-35R, 353X-35R, 345-36R, and 363-27R, and Location of the Phase 2 Wells: 357-7R and 355-7R, respectively.
[6] DEIR, Volume 1, p. 3-16.
[7] 49CFR§195 and California Code, Chapter 5.5. The Elder California Pipeline Safety Act of 1981.

missing basic information to permit independent evaluation and verification of the Project.

5. The location of compressor equipment is not well defined.

The DEIR states "Two new CO_2 compressor packages are proposed for installation at the facility. Compressors would be of the reciprocating type and driven by electric motors."[8] The general location and specific phase of the CO_2 feeding into such equipment is very important to the safe operation of the system and, more importantly, the compressors. One way to blow up a reciprocating compressor is to inadvertently introduce liquid into the compressor. I cannot determine from the limited and confusing information provided in the DEIR whether the location of the proposed compressors will be safely placed within the system to assure liquid CO_2 cannot be inadvertently introduced into the compressors.

6. The placement of mainline valves along the pipelines are not defined.

The DEIR states: "New valves would be installed based on regulatory and owner requirements."[9] As should become obvious from reading this report, such important valve determinations have not been clearly defined, so this DEIR citation is meaningless. Also, the DEIR does not identify whether mainline valves will be manually operated or remotely operated. Manually operated valves can take considerable time to reach and then close (especially for larger diameter pipelines such as a 16-inch mainline valve) increasing the tonnage of CO_2 released upon pipeline rupture.

As a point of reference, a 16-inch diameter CO_2 pipeline, depending on whether the CO_2 inventory is in a supercritical or liquid phase and its associated density, will release approximately 110 to 200 tons per mile of CO_2 upon a pipeline rupture once pipeline mainlines have been closed. What makes transportation pipelines unique, especially for CO_2, is the amount of tonnage undergoing phase change from cooling, that can be de-inventoried from a ruptured pipeline, releasing tons of CO_2 between mainline valves once such valves have been closed. The lack of timely closure of valves was a significant contributing factor for the Satartia, MS rupture CO_2 release as discussed later in this report.

7. The CO_2 temperature along the pipelines is not provided.

An important variable in the DEIR, approximate CO_2 temperature along the pipelines, dictates the CO_2, whether liquid or supercritical phase (which can change) along the pipelines as temperature changes at the expected pipeline operating pressure. This important temperature parameter is not mentioned nor discussed anywhere in the DEIR. What phase a segment of a pipeline is transporting CO_2 in can have serious significance on issues such as safety jurisdiction, design/operation, and pipeline rupture

[8] DEIR, Volume 1, p. 3-17.
[9] DEIR, Volume 1, p. 3-18.

release dynamics and safety buffer zones. For example, current federal minimum pipeline safety regulations do not regulate pipelines operating in liquid CO_2 phase. I have previously mentioned the importance of assuring that reciprocating compressors do not inadvertently receive liquid. Without understanding the initial phase CO_2 will most likely be in in a specific pipeline segment, attempts to establish safe buffer or impact zones are meaningless. Two temperature extreme boundary cases for CO_2 are usually necessary; a high temperature season and a low temperature season to assist in defining the range of CO_2 phases (liquid or supercritical), and associated release modeling/pipeline buffer safety margins for the operation.

8. The DEIR misses the importance of CO_2 phase.

The DEIR also misses the important differences associated with varying phases of CO_2 in a liquid pipeline operation that are not properly addressed in current pipeline safety regulations, leaving such pipelines basically unregulated in many critically important areas. While the DEIR attempts to address certain environmental impacts related to the Project, the real issue relates to pipeline safety and the possible impact to public safety. The DEIR is incomplete in this important area and needs to be supplemented with this missing information before this Project can move forward.

While not mentioned in the DEIR, at the expected pressures and temperatures of the proposed Project's pipelines, I would anticipate the Project's pipelines to be operated in either liquid CO_2 or supercritical CO_2 phases, with the phases changing somewhat with time depending on the temperature of the buried pipelines. Whether a pipeline segment is liquid or supercritical phase at the time of rupture affects the expected phase change occurring at the rupture site, the rate of release, the tonnage that will be released between closed valves, and expected buffer impact zones.

D. The California OSFM is limited in what pipeline safety regulations it can enforce for intrastate liquid carbon dioxide transportation pipelines.

Despite the best of recent intentions to enact improvements in carbon dioxide pipeline safety regulations within California, the California Legislature has failed to pass meaningful improvements in pipeline safety regulations as it applies to intrastate carbon dioxide pipelines. Without such new legislation, the California OSFM can only implement and enforce pipeline safety regulations for intrastate CO_2 liquid pipelines within the state as codified in federal minimum pipeline safety regulations (49CFR§195) intended for liquid transportation pipelines. Based on my extensive experience in California liquid pipeline operation and many pipeline investigations within the state, it is my understanding that the OSFM can only enforce federal pipeline safety regulations for CO_2 liquid pipelines codified in current federal regulations.

Federal regulations for carbon dioxide pipelines are currently woefully inadequate as discussed in more detail in my recently referenced March 23, 2022 CO_2 public paper. In addition, announcements by PHMSA to move forward with carbon dioxide safety regulations may miss many of the safety issues and concerns related to carbon dioxide liquid pipelines

which can take some time to properly address, given the highly unusual restrictive regulatory process imposed on PHMSA.[10]

E. The DEIR attempts to minimize the impact of the Satartia rupture on the public.

Some additional information might be helpful to add to the February 22, 2020 Satartia, MS 24-inch pipeline rupture discussion in the DEIR.[11] Depending on the density one assumes in the pipeline, the rupture released 3,000 to 5,000 tons of carbon dioxide after the mainline valves were eventually closed on the 24-inch pipeline, which took considerable time to isolate the ruptured segment**.** The CO_2 plume went beyond the Town of Satartia, crossing the Yazoo River, extending well over a mile from the pipeline release site which was basically downhill from the rupture releasing heavier than air CO_2. The DEIR fails to mention that the Town of Satartia was not identified as a high consequence area in the pipeline operator's integrity management program and the air dispersion model was unfit for the 24-inch pipeline. The high rain situations and steep terrain should not come as a surprise in this challenging location, and the wording in the DEIR appears to try to downplay that the rupture threat was a unique situation in that area of Mississippi. PHMSA's corrective action order requiring review of geohazard potential along the pipeline should dispel any illusion that breakaway landslide was an unusual threat. Despite the release of a PHMSA Advisory following the Satartia rupture, PHMSA knows that there have been pipeline regulations in effect for many decades that place the responsibility on the pipeline operator to monitor their pipeline right-of-way for signs of possible abnormal loading such as massive landslide potential (what is known in the industry as a breakaway landslide threat) that can easily result in pipeline rupture.[12]

F. Well Blowout prevention and Aliso Canyon similarities.

While not a specific pipeline associated matter, I have an ethical responsibility to note that the DEIR does not address the possibility of a CO_2 injection well blowout on any of the six proposed CO_2 injection wells. In late 2015, California was associated with an underground natural gas storage well blowout, the Aliso Canyon failure, that released well over 100,000 tons of natural gas which is normally lighter than air as compared to CO_2 which is heavier than air. The Aliso Canyon failure demonstrated to the public some of the risk of large high pressure underground storage reservoirs. I would advise that the Project incorporate some form of well blowout prevention design to prevent release of massive quantities of heavier than air CO_2 from the underground reservoirs should an injection well experience a blowout. The safety design should incorporate an approach with prudent independent safeties to assure that the installation will actually work and stop the release of CO_2 from the high-pressure reservoir if a well blowout occurs. Without getting into specific design issues, there are various ways to approach this possible threat, such as incorporating an automatic subservice safety valve as a blowout preventor on each injection well. The tonnage of CO_2 released from a well blowout

[10] "PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak," May 26, 2022 at PHMSA website: https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures.
[11] DEIR, Volume 1, pp. 4.9-8 & 4.9-9.
[12] PHMSA updated ADB-2022-01, "Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards," June 2, 2022.

can easily exceed, by many orders of magnitude, the tonnage of CO_2 released from a pipeline rupture. As history has often demonstrated, well blowouts can release many thousands of tons from essentially an infinite supple of CO_2 in the reservoir, easily surpassing pipeline rupture releases.

G. Background/Experience.

Accufacts was asked to review the DEIR for the Project recently released in December 2023.[13] I have over fifty years of experience in the energy industry, including almost 25 years as president of Accufacts Inc. ("Accufacts"). Accufacts provides independent expert consulting services to assist decision makers in making informed decisions concerning pipelines. Pipeline safety expertise is provided in areas including, but not limited to; pipeline failure investigation, risk management, siting, construction, design, operation, maintenance, training, control room management including Supervisory Control and Data Acquisition ("SCADA") approaches, leak/rupture detection, integrity management, emergency response, and pipeline safety regulatory development and compliance. Much of my background is grounded in pipeline incident investigations following numerous pipeline rupture tragedies spanning several decades.

For the past two decades I have been involved as a representative of the public, which carries special obligations to avoid a conflict of interest, in advancing pipeline safety regulations at the federal and various state levels as demonstrated by my CV. For example, I played a significant role representing the public in developing integrity management federal pipeline safety regulations in the early 2000s for both liquid and gas transmission pipelines. These regulatory approaches emulated a safety process approach that I instituted and developed for the City of Bellingham, WA. This process, identified as the Safety Immediate Action Plan, or SIAP, identified steps that the pipeline operator was to complete following the Bellingham rupture tragedy of June 10, 1999, before that pipeline could be permitted to be returned to service.

H. Conclusion.

The DEIR is seriously incomplete and deficient in many areas as discussed above. These deficiencies need to be properly addressed before a DEIR can be deemed complete and sufficient for the Project to move forward. It is my understanding that the County can require that such critical information related to pipeline safety and CO_2 pipelines can be ordered to be provided, or supplemented, before this Project can be allowed to move forward.

Richard B. Kuprewicz, President, Accufacts Inc. *Richard B. Kuprewicz*

[13] Draft Environmental Impact Report – SCH# 2022030180 Volume 1, Chapters 1 through 12, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol_1_Ch_1-12_upd.pdf, and Draft Environmental Impact Report – SCH# 2022030180 Volume 2, Appendices A-K, CARBON TERRAVAULT I (KERN COUNTY) by California Resources Corporation (PP22405) at: https://psbweb.kerncounty.com/planning/pdfs/eirs/ctv1/CTV1_DEIR_Vol2.pdf, December 2023.

Attachment A
to Technical Comments of Richard Kuprewicz:
Qualifications and Experience

Curriculum Vitae.

Richard B. Kuprewicz

8151 164th Ave NE
Redmond, WA 98052

Tel: 425-802-1200 (Office)
E-mail: kuprewicz@comcast.net

Profile:

As president of Accufacts Inc., I specialize in gas and liquid pipeline investigation, auditing, risk management, siting, construction, design, operation, maintenance, training, SCADA, leak detection, management review, emergency response, and regulatory development and compliance. I have consulted for various local, state and federal agencies, NGOs, the public, and pipeline industry members on pipeline regulation, operation and design, with particular emphasis on operation in unusually sensitive areas of high population density or environmental sensitivity.

Employment:

Accufacts Inc. **1999 – Present**

Pipeline regulatory advisor, incident investigator, and expert witness on all matters related to gas and liquid pipeline siting, design, operation, maintenance, risk analysis, and management.

Position: President
Duties:
> Full business responsibility
> Technical Expert

Alaska Anvil Inc. **1993 – 1999**

Engineering, procurement, and construction (EPC) oversight for various clients on oil production facilities, refining, and transportation pipeline design/operations in Alaska.

Position: Process Team Leader
Duties:
> Led process engineers group
> Review process designs
> Perform hazard analysis
> HAZOP Team leader
> Assure regulatory compliance in pipeline and process safety management

ARCO Transportation Alaska, Inc. **1991 - 1993**

Oversight of Trans Alaska Pipeline System (TAPS) and other Alaska pipeline assets for Arco after the Exxon Valdez event.

Position: Senior Technical Advisor
Duties:
> Access to all Alaska operations with partial Arco ownership
> Review, analysis of major Alaska pipeline projects

ARCO Transportation Co. **1989 – 1991**

Responsible for strategic planning, design, government interface, and construction of new gas pipeline projects, as well as gas pipeline acquisition/conversions.

Position: Manager Gas Pipeline Projects
Duties:
> Project management
> Oil pipeline conversion to gas transmission
> New distribution pipeline installation
> Full turnkey responsibility for new gas transmission pipeline, including FERC filing

Four Corners Pipeline Co. **1985 – 1989**

Managed operations of crude oil and product pipelines/terminals/berths/tank farms operating in western U.S., including regulatory compliance, emergency and spill response, and telecommunications and SCADA organizations supporting operations.

Position: Vice President and Manager of Operations
Duties:
> Full operational responsibility
> Major ship berth operations
> New acquisitions
> Several thousand miles of common carrier and private pipelines

Arco Product CQC Kiln **1985**

Operations manager of new plant acquisition, including major cogeneration power generation, with full profit center responsibility.

Position: Plant Manager
Duties:
> Team building of new facility that had been failing
> Plant design modifications and troubleshooting
> Setting expense and capital budgets, including key gas supply negotiations
> Modification of steam plant, power generation, and environmental controls

Arco Products Co. **1981 - 1985**

Operated Refined Product Blending, Storage and Handling Tank Farms, as well as Utility and Waste Water Treatment Operations for the third largest refinery on the west coast.

Position: Operations Manager of Process Services
Duties:
> Modernize refinery utilities and storage/blending operations
> Develop hydrocarbon product blends, including RFGs
> Modification of steam plants, power generation, and environmental controls
> Coordinate new major cogeneration installation, 400 MW plus

Arco Products Co. **1977 - 1981**

Coordinated short and long-range operational and capital planning, and major expansion for two west coast refineries.

Position: Manager of Refinery Planning and Evaluation
Duties:
> Establish monthly refinery volumetric plans
> Develop 5-year refinery long range plans
> Perform economic analysis for refinery enhancements
> Issue authorization for capital/expense major expenditures

Arco Products Co. **1973 - 1977**

Operating Supervisor and Process Engineer for various major refinery complexes.

Position: Operations Supervisor/Process Engineer
Duties:
> FCC Complex Supervisor
> Hydrocracker Complex Supervisor
> Process engineer throughout major integrated refinery improving process yield and energy efficiency

Qualifications:

Served for over fifteen years as a member representing the public on the federal Technical Hazardous Liquid Pipeline Safety Standards Committee (THLPSSC), a technical committee established by Congress to advise PHMSA on pipeline safety regulations.

Committee members are appointed by the Secretary of Transportation.

Served seven years, including position as its chairman, on the Washington State Citizens Committee on Pipeline Safety (CCOPS).

Positions are appointed by the governor of the state to advise federal, state, and local governments on regulatory matters related to pipeline safety, routing, construction, operation and maintenance.

Served on Executive subcommittee advising Congress and PHMSA on a report that culminated in new federal rules concerning Distribution Integrity Management Program (DIMP) gas distribution pipeline safety regulations.

As a representative of the public, advised the Office of Pipeline Safety on proposed new liquid and gas transmission pipeline integrity management rulemaking following the pipeline tragedies in Bellingham, Washington (1999) and Carlsbad, New Mexico (2000).

Member of Control Room Management committee assisting PHMSA on development of pipeline safety Control Room Management (CRM) regulations.

Certified and experienced HAZOP Team Leader associated with process safety management and application.

Education:

MBA (1976)	Pepperdine University, Los Angeles, CA
BS Chemical Engineering (1973)	University of California, Davis, CA
BS Chemistry (1973)	University of California, Davis, CA

Publications in the Public Domain:

1. "An Assessment of First Responder Readiness for Pipeline Emergencies in the State of Washington," prepared for the Office of the State Fire Marshall, by Hanson Engineers Inc., Elway Research Inc., and Accufacts Inc., and dated June 26, 2001.

2. "Preventing Pipeline Failures," prepared for the State of Washington Joint Legislative Audit and Review Committee ("JLARC"), by Richard B. Kuprewicz, President of Accufacts Inc., dated December 30, 2002.

3. "Pipelines - National Security and the Public's Right-to-Know," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated May 14, 2003.

4. "Preventing Pipeline Releases," prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, dated July 22, 2003.

5. "Pipeline Integrity and Direct Assessment, A Layman's Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated November 18, 2004.

6. "Public Safety and FERC's LNG Spin, What Citizens Aren't Being Told," jointly authored by Richard B. Kuprewicz, President of Accufacts Inc., Clifford A. Goudey, Outreach Coordinator MIT Sea Grant College Program, and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated May 14, 2005.

7. "A Simple Perspective on Excess Flow Valve Effectiveness in Gas Distribution System Service Lines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated July 18, 2005.

8. "Observations on the Application of Smart Pigging on Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated September 5, 2005.

9. "The Proposed Corrib Onshore System - An Independent Analysis," prepared for the Centre for Public Inquiry by Richard B. Kuprewicz, dated October 24, 2005.

10. "Observations on Sakhalin II Transmission Pipelines," prepared for The Wild Salmon Center by Richard B. Kuprewicz, dated February 24, 2006.

11. "Increasing MAOP on U.S. Gas Transmission Pipelines," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2006. This paper was also published in the June 26 and July 1, 2006 issues of the Oil & Gas Journal and in the December 2006 issue of the UK Global Pipeline Monthly magazines.

12. "An Independent Analysis of the Proposed Brunswick Pipeline Routes in Saint John, New Brunswick," prepared for the Friends of Rockwood Park, by Richard B. Kuprewicz, dated September 16, 2006.

13. "Commentary on the Risk Analysis for the Proposed Emera Brunswick Pipeline Through Saint John, NB," by Richard B. Kuprewicz, dated October 18, 2006.

14. "General Observations On the Myth of a Best International Pipeline Standard," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated March 31, 2007.

15. "Observations on Practical Leak Detection for Transmission Pipelines – An Experienced Perspective," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated August 30, 2007.

16. "Recommended Leak Detection Methods for the Keystone Pipeline in the Vicinity of the Fordville Aquifer," prepared for TransCanada Keystone L.P. by Richard B. Kuprewicz, President of Accufacts Inc., dated September 26, 2007.

17. "Increasing MOP on the Proposed Keystone XL 36-Inch Liquid Transmission Pipeline," prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, dated February 6, 2009.

18. "Observations on Unified Command Drift River Fact Sheet No 1: Water Usage Options for the current Mt. Redoubt Volcano threat to the Drift River Oil Terminal," prepared for Cook Inletkeeper by Richard B. Kuprewicz, dated April 3, 2009.

19. “Observations on the Keystone XL Oil Pipeline DEIS,” prepared for Plains Justice by Richard B. Kuprewicz, dated April 10, 2010.

20. “PADD III & PADD II Refinery Options for Canadian Bitumen Oil and the Keystone XL Pipeline,” prepared for the Natural Resources Defense Council (NRDC), by Richard B. Kuprewicz, dated June 29, 2010.

21. “The State of Natural Gas Pipelines in Fort Worth,” prepared for the Fort Worth League of Neighborhoods by Richard B. Kuprewicz, President of Accufacts Inc., and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated October, 2010.

22. “Accufacts’ Independent Observations on the Chevron No. 2 Crude Oil Pipeline,” prepared for the City of Salt Lake, Utah, by Richard B. Kuprewicz, dated January 30, 2011.

23. “Accufacts’ Independent Analysis of New Proposed School Sites and Risks Associated with a Nearby HVL Pipeline,” prepared for the Sylvania, Ohio School District, by Richard B. Kuprewicz, dated February 9, 2011.

24. “Accufacts’ Report Concerning Issues Related to the 36-inch Natural Gas Pipeline and the Application of Appleview, LLC Premises: 7009 and 7010 River Road, North Bergen, NJ,” prepared for the Galaxy Towers Condominium Association Inc., by Richard B. Kuprewicz, dated February 28, 2011.

25. “Prepared Testimony of Richard B. Kuprewicz Evaluating PG&E’s Pipeline Safety Enhancement Plan,” submitted on behalf of The Utility Reform Network (TURN), by Richard B. Kuprewicz, Accufacts Inc., dated January 31, 2012.

26. “Evaluation of the Valve Automation Component of PG&E’s Safety Enhancement Plan,” extracted from full testimony submitted on behalf of The Utility Reform Network (TURN), by Richard B.Kuprewicz, Accufacts Inc., dated January 31, 2012, Extracted Report issued February 20, 2012.

27. “Accufacts’ Perspective on Enbridge Filing to NEB for Modifications on Line 9 Reversal Phase I Project,” prepared for Equiterre Canada, by Richard B. Kuprewicz, Accufacts Inc., dated April 23, 2012.

28. “Accufacts’ Evaluation of Tennessee Gas Pipeline 300 Line Expansion Projects in PA & NJ,” prepared for the Delaware RiverKeeper Network, by Richard B. Kuprewicz, Accufacts Inc., dated June 27, 2012.

29. “Impact of an ONEOK NGL Pipeline Release in At-Risk Landslide and/or Sinkhole Karst Areas of Crook County, Wyoming,” prepared for landowners, by Richard B. Kuprewicz, Accufacts Inc., and submitted to Crook County Commissioners, dated July 16, 2012.

30. “Impact of Processing Dilbit on the Proposed NPDES Permit for the BP Cherry Point Washington Refinery,” prepared for the Puget Soundkeeper Alliance, by Richard B. Kuprewicz, Accufacts Inc., dated July 31, 2012.

31. “Analysis of SWG’s Proposed Accelerated EVPP and P70VSP Replacement Plans, Public Utilities Commission of Nevada Docket Nos. 12-02019 and 12-04005,” prepared for the State of Nevada Bureau of Consumer Protection, by Richard B. Kuprewicz, Accufacts Inc., dated August 17, 2012.

32. “Accufacts Inc. Most Probable Cause Findings of Three Oil Spills in Nigeria,” prepared for Bohler Advocaten, by Richard B. Kuprewicz, Accufacts Inc., dated September 3, 2012.

33. “Observations on Proposed 12-inch NGL ONEOK Pipeline Route in Crook County Sensitive or Unstable Land Areas,” prepared by Richard B. Kuprewicz, Accufacts Inc., dated September 13, 2012.

34. “Findings from Analysis of CEII Confidential Data Supplied to Accufacts Concerning the Millennium Pipeline Company L.L.C. Minisink Compressor Project Application to FERC, Docket No. CP11-515-000,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Minisink Residents for Environmental Preservation and Safety (MREPS), dated November 25, 2012.

35. “Supplemental Observations from Analysis of CEII Confidential Data Supplied to Accufacts Concerning Tennessee Gas Pipeline’s Northeast Upgrade Project,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Delaware RiverKeeper Network, dated December 19, 2012.

36. “Report on Pipeline Safety for Enbridge’s Line 9B Application to NEB,” prepared by Richard B. Kuprewicz, Accufacts Inc., for Equiterre, dated August 5, 2013.

37. “Accufacts’ Evaluation of Oil Spill Joint Investigation Visit Field Reporting Process for the Niger Delta Region of Nigeria,” prepared by Richard B. Kuprewicz for Amnesty International, September 30, 2013.

38. “Accufacts’ Expert Report on ExxonMobil Pipeline Company Silvertip Pipeline Rupture of July 1, 2011 into the Yellowstone River at the Laurel Crossing,” prepared by Richard B. Kuprewicz, November 25, 2013.

39. “Accufacts Inc. Evaluation of Transco’s 42-inch Skillman Loop submissions to FERC concerning the Princeton Ridge, NJ segment,” prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated June 26, 2014, and submitted to FERC Docket No. CP13-551.

40. Accufacts report “DTI Myersville Compressor Station and Dominion Cove Point Project Interlinks,” prepared by Richard B. Kuprewicz for Earthjustice, dated August 13, 2014, and submitted to FERC Docket No. CP13-113-000.

41. “Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco’s Leidy Southeast Expansion Project,” prepared by Richard B. Kuprewicz for the Princeton Ridge Coalition, dated September 3, 2014, and submitted to FERC Docket No. CP13-551.

42. Accufacts’ “Evaluation of Actual Velocity Critical Issues Related to Transco’s Leidy Expansion Project,” prepared by Richard B. Kuprewicz for Delaware Riverkeeper Network, dated September 8, 2014, and submitted to FERC Docket No. CP13-551.

43. “Accufacts’ Report to Portland Water District on the Portland – Montreal Pipeline,” with Appendix, prepared by Richard B. Kuprewicz for the Portland, ME Water District, dated July 28, 1014.

44. “Accufacts Inc. Report on EA Concerning the Princeton Ridge, NJ Segment of Transco’s Leidy Southeast Expansion Project,” prepared by Richard B. Kuprewicz and submitted to FERC Docket No. CP13-551.

45. Review of Algonquin Gas Transmission LLC’s Algonquin Incremental Market (“AIM Project”), Impacting the Town of Cortlandt, NY, FERC Docket No. CP14-96-0000, Increasing System Capacity from 2.6 Billion Cubic Feet (Bcf/d) to 2.93 Bcf/d,” prepared by Richard B. Kuprewicz, and dated Nov. 3, 2014.

46. Accufacts’ Key Observations dated January 6, 2015 on Spectra’s Recent Responses to FERC Staff’s Data Request on the Algonquin Gas Transmission Proposal (aka “AIM Project”), FERC Docket No. CP 14-96-000) related to Accufacts’ Nov. 3, 2014 Report and prepared by Richard B. Kuprewicz.

47. Accufacts’ Report on Mariner East Project Affecting West Goshen Township, dated March 6, 2015, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

48. Accufacts’ Report on Atmos Energy Corporation (“Atmos”) filing on the Proposed System Integrity Projects (“SIP”) to the Mississippi Public Service Commission (“MPSC”) under Docket No. 15-UN-049 (“Docket”), prepared by Richard B. Kuprewicz, dated June 12, 2015.

49. Accufacts’ Report to the Shwx’owhamel First Nations and the Peters Band (”First Nations”) on the Trans Mountain Expansion Project (“TMEP”) filing to the Canadian NEB, prepared by Richard B. Kuprewicz, dated April 24, 2015.

50. Accufacts Report Concerning Review of Siting of Transco New Compressor and Metering Station, and Possible New Jersey Intrastate Transmission Pipeline Within the Township of Chesterfield, NJ (“Township”), to the Township of Chesterfield, NJ, dated February 18, 2016.

51. Accufacts Report, “Accufacts Expert Analysis of Humberplex Developments Inc. v. TransCanada Pipelines Limited and Enbridge Gas Distribution Inc.; Application under Section 112 of the National Energy Board Act, R.S.C. 1985, c. N-7,” dated April 26, 2016, filed with the Canadian Nation Energy Board (NEB).

52. Accufacts Report, “ A Review, Analysis and Comments on Engineering Critical Assessments as proposed in

PHMSA's Proposed Rule on Safety of Gas Transmission and Gathering Pipelines," prepared for Pipeline Safety Trust by Richard B. Kuprewicz, dated May 16, 2016.

53. Accufacts' Report on Atmos Energy Corporation ("Atmos") filing to the Mississippi Public Utilities Staff, "Accufacts Review of Atmos Spending Proposal 2017 – 2021 (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 15, 2016.

54. Accufacts Report, "Accufacts Review of the U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) for the Dakota Access Pipeline ("DAPL")," prepared for Earthjustice by Richard B. Kuprewicz, dated October 28, 2016.

55. Accufacts' Report on Mariner East 2 Expansion Project Affecting West Goshen Township, dated January 6, 2017, to Township Manager of West Goshen Township, PA, and prepared by Richard B. Kuprewicz.

56. Accufacts Review of Puget Sound Energy's Energize Eastside Transmission project along Olympic Pipe Line's two petroleum pipelines crossing the City of Newcastle, for the City of Newcastle, WA, June 20, 2017.

57. Accufacts Review of the Draft Environmental Impact Statement for the Line 3 Pipeline Project Prepared for the Minnesota Department of Commerce, July 9, 2017, filed on behalf of Friends of the Headwaters, to Minnesota State Department of Commerce for Docket Nos. CN-14-916 & PPL-15-137.

58. Testimony of Richard B. Kuprewicz, president of Accufacts Inc., in the matter West Goshen Township and Concerned Citizens of West Goshen Township v. Sunoco Pipelines, L.P. before the Pennsylvania Public Utilities Commission, Docket No. C-2017-2589346, on July 18, 2017, on Behalf of West Goshen Township and Concerned Citizens of West Goshen Township.

59. Direct Testimony of Richard B. Kuprewicz, president of Accufacts Inc., on Behalf of Friends of the Headwaters regarding Enbridge Energy, Limited Partnership proposal to replace and reroute an existing Line 3 to the Minnesota Office of Administrative Hearings for the Minnesota Public Utilities Commission (MPUC PL-9/CN-14-916 and MPUC PL-9/PPL-15-137), September 11, 2017 and October 23, 2017.

60. Direct Testimony of Richard B. Kuprewicz On Behalf of The District of Columbia Government, before the Public Service Commission of the District of Columbia, in the matter of the merger of AltaGas Ltd. and WGL Holdings, Inc., Formal Case No. 1142, September 29, 2017.

61. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2018 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated December 4, 2017.

62. Report to Hugh A. Donaghue, Esquire, Concord Township Solicitor, "Accufacts Comments on Adelphia Project Application to FERC (Docket No. CP18-46-000) as it might impact Concord Township," dated May 30, 2018.

63. Report to Mississippi Public Utilities Staff ("MPUS"), "Accufacts Review on Atmos Energy Corporation's Proposed Capital Budget for Fiscal Year 2019 related to System Integrity Program Spending (Docket N. 2015-UN-049)," prepared by Richard B. Kuprewicz, dated August 20, 2018.

64. Report to West Goshen Township Manager, PA, "Accufacts report on the repurposing of an existing 12-inch Sunoco pipeline segment to interconnect with the Mariner East 2 and Mariner East 2X crossing West Goshen Township," dated November 8, 2018.

65. Report to West Whiteland Township Manager, PA, "Accufacts Observations on Possible Pennsylvania State Pipeline Safety Regulations," prepared by Richard B. Kuprewicz, dated March 22, 2019.

66. Accufacts Public Comments on the Proposed Joint Settlement, BI&E v. Sunoco Pipeline L.P. ("SPLP"), Docket No. C-2018-3006534 ("Proposed Settlement"), submitted on August 15, 2019 to the Pennsylvania Public Utility Commission on the behalf of West Goshen Township as an intervener.

67. Report to West Whiteland Township Manager, Ms. Mimi Gleason, "Accufacts Perspective on Two Questions from West Whiteland's Board of Supervisors on Proposed Changes to ME 2 and ME 2X Construction/Operational Activities within West Whiteland," dated September 5, 2019."

68. Report to West Goshen Township Manager, Mr. Casey LaLonde, “Accufacts Report on the episode on the evening of 8-5-19 at the Mariner East Boot Road Pump Station (“Event”), Boot Road, West Goshen Township, PA,” dated September 16, 2019.

69. Provided direct testimony before the Arizona Corporation Commission, In the Matter of the Application of Southwest Gas Corporation for the Establishment of Just and Reasonable Rates and Charges Designed to Realize a Reasonable Rate of Return on Fair Value of the Properties of Southwest Gas Corporation Devoted to its Arizona Operations (Docket No. G-01551A-19-0055), testified on behalf of Utilities Division Arizona Corporation Commission, February 19, 2020.

70. Report to West Goshen Township Manager, Mr. Casey LaLonde, “Accufacts Report on the Mariner East 2X Pipeline Affecting West Goshen Township,” dated July 23, 2020.

71. Assisted the Commonwealth of Massachusetts, Office of the Attorney General in developing pipeline safety processes to be incorporated into the settlement agreement related to Columbia Gas’ sale of Assets to Eversource following the Merrimack Valley, Massachusetts overpressure event of September 13, 2018.

72. Report to Natural Resources Defense Council, Inc., “Accufacts’ Observations on the Use of Keystone XL Pipeline Pipe Exhibiting External Coating Deterioration Issues from Long Term Storage Exposure to the Elements,” October 1, 2020.

73. Report to Pennsylvania Public Utilities Commission (“PAPUC”), “Accufacts Comments on Proposed Pennsylvania Intrastate Liquid Pipeline Safety Regulations,” dated October 29, 2021, prepared for West Whiteland Township Board of Supervisors, West Whiteland Township, PA. Filed to PAPUC public web docket November 5, 2021 by West Whiteland Township under Reference Docket Number L-2019-3010267. Addresses suggested improvements in proposed pipeline safety rules for PA intrastate liquid transmission pipelines.

74. Submitted written testimony of Richard B. Kuprewicz on Behalf of Bay Mills Indian Community to ALJ Dennis Mack, dated December 14, 2021, in the matter of the Application of Enbridge Energy, Limited Partnership for Authority to Replace and Relocate the Segment of Line 5 Crossing the Straits of Mackinac into a Tunnel Beneath the Straits of Mackinac, before the State of Michigan Public Service Commission, U-20763.

75. Public presentation to New York State Indian Point Nuclear Facility Decommissioning Oversight Board on Holtec removal activities in proximity to Enbridge three Natural Gas Transmission Pipelines, March 17, 2022.

76. Report to Pipeline Safety Trust and Bold Alliance, “Accufacts’ Perspectives on the State of Federal Carbon Dioxide Transmission Pipeline Safety Regulations as it Relates to Carbon Capture, Utilization, and Sequestration within the U.S.,” March 23, 2022.

77. Accufacts Inc., Public Presentation For the National Academies of Science Engineering Medicine and The Transportation Research Board, “To Committee on Criteria for Installing Automatic and Remote-Controlled Shutoff Valves on Existing Gas and Hazardous Liquid Transmission Pipelines,” 4/27/22.

78. Accufacts Inc, “6/13/22 Webinar to Illinois Emergency Responders, Healthcare Providers, & Local Officials on Responses to CO_2 Transmission Pipeline Releases,“ 6/13/22.

79. Accufacts Report for Pipeline Safety Trust, “Safety of Hydrogen Transportation by Gas Pipelines,” 11/28/22.

80. Completed a series of testimonies related to Enbridge’s Line 5 proposal to replace 2 – 20-inch diameter existing submerged pipelines currently lying across the bottom of the Straits of Mackinac with a 30-inch diameter grade X-70 pipeline, proposed to be installed in a 21-foot diameter concrete tunnel to be installed across the approximate 4 mile span of the Straits of Mackinac. Testified on Behalf of the Bay Mill Indian Community before the State of Michigan Public Service Commission, Docket U-20763, in opposition to this very poorly designed proposal/installation allowing for movement of the pipeline on rollers within the tunnel. Final testimony to the docket submitted May 19, 2023. This is the only pipeline proposal I am aware of in the world that would place a crude oil and liquid propane pipeline, especially a 30-inch diameter pipeline, within a tunnel.

81. Issued to Ms. Niroop Srivatsa, City Manager, “Accufacts Report for the City of Lafayette on the Status of the Tree Assessment Process with PG&E,” indicating most of the trees identified for removal by PG&E risk management

approach have nothing to do with gas pipeline safety, June 15, 2023.

82. Issued Direct Testimony to Illinois Commerce Commission (“ICC”) on the Navigator Heartland Greenway LLC Application for a Carbon Dioxide Transportation and Sequestration pipeline, under Docket 23-0161, on behalf of Citizens Against Heartland Pipeline (“CAHGP”), McDonough County, Christian County and Hancock County (the “Counties”) (jointly, “Citizen and County Intervenors” of “CCI”), raising serious questions as to PHMSA’s recent assertions of pipeline safety jurisdiction, and underscoring the ICC’s authority for pipeline siting jurisdiction of said pipeline proposal in the State of Illinois, filed June15, 2023.

Keith Alvidrez

From: rickgarcia@westkern.net
Sent: Thursday, February 1, 2024 11:08 AM
To: Keith Alvidrez
Subject: LULAC Council 3272 Comments on the Carbon Terra Vault Project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

As President of the Kern County LULAC, Council 3272, our organization stands in support of California Resources Corporation (CRC) proposed Carbon Terra Vault Project. LULAC Council 3272 continues to be committed to our Mission of advancing opportunities that benefit our community through jobs, economic conditions, health, and education. This project aligns perfectly with our Mission. LULAC Kern County Council 3272 stands in support of the CRC Carbon Terra Vault Project which not only will reduce carbon emissions but will also create technical high paying jobs that will benefit disadvantaged communities in Kern County.

Richard F. Garcia
President LULAC Council 3272

From: Sarah D Saltzer
To: CTV1EIRComments
Subject: Support note for Elk Hills CCS Project
Date: Monday, March 18, 2024 9:47:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

I write this note in support of CTV's CCS project at Elk Hills.

California has very ambitious GHG reduction goals, and CCS is an important technology that is needed to get to net-zero in California. CCS is a proven technology. As of November 2023, there were 41 operational CCS projects across the globe with a total capture capacity of 49 million tonnes of CO2 per year. These projects capture and store safely emissions from power plants, oil refineries, natural gas processing plants, and industrial facilities making iron, steel, cement, hydrogen, ammonia, fertilizer and other chemicals. The earliest capture project came online in 1972. Since then, well over 200 million tonnes of CO2 has been captured and safely stored in deep geologic formations.

The Elk Hills project contains many elements making it optimally-suited to be the first CCS project in the State of California. It has the proper geology for permanent storage of CO2, including a deep reservoir with sufficient injectivity and capacity and an impermeable top seal. It is not near any Quaternary faults or adjacent to locations with recent seismicity. It is also not near any large population centers. The carbon capture will be done at facilities on site, negating the need for construction of a CO2 pipeline.

Kern County has some of the worst air quality in the state. Emerging modeling suggests that CCS will not worsen air quality and, in fact, it has the potential to do the opposite. During capture, chemical scrubbers strip the CO_2 from the gasses that would otherwise be emitted. The Clean Air Task Force found that carbon capture retrofits reduce particulate emissions by >90% and nearly eliminate sulfur emissions that are responsible for acid rain. The Great Plains Institute, and others, went a step further and modeled the positive health benefits and the economic value of copollutant removal. Both studies included the small additional emissions associated with running the capture facility.

CCS is a vital tool available today to tackle the carbon dioxide emissions that drive climate change without degrading the local environment or threatening health. The Elk Hills project meets the criteria to be the first CCS project for the State of California.

Sincerely,
Sarah Saltzer

Sarah D. Saltzer, Ph. D.
Managing Director, Stanford Center for Carbon Storage &
Stanford Carbon Removal Initiative

Stanford University

office: Y2E2 Room 319
phone (+1) 650.721.3174
mobile (+1) 925.785.4940
email: sarah.saltzer@stanford.edu
web: sccs.stanford.edu and https://energy.stanford.edu/carbon-initiative

From: William Solomon
To: CTV1EIRComments
Subject: ***Reject*** Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:02:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will ***prolong*** the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have ***consistently*** over-promised and under-delivered, but oil companies are promoting this *flawed* technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition ***off*** fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes ****threaten**** the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses ***other serious*** safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's ****fragile**** water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where ****water is already limited**** is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

William Solomon
sunguy@localnet.com
271 Marietta Ln
Shipman, Virginia 22971

From: Rose Ann Witt
To: CTV1EIRComments
Subject: A Liability in the Making: Reject Carbon TerraVault I carbon capture & storage scheme
Date: Friday, February 23, 2024 7:50:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

My family spent several days visiting the Carrizo Plain and Antelope Valley last spring to experience California's intoxicating wildflower display. Enroute we passed miles upon miles of toxic oil and gas derricks, where a noxious haze stung our eyes, burned our throats, and obscured the mountain vistas. It was late the night we headed home, and it would have been so easy to overnight in Kern County and inject some of our tourist dollars into your economy. Instead, we drove through the night to sleep in our own beds in Ventura County -- because we didn't want to drink your water or breathe your air for one minute more than we had to. The fossil fuel era is coming to an end, and building carbon capture infrastructure is a short-sighted mistake that will saddle your area with yet more expensive, stranded assets; if you are wise, you will start diversifying Kern County's economy now.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will only prolong your dependence on polluting fossil fuel operations and divert critical resources away from truly clean and affordable renewable energy. The project will threaten both public health and Kern County’s limited water supplies while doing nothing to protect your, and our, climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only exacerbate an already toxic situation, while driving dangerous impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region. The fossil fuel industry publicly promotes CCS as a "fledgling" technology that they’re scaling up; but CCS is a mature technology, not a new one. Way back in 1980, Imperial Oil (a subsidiary of Exxon) admitted, "Technology exists to remove CO2 from stack gases but removal of only 50% of the CO2 would double the cost of power generation." Only a year later, Exxon internally assessed the climate problem accurately: "The cost of scrubbing large quantities of CO2 from flue gases is exorbitant ... energy conservation or shifting to renewable energy sources, represent the only options that might make sense." ." Renewables are already cheaper than fossil fuels plus CCS; and they’re widening that gap every single day. Don’t be suckered into letting the industry make their problem your problem.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have “significant and unavoidable” impacts on air quality in an air basin that is already considered one of the most polluted in the entire country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death do an internet search for "Satartia gas leak" -- for which you could be held liable as society turns against enablers of the death and destruction resulting from intensifying fossil-fueled disasters.

The project also threatens Kern County’s fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of clean air and water, human health, climate stability, and Kern's future economic prospects, I urge you to reject this dangerous project.

Rose Ann Witt
rawitt@verizon.net
1282 Oak Grove Place
Thousand Oaks, California 91362

From: Nishanga Bliss
To: CTV1EIRComments
Subject: A mother urges: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:42:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I have a teenage son, and I'm so worried about our climate, health and future. We need to decarbonize energy and do so in a way that protects nature and further harm.
The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nishanga Bliss
nishangabliss@gmail.com
1210 Carleton Street
Berkeley, California 94702

From: Kae Bender
To: CTV1EIRComments
Subject: Carbon capture and storage is a boondoggle; Reject Carbon TerraVault I
Date: Wednesday, February 28, 2024 11:14:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

So-called Carbon capture doesn't really take carbon out of the environment, It merely moves it around. There is no good way to store carbon that will improve our current climate disaster.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kae Bender
livingcommonunity@gmail.com
42955 Cherbourg Lane
Lancaster, California 93536

From: Barry Price
To: CTV1EIRComments
Subject: Carbon capture and storage is a scam!
Date: Friday, February 23, 2024 12:15:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barry Price
pricebarrya@gmail.com
3380 Sequoia Dr
Sn Luis Obisp, California 93401

From: Marc LeMaire
To: CTV1EIRComments
Subject: Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

This dangerous and irresponsible project should be rejected. The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marc LeMaire
ralph.fredrickson1@gmail.com
430 E Court St
Viroqua, Wisconsin 54665

From: Stewart Wilber
To: CTV1EIRComments
Subject: Carbon TerraVault I carbon capture and storage
Date: Friday, February 23, 2024 1:11:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have “significant and unavoidable” impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County’s fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stewart Wilber
s.wilber@mindspring.com

1923 15th St # A
San Francisco, California 94114

From:	Woody Little
To:	CTV1EIRComments
Subject:	Comments re: CRC"s Carbon TerraVault I project
Date:	Friday, March 1, 2024 3:36:03 PM
Attachments:	Kern County Comments 3_01_34.xlsx Kern County Comments 3_01_34.csv

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Dear Mr. Alvidrez,

Please see attached for comments opposing the Elk Hills Carbon TerraVault I project. I am submitting them on behalf of 1406 Californians.

The comments in both files are the same, I'm just submitting in excel and csv formats, in case one or the other is more easily compatible with your systems.

Please let me know if you have any questions regarding the comment files.

Thank you,
Woody Little

--

Woody Little | *he/him*
Organizing and Special Projects Manager
Last Chance Alliance
woody@lastchancealliance.org | 510-418-8785

From: Mary Herring
To: CTV1EIRComments
Subject: Give a Shit. Please!
Date: Tuesday, February 27, 2024 5:33:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I am begging you to care about OUR environment and health and that of other people. This is not safe nor healthy. Please please please stop this project. It will not work.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

A voter, a tax payer, a constituent,

Mary

Mary Herring
bizgalemme@gmail.com
532 Perry Ave
Pacifica, California 94044

From: Errol Roberts
To: CTV1EIRComments
Subject: My name: Added to those Rejecting Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:29:44 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Yep - a supplied letter below - but I'm 100% behind it - take heed.

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already

over drafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our GLOBAL air, water, health, and climate, I urge you to reject this dangerous project.

Errol Roberts
errol@adam.com.au
16 Boomerang Cresent
Aldgate, South Australia 5154

From: Susan Schacher
To: CTV1EIRComments
Subject: Oppose Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:22:10 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Schacher
susan4@jps.net
3500 35th Ave, Apt 27
Oakland, California 94619

From: Judith Smith
To: CTV1EIRComments
Subject: PLEASE Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:31:44 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Smith
judithsmith313@gmail.com
2712 Grande Vista Ave
Oakland, California 94601

From: Claudia Delman
To: CTV1EIRComments
Subject: Please Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:06:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I hope you're aware that the Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. It will also threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Projects like this have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

Posing serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions which will pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

To add to the litany of what's wrong, the project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

I urge you to reject this dangerous project for the sake of our air, water, health, and climate!!!

Claudia Delman
claudia.delman@gmail.com
285 W Chanslor Ave
Richmond, California 94801

From: Brad Donahue
To: CTV1EIRComments
Subject: Please Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:30:11 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

This is extremely important. The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brad Donahue
swirlnotch@mindspring.com
3434 S Centinela Ave, #7
Los Angeles, California 90066

From: Amy Hunter
To: CTV1EIRComments
Subject: Please Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:18:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amy Hunter
aehunter3@gmail.com
3 madison ave west
Winchester, Massachusetts 01890

From: Roxanne Dubois
To: CTV1EIRComments
Subject: PLEASE Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:33:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

A LEAK COULD BE VERY DANGEROUS.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Roxanne Dubois
rduboisusa@gmail.com
1399 Robnick Ct
Campbell, California 95008

From: Pavle Cajic
To: CTV1EIRComments
Subject: Please Reject Carbon TerraVault I carbon capture scheme
Date: Tuesday, February 27, 2024 5:31:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

To the Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I have heard about the Carbon TerraVault I Elk Hills carbon capture project. I have learned that projects of this sort are frequently unsafe and ineffective. Therefore, I believe this is a dangerous distraction that will prolong the life of polluting fossil fuel operations and divert critical resources away from truly clean, renewable energy. Moreover, the project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered. Carbon TerraVault I will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pavle Cajic
cajicpaja@gmail.com
291 15th Avenue
San Francisco, California 94118

From: Jed Holtzman
To: CTV1EIRComments
Subject: Please reject Carbon TerraVault I carbon capture and storage project
Date: Friday, February 23, 2024 6:31:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jed Holtzman
jed.holtzman@gmail.com
847 Scott St.
San Francisco, California 94117

From: Deb Runyan
To: CTV1EIRComments
Subject: Please reject the Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:51:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Deb Runyan
deb.runyan408@gmail.com
638 Sobrato Ln
Campbell, California 95008

From: Melissa Davis
To: CTV1EIRComments
Subject: Please! Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:29:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melissa Davis
melissadavis_2000@yahoo.com
9815 Steelhead Rd
Paso Robles , California 93446

From: Mark Bartleman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I Carbon Capture and Storage Scheme
Date: Friday, February 23, 2024 10:55:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman:

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Thank you.

Mark Bartleman
mbartleman86@gmail.com
1984 Del Mar Ave
Laguna Beach, California 92651

From: Rosario Sandel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 11:52:23 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rosario Sandel
rgopezsandel@yahoo.com
8215 Zelzah Avenue
Reseda, California 91335

From: Karen Kirschling
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 8:47:11 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Kirschling
kumasong@icloud.com
633 Oak
SF, California 94117

From: Anika Bull
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 6:13:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anika Bull
anikalbull@gmail.com
5446 Gilbert Dr.
San Diego, California 92115

From: Amina Aslam-Mir
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 6:13:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amina Aslam-Mir
a.minaaslammir@gmail.com
16303 Alipaz Ct
San Diego, California 92127

From: Allison Lee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 6:13:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Allison Lee
allisonlee24@icloud.com
15709 Tanner Ridge Road
San Diego, California 92127

From: andywellspring@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 1:51:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

andywellspring@gmail.com
21584 John Hyman Road
Fort Bragg, California 95437

From: Alvaro Ramos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 1:36:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alvaro Ramos
ramosalvaro131313@gmail.com
873 Fulton Ave
San Leandro, California 94577

From: Paul Lapidus
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, March 4, 2024 12:39:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Paul Lapidus
plapidus@ebold.com
2995 Rea Ct
Aromas, California 95004

From: Beverly Jennings
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, March 3, 2024 9:50:19 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Beverly Jennings
bevjenn@cruzio.com
602 Chestnut Street
Santa Cruz , California 95060

From: Linda A. Heath
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, March 3, 2024 7:32:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Linda A. Heath
heathster52@gmail.com
PO Box 397
Senecaville, Ohio 43780

From: Nancy Caponi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, March 3, 2024 4:20:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Caponi
earthknwr@aol.com
225 West Figueroa Street
Santa Barbara, California 93101

From: Erika Wanenmacher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, March 3, 2024 11:11:37 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erika Wanenmacher
ewanenmacher@gmail.com
1422 Agua Fria St
Santa Fe, New Mexico 87505-0960

From: Ellen McCann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, March 3, 2024 7:37:14 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ellen McCann
ellenmccann63@hotmail.com
1262 Amalfi Place
Escondido, California 92027

From: Deb Federin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 11:10:56 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Deb Federin
dfederin@gmail.com
23 Linda Vista Place
Monterey, California 93940

From: vanzen2@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 10:50:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

vanzen2@gmail.com
14447 Placid Dr, Whittier, CA, USA
Whittier, California 90604

From: Shawn Johnson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 9:19:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shawn Johnson
shawninbarca@gmail.com
951 Stratford Dr
Encinitas, California 92024

From: Satya Vayu
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 3:31:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Satya Vayu
satyavayu@gmail.com
608 SE 45th Ave
Portland, Oregon 97215

From: Shakayla Thomas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 2:41:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Shakayla Thomas
tshakayla88@yahoo.com
407 South Taper Avenue,
Compton, California 90220

From: M. Steere
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 2:26:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

M. Steere
msteere6@gmail.com
365 King Rd
Petaluma, California 94952

From: SCOTT NELSON
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 1:19:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

SCOTT NELSON
play@kiteisland.com
P.O. Box 1075
Bethel Island, California 94511

From: Barbara Rosenthal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 12:40:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Barbara Rosenthal
bbarb9@gmail.com
11275 Westminster Ave
Los Angeles, California 90066

From: Claire Vela
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 11:20:58 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Claire Vela
claire.m.vela@gmail.com
3336 Quintara Street
San Francisco, California 94116

From: an.fidleir@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 11:12:20 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

an.fidleir@gmail.com
PO Box 8674
La Crescenta, California 91224

From: Cheri Porter Keisner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 8:07:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cheri Porter Keisner
c144p@outlook.com
280 Pepperwood Springs Rd.
Piercy, California 95587

From: Carol Bardoff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, March 2, 2024 7:40:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Bardoff
kairu22@gmail.com
978 Begier Ave.
San Leandro, California 94577

From: Raena Grainger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 8:56:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Raena Grainger
raena.grainger@gmail.com
1840 Baker Avenue
Madison, Wisconsin 53705

From: kyndellejo@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 8:09:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

kyndellejo@gmail.com
950 AVIS DR.
El Cerrito, CA, California 94530-2943

From: Ginny Madsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 7:03:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ginny Madsen
madsenginny3@gmail.com
13461 Aurora Drive
San Leandro, California 94577

From: Stephanie Boughton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 5:51:22 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Boughton
fragmentdesign1@gmail.com
42 Kobus Heights
Roleystone, Western Australia 6111

From: oneiler18@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 12:30:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

oneiler18@gmail.com
2692 Highland Ave
Highland , California 92346

From: Kennedy Davis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 12:14:06 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kennedy Davis
kennedydavis0212@gmail.com
247 E 500 N
Sharpsville, Indiana 46068

From: emmwake@hotmail.co.uk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 12:11:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

emmwake@hotmail.co.uk
6006 Claremont Ave, Apt 2
Oakland, 94618

From: rustyletters12@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 11:19:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

rustyletters12@gmail.com
61 W Church St
Denver, Pennsylvania 17517

From: Juliana Stoner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 11:08:58 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Juliana Stoner
juliana.f.stoner@gmail.com
61 Adams St
Keene, New Hampshire 03431

From: Robert Rutherford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 10:32:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Robert Rutherford
drjakekt@sonic.net
831A, University St
Healdsburg, California 95448

From: bridgetlowry22@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 10:18:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

bridgetlowry22@gmail.com
4 Laverne Avenue
Mill Valley, California 94941

From: Scott Jung
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 9:47:37 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Scott Jung
sjung810@hotmail.com
124 Monterey Rd Unit 204
South Pasadena, California 91030-5033

From: Scott Douglas Laxier
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 9:17:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Greed & deceit dictating public policy is a ruthless and unsustainable strategy.

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Scott Douglas Laxier
scottlaxier@gmail.com
540 Quail Run Ct
Del Rey Oaks, California 93940-5727

From: joyce banzhaf
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, March 1, 2024 9:04:14 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

joyce banzhaf
joycebanzhaf@gmail.com
112 Anita Street
Santa Cruz, California 95060

From: Glenn Mullins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 10:52:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Glenn Mullins
nascar8160@hotmail.com
7650 Puerto Rico Dr
Buena Park, California 90620

From: Caduceus3@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 10:06:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Caduceus3@gmail.com
401 NE 127th Ave
Portland, Oregon 97230

From: Ellen Ryan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 9:30:24 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ellen Ryan
ellenryan3843@gmail.com
2120 Foxwood Drive
Eureka, California 95503

From: Lucy Clark
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 9:29:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lucy Clark
lucyg391@gmail.com
HC 3 Box 88, Granite Station
Bakersfield, California 93308-9124

From: Natalie Walsh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 8:36:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Natalie Walsh
natalie@nataliewalsh.com
3246 Baker Street
San Francisco, California 94123

From: Anna Henry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 7:20:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Anna Henry
aphenry27@gmail.com
1522 Elm St
El Cerrito, California 94530

From: Noah Haydon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 6:55:52 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Noah Haydon
noahhaydon@gmail.com
405 91st St
Daly city , California 94015

From: Todd Snyder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 5:46:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Todd Snyder
toddclarksnyder@gmail.com
1941 Turk st
San Francisco, California 94115

From: Jonathan Weinstock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 5:12:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Jonathan Weinstock
jstock522@yahoo.com
2208 7th St
Berkeley, California 94710

From: Moira Birss
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 4:16:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I'm writing to ask you to reject the Carbon TerraVault I carbon capture and storage scheme.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Moira Birss
moira.birss@gmail.com
1734 20th Ave
Oakland , California 94606

From: allyson.finkel@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 3:47:22 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

allyson.finkel@gmail.com
29 Vista Barranca
Rancho Santa Margarita, California 92688

From: Margaret Levin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 3:31:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margaret Levin
m.f.levin@gmail.com
1218 Sequoia Pl
Davis, California 95616

From: Scott Nelson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 3:20:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Scott Nelson
play@kiteisland.com
P.O. Box 1075
Bethel Island, California 94511

From: Renee ONeil
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 2:59:57 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Renee ONeil
oneiler18@gmail.com
2692 Highland Ave Spc 88
Highland, California 92346

From: Paul Eisenberg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 2:56:58 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.
Paul Eisenberg

Paul Eisenberg
eisenber@indiana.edu
6 Upland Road
Baltimore, Maryland 21210

From: Lara Ingraham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 12:53:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lara Ingraham
laraingraham@gmail.com
800 N Las Palmas Ave Apt 105
Los Angeles , California 90038

From: Christopher Ware
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 11:50:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Christopher Ware
cmdubb@yahoo.com
45746 Bridgeport Dr
Fremont, California 94539

From: dgwcitrine@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 11:19:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

dgwcitrine@gmail.com
5118 De Longpre Avenue, #314
Hollywood, California 90027

From: Richard Freeman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 9:37:25 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Freeman
rfree@sonic.net
59 Kenyon Avenue
Kensington, California 94708

From: Kenneth Pennington
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 9:17:48 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kenneth Pennington
elbows-rayon-0s@icloud.com
2257 Hillcrest Drive
Ventura, California 93001

From: Debbie Woods
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 8:55:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Debbie Woods
dwoods1961@gmail.com
4513 Fairway Dr
Ronert Park, California 94928

From: Marisa Morales
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 8:33:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marisa Morales
marisamcawthorne@gmail.com
9122 E 53rd Ave.
Denver, Colorado 80238

From: Mark Hupf
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 8:11:38 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Mark Hupf
mhupf@icloud.com
37388 Medjool
Palm Desert, California 92211

From: Dan Perdios
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 8:06:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dan Perdios
danpinps@aol.com
775 N Plaza Amigo
Palm Springs, California 92262

From: Marilyn Barthelow
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 7:54:43 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Marilyn Barthelow
sue_barthelow@yahoo.com
365 Westlake Rd
Auburn, California 95602

From: Abbie Bernstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 3:30:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Abbie Bernstein
hedgebeast@aol.com
1245 N Kings Rd Apt 7
West Hollywood, California 90069-2821

From: Jose Rodriguez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 1:18:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jose Rodriguez
branemm1014@icloud.com
15829 Landmark Drive
Whittier , California 90604

From: Ellen Lewis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 12:34:33 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ellen Lewis
eggbert26@yahoo.com
1153 Adrienne Way
Santa Rosa, California 95401

From: Margie Halladin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 12:32:07 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margie Halladin
margiehalladin@yahoo.com
454 Las Gallinas Avenue, #149
San Rafael, California 94903

From: Aixa Fielder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Thursday, February 29, 2024 12:14:38 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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Thank you.

Aixa Fielder
aixafielder@gmail.com
1803 N Wilton Pl
LA, California 90028

From: Allan Campbell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:33:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Allan Campbell
allanlc16@gmail.com
3162 Isadora
San Jose, California 95132

From: Debbie Yousef
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:30:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Debbie Yousef
dy.mkalthwy@yahoo.com
30711 Paradise Palm Avenue, 317
HOMELAND, California 92548

From: Utkarsh Nath
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:12:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

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Thank you.

Utkarsh Nath
utkarsh.nath@yahoo.com
34462 Alberta Terrace
Fremont, California 94555

From: AJ Cho
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:07:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

AJ Cho
amenoartemis@gmail.com
159 Santa Teresa
San Leandro, California 94579

From: Tracy McCowan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:01:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tracy McCowan
tekmcc@yahoo.com
706 Douglas St
Bakersfield , California 93308

From: Diane Krell-Bates
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:56:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Diane Krell-Bates
diane_krellbates@yahoo.com
9115 Judicial Dr
San Diego, California 92122

From: Roberta Lutsky
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:54:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Roberta Lutsky
robynlutsky@gmail.com
18747 Hatteras St
Lucerne Valley, California 92356

From: 3qlschultz@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:50:10 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

3qlschultz@gmail.com
874 York St.
Oakland, California 94610

From: Francesca Rago
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:42:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Francesca Rago
bah000224@hotmail.com
111 Cleaveland Road, Apt. 100, Apt. 100
Pleasant Hill, California 94523

From: Barbara Diederichs
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:42:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Diederichs
barbara@diederichs.me
12956 Christman Ln
Poway, California 92064

From: Ked Garden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:38:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ked Garden
kedz2garden@gmail.com
2348 Main street
Lemon Grove, California 91945

From: Melodi Gulsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:29:15 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melodi Gulsen
melodi2727@yahoo.com
2014 Associated Rd
Fullerton, California 92831

From: Theresa Bucher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:04:12 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Theresa Bucher
buchert@equinetradingco.com
5405 Topeka Dr
Tarzana, California 91356

From: Brian Still
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:02:28 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Brian Still
brianmstill@gmail.com
4077 3rd Ave unit 307
San Diego , California 92103

From: Isaac Ramirez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:38:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

We need environmental justice and protection for all Americans communities who are suffering from the effects of environmental racism, and other systemic problems that cause them to be the most vulnerable to climate and environmental related problems.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Isaac Ramirez
isaac2022rr@gmail.com
2445 Cameron Drive
Union city, California 94587

From: Carla Holguin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:32:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carla Holguin
lakerjulie32@gmail.com
2228 Observatory Ave
Los Angeles , California 90027

From: Ann Wasgatt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:26:10 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ann Wasgatt
wasgatta@gmail.com
308 Alta Vista Ave
Roseville, California 95678

From: John Lamb
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:22:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Lamb
johnlamb46@gmail.com
159 W Montecito Ave Apt B
Sierra Madre, California 91024

From: Tia Triplett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:09:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tia Triplett
tia@anlf.com
3959 Berryman Ave
Los Angeles, California 90066

From: Steve Sketo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:08:07 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Sketo
stevesketo58@gmail.com
11522 Bay Meadows Ln.
Bakersfield, California 93312

From: B G
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:06:50 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

B G
barbaran2323@gmail.com
2355 Brommer
Santa Cruz , California 96062

From: Ann Dorsey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:46:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ann Dorsey
aedorsey@hotmail.com
18042 Schoenborn St #5
Northridge, California 91325

From: Julie Jacobson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:39:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Julie Jacobson
juliesadla@me.com
17424 blythe street northridge CA 91325
northridge, California 91325

From: Lacey Wozny
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:18:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lacey Wozny
wozny.lacey@gmail.com
1842 N Avenue 56
Los Angeles, California 90042

From: etrucker86@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:12:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

etrucker86@gmail.com
2312 Clay St
NAPA, California 94559

From: Melanie Schimpf
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:06:04 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melanie Schimpf
melanieaschimpf@gmail.com
99 e laurel ave
sierra madre, California 91024

From: Jane Harada
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:55:15 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jane Harada
jtharada@yahoo.com
1223 Oxford Street
Berkeley, California 94709

From: Susan Blain
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:50:37 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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There is no positive side to carbon capture and storage. It is just another false solution. It causes harm, rather than relief from harm.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Susan Blain
s_blain@mwcc.mass.edu
4353 34th Street, Apt 103
San Diego, California 92104

From: Tina Ann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:47:10 PM

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Kern County,

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Tina Ann
8tinaann@gmail.com
p.o. box 265
Bolinas, California 94924

From: Russell Weisz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:43:36 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Russell Weisz
russweisz1@gmail.com
319 Laguna Street
Santa Cruz, California 95060

From: Judith Falck-Madsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:39:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.
Sincerely,
Judith Falck-Madsen

Judith Falck-Madsen
judithfalckmadsen@gmail.com
205 Oceanview
Carpinteria, 93013

From: Beverly Kuck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:33:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Beverly Kuck
b_kuck@aol.com
14402 Pine Knob Lane
Bakersfield, California 93306

From: Christopher Geukens
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:27:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher Geukens
cgeukens@gmail.com
16856 Marilla Street
Northridge, California 91343

From: Bonnie Grossman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:22:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bonnie Grossman
u_majesty@yahoo.com
44 Jade Court, 44 Jade Court, Apartment #8
Novato, California 94945

From: Joan Murray
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:21:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joan Murray
jsmurray24@gmail.com
3330 Grand View Blvd
Los Angeles , California 90066

From: Ellen Riegelhuth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:19:11 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ellen Riegelhuth
eriegelhuth@yahoo.com
1708 Oakmont Dr, Apt 3
Walnut Creek, California 94595

From: Pat Magrath
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:53:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pat Magrath
phatmcass@gmail.com
1905 N. Vallejo Way
Upland, California 91784-1674

From: Michael Eisenscher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:52:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Whatever might be said bout the Carbon TerraVault I Elk Hills carbon capture project, the only thing is designed to do is perpetuate the use of fossil fuels and its primary objective is to capture profits, not carbon.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Eisenscher
meisenscher@gmail.com
4654 Congress Ave.
Oakland, California 94601

From: Bonnie Burke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:42:05 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Bonnie Burke
b_margay@yahoo.com
PO Box 601493
San Diego, California 92160

From: Michael Grant White
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:32:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Michael Grant White
michaelgrant2@mac.com
1264 Hawthorne St
Alameda, California 94501

From: Martha Booz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:26:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Martha Booz
mlbooz@calnatives.com
3823 Valley Lane
El Sobrante, California 94803-3118

From: Jered Cargman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:22:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Jered Cargman
jered@swingin60s.com
48700 Twin Pines Rd
Banning, California 92220

From: 2headedserpent@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:21:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

2headedserpent@gmail.com
4035 Stautlo Avenue
Beverly Hills , 90210

From: Katya Abbott
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:14:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katya Abbott
fivestarep48@gmail.com
3825 Via Romaya
National City, California 91950

From: Keiko Barrett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 5:13:41 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Keiko Barrett
moikadiekat@gmail.com
1150 J Street Unit 306
San Diego, California 92101

From: John Miller
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:49:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

John Miller
zenmastermiller@gmail.com
45 Tangerine
Irvine, California 92618

From: Richard Patenaude
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:40:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Richard Patenaude
patnod@mac.com
68 Nile Street
Palm Springs, California 92264-0510

From: Derek Young
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:37:49 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Derek Young
derekallenyoung@yahoo.com
7921 McConnell Ave. , Westchester
Los Angeles, California 90045

From: diana waters
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:33:23 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

diana waters
dianawaters09@gmail.com
19901 prairie ave
torrance, California 90503

From: johnpasqua57@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:22:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

johnpasqua57@gmail.com
843 s escondido Blvd
Escondido , California 92025

From: antimony.sharpe@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:10:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

antimony.sharpe@gmail.com
930 Figueroa Terrace
Los Angeles, California 90012

From: britanig106@hotmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:10:15 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

britanig106@hotmail.com
1235 s winery
Fresno , California 93727

From: Onofre A Abarca
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:08:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.
Onofre Antonio Abarca

Onofre A Abarca
onofreabarca@sbcglobal.net
3735 Nevil St
Oakland, California 94601

From: Diana Bohn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:08:25 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Diana Bohn
nicca@igc.org
618 San Luis Rd
Berkeley, California 94707-1726

From: Christopher DiFonso
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:05:06 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher DiFonso
csdifonso@yahoo.com
28866 WOODCREEK
MISSION VIEJO, California 92692

From: cbbrown18@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:02:08 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

cbbrown18@gmail.com
1050 63rd St
Oakland, California 94608

From: Carmen Gagne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 3:46:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Carmen Gagne
cbg@ebold.com
1008 Brewington Avenue
Watsonville, California 95076

From: Greg Perkins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 3:39:41 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Greg Perkins
gperkins@glendale.edu
343 1/2 Wisconsin Ave
Long beach, California 90814

From: Mary Flanagan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 3:36:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Flanagan
tomaryflanagan@gmail.com
661 Alcatraz Ave #3
Oakland, California 94609

From: Colleen Bergh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 3:20:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Colleen Bergh
colleenbergh@hotmail.com
3050 S Bristol St Unit 9H
Santa Ana, California 92704

From: Darrell Trombley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 3:05:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Darrell Trombley
awokenchrist@gmail.com
252 Ridge road
Palm Springs, California 92264

From: j yudell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:57:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

j yudell
turtleshmertle@gmail.com
P.O. Box 5114
Santa Monica, California 90409

From: Lusineharutyunyan@yahoo.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:54:44 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lusineharutyunyan@yahoo.com
17340 Burbank Blvd, 206
Los Angeles, California 91316

From: Michael A. Johnston
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:49:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael A. Johnston
pluto_of_the_underworld@hauntedmansion.com
P.O. Box 16321
San Diego, California 92176

From: Saran K.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:47:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Saran K.
sarank@mac.com
1710 Bagley Ave,
Los Angeles, California 90035

From: Dan and Lilly Kittredge
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:44:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dan and Lilly Kittredge
dan.kittredge@gmail.com
7620 Eastridge Drive
La Mesa, California 91941-7881

From: Susan McCorry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:18:51 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Susan McCorry
smcpistil@aol.com
230 Pacific Street, # 108
Santa Monica, California 90405

From: Annika Nabors
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:18:10 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Annika Nabors
annika.nabors@gmail.com
13207 Wimberly Square
San Diego, California 92128

From: Melony Paulson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:14:38 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Melony Paulson
melony@silverlightpress.com
21919 Santaquin Dr
Diamond Bar, California 91765

From: Charlene Woodcock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:14:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

We know that it is the mining, transport, and burning of fossil fuels that drive the climate crisis. We know that Kern County is fast becoming a sacrifice zone. We understand that carbon capture is an unproven technology that bodes ill for future generations. This terrible environmental degradation must STOP!
The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Charlene Woodcock
charlene@woodynet.net
2355 Virginia Street
Berkeley, California 94709

From: Tammy Bullock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:13:35 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Tammy Bullock
tamibullock@yahoo.com
1212 H St Spc 80,
Ramona, California 92065

From: Susi Higgins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:12:42 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Susi Higgins
susi_higgins@hotmail.com
611 N Brand Blvd
Glendale, California 91203

From: Dean Griswold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:03:56 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Dean Griswold
griswomd@ix.netcom.com
8784 Mohawk Way
Fair Oaks, California 95628

From: Stephen Rosenblum
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:03:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Stephen Rosenblum
pol1@rosenblums.us
212 Santa Rita Ave
Palo Alto, California 94301

From: Rebekah Moan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 2:02:41 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rebekah Moan
rebekah.moan@gmail.com
3721 Lincoln ave
Oakland, California 94602

From: Karen Jacques
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:59:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate. It must be stopped immediately.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Jacques
threegables1819@gmail.com
1209 T St
Sacramento, California 95811

From: Christine Fisher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:59:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Christine Fisher
chris@gettingby.net
6280 Central Ave
Newark, California 94560

From: oceanviewconsult@sbcglobal.net
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:54:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

oceanviewconsult@sbcglobal.net
827 Curtis St
Albany, California 94706

From: Norm Wilmes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:46:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Norm Wilmes
normw25@hotmail.com
849 Lincoln Rd
Yuba City, California 95991

From: Francine Kubrin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:45:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Francine Kubrin
fkubrin@gmail.com
11628 Montana Ave Apt 306
Los Angeles, California 90049

From: joannatang@ucsb.edu
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:44:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

joannatang@ucsb.edu
52 rip curl place
Goleta, California 93117

From: Erik Ferry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:43:25 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Carbon Capture and Storage, in all its manifestations and as-proposed for Kern County, is nothing more than a scam and a distraction from meaningful action on climate change. Deny another example of this cynical greenwashing scheme, which pays fossil fuel interests as they deceive societies into believing that CCS is an actual solution. It is not.

Erik Ferry
meleagris69@gmail.com
2550 Ellsworth Street
Berkeley, California 94704

From: ackermanjay@icloud.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:39:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

ackermanjay@icloud.com
5333, Terra Granada Dr. 2A Entry 23
Walnut Creek, California 94595 4080

From: Celeste Hong
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:39:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Celeste Hong
celestehong13@gmail.com
4758 Cromwell Avenue
Los Angeles, California 90027-1144

From: Marguerite Barragan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:31:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Big Oil has outdone itself with this ridiculous and dangerous proposal. The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marguerite Barragan
miggleb@gmail.com
209 Bronson St
Watsonville, California 95076

From: John Schaefer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:16:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Schaefer
jcschaef@igc.org
1734 Roberts Way
Arcata, California 95521

From: Lissette Garcia
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:09:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lissette Garcia
ggarcialissette@icloud.com
320 Park Drive
Bakersfield , California 93306

From: Charles Sharpe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 1:06:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department,
and Dear EPA Region 9 Administrator Guzman,

“TerraVault” carbon-capture is a gimmick devised by floundering fossil fuel purveyors to keep dollars flowing to their companies. This kind of carbon capturing,, sequestering, and piping is ineffective and will require more expenditure of energy, more combustion of fuels, and more production of greenhouse gases than it could hope to “capture.”

This project will only introduce more hazards to our communities. Please quit trying to forestall the end of the fossil-fuel era.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County’s limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have “significant and unavoidable” impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Charles Sharpe
chipsharpe@icloud.com
1644 Old Arcata Road
Bayside, California 95524-9301

From: Ken Rosen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:58:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ken Rosen
krosen13@me.com
138 S. Bedford Dr.
Beverly Hills, California 90212

From: Michelle Grimes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:55:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Michelle Grimes
mjlgrimes@hotmail.com
5425 Adams Avenue
San Diego, California 92115

From: Annamarie jones
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:55:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Annamarie jones
annamariejones1@hotmail.com
312 n. court st.
alturas, California 96101

From: Marla Flores-Jauregui
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:51:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Marla Flores-Jauregui
senorajauregui68@yahoo.com
6300 Denslow Way
Sacramento , California 95823

From: Kenneth Nahigian
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:48:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kenneth Nahigian
appalonius@netzero.net
9570 Harvest View Way
Sacramento, California 95827-3266

From: Joanna Welch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:47:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joanna Welch
jfwelch22@gmail.com
2945 Lowell St, 2945 Lowell
Eureka, California 95501

From: Karen McCaw
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:45:46 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Karen McCaw
mccaw.karen@yahoo.com
4526 Mount Vernon Dr
Los Angeles, California 90043

From: sue mossman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:44:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

We have a moral imperative to protect our air, water, health, and climate, I urge you to reject this dangerous project.

sue mossman
syl1@humboldt.edu
PO Box 223
Arcata, California 95518

From: Marilyn Eng
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:33:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marilyn Eng
mreng5@yahoo.com
348 San Leandro Drive
Diamond Bar, California 91765

From: Linda Webb
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:29:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Linda Webb
lwebb@dmjca.org
5300 Crest Road
Rancho Palos Verdes , California 90275

From: Greg C
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:29:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Greg C
gac37@hotmail.com
811 N Main
Santa Ana , California 92701

From: Mox Mox
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:27:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Mox Mox
moxaruge@aol.com
14552 Hesby Street
Sherman Oaks, California 91403

From: Tara Strand
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:26:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tara Strand
quinnster@gmail.com
11127 Hesby St, Unit 7
North Hollywood, California 91601

From: Nikki Nafziger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:24:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Nikki Nafziger
nikkinashmusic@gmail.com
1101 Porter St
Vallejo, California 94590

From: Laura Patrick
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:23:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Laura Patrick
laurag2pets@yahoo.com
1653 Mc Fadden Ave
Santa Ana, California 92704

From: David Cotner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:21:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

David Cotner
hertzlion@gmail.com
675 E Santa Clara Street
Ventura, California 93001

From: Judy Shively
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:14:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judy Shively
jashively01@gmail.com
1475 Imperial Ave
San Diego, California 92101

From: Rick StJohn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:14:39 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rick StJohn
rinsfcausa@gmail.com
1 Daniel Burnham Court
San Francisco, California 94109

From: Richard Bold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:11:56 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Richard Bold
boldgilman@aol.com
2098 Hawley Dr
Vista, California 92084

From: Lynne Weiske
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:11:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lynne Weiske
movieblonde@hotmail.com
6128 Wilshire
Los Angeles , California 90048

From: plumascountydemocrats@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:11:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

plumascountydemocrats@gmail.com
PO Box 3012
Quincy, California 95971

From: Michele May
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:10:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Michele May
mishame1953@gmail.com
29801 N Hwy 101
Willits, California 95490

From: knarfdnomyah4@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:09:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

knarfdnomyah4@gmail.com
4305 CARNATION LN
LAS VEGAS, Nevada 89108

From: Lauren Murdock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:09:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lauren Murdock
murdock_ls@hotmail.com
3940 Via Lucero
Santa Barbara, California 93110

From: Louise Doozan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 12:07:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Louise Doozan
loudoozan@icloud.com
4158 Pinewood Lake Drive
Bakersfield , California 93309

From: PAUL MEHLING
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:58:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

PAUL MEHLING
pazzo@hcsf.com
3105 Ashbrook court
Oakland, California 94601

From: jacq_lynne@pm.me
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:57:31 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

jacq_lynne@pm.me
6038 Paseo Salinero
Carlsbad, California 92009

From: erikaarmin@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:57:22 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

erikaarmin@gmail.com
1347 Montecito Cir
Los Angeles, California 90031

From: martina nicholson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:56:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

martina nicholson
martina.nicholson@gmail.com
po box 890
Soquel, California 95073

From: Anne Henkes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:54:22 AM

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Anne Henkes
ahenkes@pacbell.net
370 Imperial Way, Apt 220
Daly City, California 94015

From: John Steponaitis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:54:13 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

John Steponaitis
steponaj@gmail.com
910 Geary 20
San Francisco, California 94109

From: Christa Neuber
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:53:24 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christa Neuber
seamusminnie@gmail.com
728 N. Doheny Drive
W. Hollywood, California 90069

From: Evelyn Johnson-Todd
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:52:58 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Evelyn Johnson-Todd
known-corgis.0w@icloud.com
2056 S Willow Ave
Fresno, California 93727

From: Ann Bein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:52:27 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ann Bein
abein@ucla.edu
2216 Overland Ave.
Los Angeles, California 90064

From: Lisa Patton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:47:45 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Lisa Patton
lapatton729@hotmail.com
1881 SUTTER ST APT 101
San Francisco, California 94115

From: Joyce Calagos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:45:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joyce Calagos
joycecalagos1@gmail.com
1636 Geneva Ave.
San Francisco, California 94134

From: Andrew Donahue
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:44:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andrew Donahue
adonahue14@gmail.com
1410 36th Avenue
San Francisco, California 94122

From: Sheilah Fish
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:44:32 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sheilah Fish
sheilahfish@yahoo.com
561 Augusta Dr.
Moraga, California 94556

From: Christopher Hamilton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:44:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I grew up in the Centrtl Valley and frequently visited Bakersfield, where so much petroleum pumping was going on--and still is.

I view the Carbon TerraVault I Elk Hills carbon capture project as dangerous to health of valley residents, because it will prolong the life of polluting fossil fuel operations while also taking away vital resources from clean and renewable energy sources. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher Hamilton
ceh41845@gmail.com
1316 Albina Avenue
Berkeley, California 94706

From: Ruby Mitchell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:38:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ruby Mitchell
rubyrubydesign@icloud.com
10619 Farallone Dr
Cupertino, California 95014

From: Betty Kissilove
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:35:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Betty Kissilove
cacaogal@gmail.com
1401 10th Ave
San Francisco, California 94122

From: George Ludwiig
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:34:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

George Ludwiig
geludwig2014@icloud.com
1210 Grandview Rd.
Vista, California 92084

From: Marc Silverman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:33:37 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marc Silverman
dhalgrn@gmail.com
6030 Graciosa Dr
Los Angeles, California 90068-3071

From: Kathie Kingett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:31:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kathie Kingett
kingett.kathie@gmail.com
807 West Road
La Habra Hts, California 90631

From: Katherine Aker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:29:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Katherine Aker
kathiaker@icloud.com
10402 McClemont Ave
Los Angeles, California 91042

From: Regina Leonard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:28:37 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Regina Leonard
mzleonard@gmail.com
3239 Iberian Dr
Sacramento, California 95833

From: Mika Menasco
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:28:37 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Mika Menasco
mikamenasco@yahoo.com
735 65th St
San Diego , California 92114

From: hwhitson@choralarchive.org
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:25:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

hwhitson@choralarchive.org
1650 Spruce St
Berkeley, California 94709

From: Mark Huising
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:24:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

The problem with DACS is that it is techno-hopium; a wishful solution that is unproven at scale and economically not viable. But it sounds nice and therefore is a favorite strategy touted by fossil fuel companies to avoid rapid reductions in fossil fuel emissions. We need to cut our GHG emissions in half by 2030 according to the Intergovernmental Panel on Climate Change (IPCC) to have any hope of keeping the Paris stretch goal of 2 degrees in sight. DACS and CCS technologies allow the California Resources Corporation - a fossil fuel company - to say they care about our climate, while what they do is to continue to sell their proven assets in fossil fuels to generate record profits for their shareholders – at the expense of our climate. The oldest and best-known Direct Air Capture company – Switzerland-based Climeworks – has been building Direct Air Capture plants since 2017. The entire worldwide direct air capture capacity in 2022 was 2714 tons of CO2. Those are the annual emissions equivalent to 590 average US passenger cars, or the amount of CO2 the world emits in 2.3 seconds. And then there's the cost of DACS of $700 - $1100 per metric ton of CO2 captured. That cost – even if it were to come down substantially – is never going to compete with not burning fossil fuels. Climeworks CEO said last week that DACS cost by 2050 will likely still be $300-500 per ton of CO2 captured. Renewables (photovoltaic, on- and offshore wind plus storage) are far cheaper to build and operate compared the operation of even existing fossil fuel coal plants and fracked methane plants – even without considering the equity aspects of who suffers the worst consequences of continuing to burn fossil fuels. Proponents of carbon capture and storage will point to the fact that the IPCC's reports do call for carbon capture approaches as part of the solution to our gargantuan emissions problem. What the California DAC hub and its fossil fuel partners are conveniently leaving out, is that the IPCC envisions Direct Air Capture to remove at most a fraction of a gigaton of CO2 per year, and no earlier than 2050. The International Energy Agency (hardly known as a bastion of raging environmental concern) puts that number at less than 0.7 gigaton of CO2 per year or 1.4% of global annual GHG emissions. In other words, DACS will at best be a very expensive niche application that we might have to use for

truly hard-to-abate emissions in the second half of the century. If the California Resources Corporation wants to be responsive to the IPCC, they should scale down their production to meet the IPCC recommended 50% cuts in GHG emissions from the oil and gas they extract by 2030. Of course CRC does not want this; fossil companies favor carbon capture technologies as they offer a reasonable-sounding approach that underwrites a greenwashing narrative where fossil fuel companies can continue fossil fuel extraction under a business-as-usual scenario while appearing to be responsive and part of the solution to our climate crisis.

Vote as if the lives and livelihoods of your communities depend on this decision, because they are.

Mark Huising
mark.o.huising@gmail.com
Main Street
Davis, California 95616

From: David Perry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:22:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,
REJECT AND NEVER ALLOW THE DISASTROUS CARBON TERRAVAULT I CARBON CAPTURE AND STORAGE SCHEME!
The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

David Perry
dperry2@gmail.com
513 Ashton Ave
Palo Alto, California 94306

From: Giovannina Fazio
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:18:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Giovannina Fazio
fazio@sndden.org
1520 Ralston Ave, 1520 Ralston Ave
Belmont, California 94002

From: Candace Batten
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:14:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Candace Batten
candace@kaimanlaw.com
2431 Altman St.
Los Angeles, California 90031

From: janet maker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:13:57 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

janet maker
janet29018@gmail.com
925 Malcolm Ave
Los Angeles, California 90024

From: Maria Molund
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:13:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Greetings Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to please reject this dangerous project.

Maria Molund
maria.molund@gmail.com
5875 Packard Street
Los Angeles , California 90019

From: John Costello
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:12:02 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Costello
jmc@monitor.net
P.O. Box 31
Bodega, California 94922

From: John-Allan Macunovich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:10:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

John-Allan Macunovich
jamacunovich@icloud.com
3675 Monon St\,Apt 201
Los Angeles, California 90027

From: Nancy Heck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:10:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Heck
nancyheck1@aol.com
822 Speed St
Santa Maria, California 93454

From: bettemiep@hotmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:10:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

bettemiep@hotmail.com
819 57th street
Oakland , California 94608

From: Brice Beckham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:09:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Brice Beckham
bbeckham@drama34.com
8261 Norton Ave 2
West Hollywood, California 90046-5973

From: Tracy Shortle
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:09:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Tracy Shortle
tracyshortle@yahoo.com
2932 Walker Lee drive
Los Alamitos, California 90720

From: Elizabeth Hedrick
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:08:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Elizabeth Hedrick
emariehedrick@gmail.com
151 Calderon Ave Apt 53
Mountain View, California 94041

From: Roger Batchelder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:07:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Roger Batchelder
rogb@nethere.com
4311 Winona Ave Apt 2
San Diego, California 92115-5054

From: scott jung
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:07:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

scott jung
sjung810@hotmail.com
124 monterey road
SOUTH PASADENA, California 91030

From: Karen Guma
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:06:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Karen Guma
guma@sonic.net
121 White Oak Cir
Petaluma, California 94952

From: alvaro garza
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:05:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

alvaro garza
garlicy2@sbcglobal.net
1721 morning dove circle
modesto, California 95354

From: Gregory Perkins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:05:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Gregory Perkins
gperkins@glendale.edu
343 1/2 Wisconsin Ave
Long beach, California 90814

From: Wayne Steffes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:05:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Wayne Steffes
camerashy@shasta.com
2187 Wisconsin Ave.
Redding, California 96001

From: Sara Van Dusen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:04:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sara Van Dusen
svdusen@hotmail.com
2641 Elmdale Ct
Palo Alto, California 94303

From: Brian Khairullah
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:03:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Brian Khairullah
bkhairul@hotmail.com
35557 Teja Ct
Yucaipa, California 92399

From: Lauren Linda
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:02:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lauren Linda
laulind714@gmail.com
2376C Via Mariposa West
Laguna Woods, California 92637

From: Steve Bloom
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:02:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Steve Bloom
sbloom@pixar.com
1417 7th Ave
San Francisco, California 94122-3702

From: Theresa Gonzalez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 11:00:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Theresa Gonzalez
lthrchick@hotmail.com
41 Broadway St
Redwood City, California 94063

From: Barbara Jue
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:57:48 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Every aspect of this project is laden with risk to public health and the environment.

Barbara Jue
sfbar48@gmail.com
81 Lansing St, Apt 411
San Francisco, California 94105

From: Alison Traina
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:57:08 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Alison Traina
alison.traina@gmail.com
1501 Encinal Avenue, Apt. B
Alameda, California 94501

From: Michael Tomczyszyn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:56:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Michael Tomczyszyn
mtomczyszyn@hotmail.com
243 Ramsell St
San Francisco, California 94132

From: Nancy Taylor
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:56:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Nancy Taylor
ngtaylor94619@yahoo.com
4207 Knoll Ave
Oakland, California 94619

From: Patricia Butler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:55:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patricia Butler
psbutler2024@gmail.com
8266 Solano Street
Ventura, California 93004-1105

From: Wendy Lohman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:55:25 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Wendy Lohman
wlohman@support.ucla.edu
1260 Veteran Ave. #324
Los Angeles, California 90024

From: Joy Pratt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:52:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joy Pratt
somispratt@gmail.com
5898 laCumbre rd
Somis, California 93066

From: Anthony Jammal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:52:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Anthony Jammal
rcquetbl1@hotmail.com
1601 Dana Way
Roseville , California 95661

From: Katherine Patterson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:51:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katherine Patterson
katpatt1969@gmail.com
1184 N.Main
Fort Bragg, California 95437

From: Emily Morris
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:50:50 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I'm writing to echo and amplify the voices of others in saying: The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Emily Morris
emilys.morris21@gmail.com
128 N Humboldt St
San Mateo, California 94401

From: Patrice Wallace
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:50:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patrice Wallace
patricewallace@cruzio.com
5498 Coast Rd
Santa Cruz, California 95060

From: Paul Thompson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:48:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Paul Thompson
paultheteacher@outlook.com
6761 Freehaven Dr
Sacramento, California 95831

From: Erh-Yen To
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:47:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Erh-Yen To
sea11wa@yahoo.com
3936 Stanwick Ave
Sacramento, California 95835

From: Marisa Landsberg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:47:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marisa Landsberg
marisalandsberg@verizon.net
815 2nd St
Manhattan Beach, California 90266

From: Carl Luhring
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:46:44 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Carl Luhring
carlluhring@hotmail.com
2179 Opal Rdg
VISTA, California 92081

From: Cherie Garrett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:46:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Cherie Garrett
dreamlover405@hotmail.com
5069 colony dr.
camarillo, California 93012

From: Jeff Hoffman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:45:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeff Hoffman
hefjeff.hof@gmail.com
825 Washington # 330
Oakland, California 94607

From: Vic Bostock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:43:20 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vic Bostock
care4animals@hotmail.co.uk
1612 Woodglen Ln
Altadena, California 91001

From: Gail Farina
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:42:30 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Gail Farina
gailster@hotmail.com
3537 Rosewood Ave.
Los Angeles, California 90066

From: Ted Fishman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:42:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ted Fishman
ted10000@hotmail.com
790 Villa Teresa Way
san jose, California 95123

From: Gregory Coyle
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:42:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Gregory Coyle
gcoyleca@gmail.com
14 Ford Street
San Francisco, California 94114

From: Ree Whitford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:41:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ree Whitford
reewhitford@gmail.com
36 Blue Jay Ct 6301
Napa, California 94558

From: Susan P. Walp
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:41:16 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Susan P. Walp
susanwalp@gmail.com
1234 El Mirador
Pasadena, California 91103

From: Philip Simon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:40:37 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Philip Simon
philsim75@aol.com
PO Box 9473
San Rafael, California 94912

From: marcy@theueckers.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:39:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

marcy@theueckers.com
414 Hillcrest Rd
San mateo CA USA, California 94402

From: Samuel Durkin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:39:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Samuel Durkin
samussr337@hotmail.com
5048 Lakeview Circle, Fairfield, CA, USA
Fairfield, California 94534

From: James Combs
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:38:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

James Combs
jamescombsmusic@me.com
6939 Camrose
Los Angeles, California 90068

From: Josef Kasperovich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:38:48 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Josef Kasperovich
jkaspero@calpoly.edu
P. O. Box 14409
San Luis Obispo, California 93406

From: donna@rebarworks.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:38:08 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

donna@rebarworks.com
15121 village 15
Camarillo , California 93012

From: Pablo Voitzuk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:37:56 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Pablo Voitzuk
pablovoitzuk@yahoo.com
5405 Broadway
Oakland, California 94618-1745

From: Christy Schauf
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:37:04 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Christy Schauf
christys@meyersound.com
27 La Vuelta St
Vallejo, California 94590

From: CHRIS OMALLEY
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:36:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

CHRIS OMALLEY
chris@utilityincentive.com
PO BOX 90902
SAN DIEGO, California 92126

From: Geoff Regalado
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:36:09 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Geoff Regalado
gregalado74@hotmail.com
P.O. Box 4183
Burbank, California 91503

From: George Ruiz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:35:57 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

George Ruiz
ruiz.george87@yahoo.com
1321 hull drive
San Carlos, California 94070

From: Barbara Jacobsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:35:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Jacobsen
barbj2@gmail.com
650 4th St W Apt 43, 43
Sonoma, California 95476-6840

From: Yves DeCargouet
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:35:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Yves DeCargouet
countzero100@gmail.com
6820 Virginia Dr
Lucerne, California 95458

From: Barbara Jacobsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:34:59 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Jacobsen
barbj2@gmail.com
650 4th St W Apt 43,
Sonoma, California 95476

From: George Ruiz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:34:59 AM

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

George Ruiz
ruiz.george87@yahoo.com
1321 hull drive
San Carlos, California 94070

From: Ted Fishman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:34:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ted Fishman
ted10000@hotmail.com
790 Villa Teresa Way
San Jose, California 95123

From: Janet Maker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:34:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Janet Maker
sugary.faraway.0n@icloud.com
925 malcolm av
los angeles, California 90024

From: Chris Rose
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:33:19 AM

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Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Chris Rose
chrisrose1994@hotmail.com
304 Sherri Court
Petaluma , California 94952

From: Carlos Arnold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:26:38 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carlos Arnold
carlos.arnold39@gmail.com
499 Fair Oaks Dr
Santa Maria, California 93455

From: Elana Sulakshana
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:19:10 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elana Sulakshana
sulak72@gmail.com
2134 Grant St
Berkeley, California 94703

From: Dan Bacher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:16:47 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dan Bacher
danielbacher53@gmail.com
3201 Eastwood Road
Sacramento, California 95821

From: ohsusieq@mac.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:14:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

ohsusieq@mac.com
35109 Highway 79, Space 263
Warner Springs, California 92086

From: Pablo Voitzuk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:14:05 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pablo Voitzuk
pablovoitzuk@yahoo.com
5405 Broadway
Oakland, California 94618

From: rvale94873@yahoo.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:12:13 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

rvale94873@yahoo.com
1072 S GARFIELD AVE
MONTEREY PARK, California 91754-5052

From: bwilliamson946@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:11:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

bwilliamson946@gmail.com
919 Buchanan st
Albany, California 94706

From: Shoshana Wechsler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:10:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shoshana Wechsler
swechs@sonic.net
59 Kenyon Ave., Kensington CA
Kensington, California 94708

From: Laurie McLaughlin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:08:15 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laurie McLaughlin
leavesongrass@icloud.com
4075 Hilldale
San Diego, California 92116

From: Jessica Dardarian
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:06:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jessica Dardarian
jessicadardarian@gmail.com
1274 Humbug Creek Court
Folsom, California 95630

From: Janet Saevitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 10:02:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Janet Saevitz
saevitzj@gmail.com
5752 Ayala Avenue
Oakland, California 94609

From: Ronit Corry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:59:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ronit Corry
ronit@worldshare.net
1711 Pampas Ave
Santa Barbara, California 93101

From: audrey.lareau@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:53:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

audrey.lareau@gmail.com
41451 Eureka Hill Rd
Point Arena, California 95468

From: cindymcpherson.cm@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:53:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

cindymcpherson.cm@gmail.com
7331 Waldo Lane
EL CERRITO, California 94530

From: cantai41@icloud.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:49:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

cantai41@icloud.com
8515 Costa Verde Blvd, unit #211
San Diego, California 92122-1137

From: Sheila Thorne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:48:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sheila Thorne
sheilathorne5@gmail.com
1326 Spruce St.
Berkeley, California 94709-1435

From: a.f. shayne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:46:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

a.f. shayne
afshayne@gmail.com
126 n. martel avenue
Los Angeles, California 90036

From: paula@larozaconstruction.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:43:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

paula@larozaconstruction.com
4087 Stanford Way
Livermore, California 94550

From: glen deardorff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:41:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

glen deardorff
guitarride@gmail.com
18250 crest
castro valley, California 94546

From: Peter Lee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:37:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peter Lee
peterboothlee@hotmail.com
3910 FULTON ST, apt 4
San Francisco, California 94118

From: Susan Gill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:37:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Gill
sulac9@yahoo.com
15006 Skaith Bend
Nevada City, California 95959

From: mzkupfer@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:35:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

mzkupfer@gmail.com
466 41st Street, Apartment #12
Oakland, California 94609

From: NANCY Bocanegra
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:34:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

NANCY Bocanegra
njbocanegra@yahoo.com
2814 Velvet Way
Walnut Creek, California 94596

From: Avi Shaprut
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:33:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Avi Shaprut
sdsurfer72-generic@yahoo.com
7050 El Fuerte St
Carlsbad, California 92009

From: Kevin Schader
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:32:13 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kevin Schader
now_what17@yahoo.com
421 Camelback Rd
Pleasant Hill, California 94523

From: Marla Flores-Jauregui
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:31:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marla Flores-Jauregui
senorajauregui68@yahoo.com
6300 Denslow Way
Sacramento , California 95823

From: Diana Kliche
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:30:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Diana Kliche
klichediana@gmail.com
3351 Ridge Pk Ct
Long Beach, California 90804

From: Susan Goldstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:28:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Goldstein
susanrgoldstein@gmail.com
14621 McGregor Blvd., #9
Ft. Myers, Florida 33908

From: Frederick Muth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:26:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Frederick Muth
frederickmuth@gmail.com
576 36th Street
Manhattan Beach, California 90266

From: Andrea Whitson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:26:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andrea Whitson
whitsonandrea@yahoo.com
1472 Bryan Ave.
San Jose, California 95118

From: Mary Stanistreet
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:21:57 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Stanistreet
mkstanistreet@yahoo.com
304 Brentwood Ave
Ventura , California 93003

From: Kathy Neely
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:16:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathy Neely
kneely7@yahoo.com
PO Box 50046
Santa Barbara, California 93150

From: Birgit Hermann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:14:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Birgit Hermann
bhermannsf@aol.com
627 Page St
San Francisco , California 94117

From: Jack Dodson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:10:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jack Dodson
jackdodson05@yahoo.com
7848 Paseo Tulipero
Carlsbad, California 92009

From: Seth Picker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:09:52 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Seth Picker
droors.no.43@gmail.com
PO Box 1252
Diamond Springs, California 95619

From: Steve Metzger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:08:13 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Metzger
onemetzgersteve@gmail.com
6002 Hardwick Cir
Huntington Beach, California 92647

From: Gabriel Graubner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:05:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gabriel Graubner
graubgabriel@gmail.com
260 California Drive, Section D
Yountville, California 94599

From: Margaret Piper McNulty
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:04:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Please stop this foolish and dangerous plan!

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margaret Piper McNulty
pipermcn4climate@gmail.com
10383 Tonita Way
Cupertino, California 95014

From: Dr. Susan Penner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:03:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dr. Susan Penner
susanpennerbybay@gmail.com
8 Admiral Drive Unit 128
EMERYVILLE, California 94608

From: Marcia Sherman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:03:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marcia Sherman
mesfunches@yahoo.com
South Wolfe Road
Sunnyvale , California 94085

From: Neal Steiner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 9:01:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Neal Steiner
nrspacific@yahoo.com
2706 Castle Heights Place
Los Angeles, California 90034-1841

From: Leana Zang-Rosetti
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:59:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Leana Zang-Rosetti
leanarosetti@gmail.com
4000 Rhoda Ave
Oakland, California 94602

From: Joyce Kolasa
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:59:10 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joyce Kolasa
petsheaven4@gmail.com
33408 Hwy 190
Springville, California 93265

From: Alexander Fierro-Clarke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:58:54 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alexander Fierro-Clarke
alexfierro.film@gmail.com
1427 McDuff Street
Los Angeles, California 90026

From: Bob Schildgen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:57:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bob Schildgen
bob.schildgen@gmail.com
2418 Spaulding Ave
Berkeley, California 94703

From: Thomas Boffi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:56:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Boffi
taboffi@yahoo.com
12715 Vanowen St, Apt #1
North Hollywood, California 91605-5202

From: Theresa Roach Melia
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:52:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Theresa Roach Melia
kcwmn1@gmail.com
420 Edison Street
Graton, California 95444

From: Richard Behrman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:51:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Behrman
rfbehrman@gmail.com
6453 Outlook Avenue
Oakland, California 94605

From: Fred Schloessinger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:50:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Fred Schloessinger
fredleosch@gmail.com
8933 Biscayne Court #223B
Huntington Beach, California 92646

From: Janan Apaydin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:47:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Janan Apaydin
janan.apaydin@gmail.com
4001 Oakmore Rd
Oakland, California 94602

From: Lynne Holt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:47:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lynne Holt
holtlynne@hotmail.com
21542 Kinsale Dr
Lake Forest, California 92630

From: Joel Masser
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:47:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joel Masser
joelmasser@pm.me
5327 Romford Drive
San Jose , California 95124

From: Martin Horwitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:45:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Martin Horwitz
martin7ahorwitz@yahoo.com
1326 23rd Ave
San Francisco, California 94122-1608

From: Steve Aderhold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:45:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Aderhold
sladerhold@gmail.com
PO Box 1135
Fallbrook, California 92088

From: Ilene Toney
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:45:25 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ilene Toney
pinknmugsy13@gmail.com
346 TENAYA AVE
SACRAMENTO, California 95833

From: Pamela Magathan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:44:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pamela Magathan
pamelaclay999@gmail.com
2401 Holly Dr
Los Angeled, California 90068

From: Lisa Gherardi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:42:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lisa Gherardi
gherardi2@aol.com
435 Alberto Way
Los Gatos, California 95032

From: Robert Reed
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:41:28 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Robert Reed
robtsreed@gmail.com
8251 La Palma Ave #443
Buena Park, California 90620

From: Nora Roman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:40:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nora Roman
noritaroman@gmail.com
68 Arnold Ave
San Francisco, California 94110

From: Jennifer Wilson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:39:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jennifer Wilson
jwilson@44blue.com
11955 Weddington St., 216
Valley Village, California 91607

From: James Adams
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:37:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

James Adams
jsadams.4910@yahoo.com
9394 Mira Del Rio Drive
Sacramento, California 95827

From: Deborah Rudell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:37:02 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Deborah Rudell
ddrudell@gmail.com
262 Mesa Dr
Camarillo, California 93010

From: sue smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:33:09 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

sue smith
georgeedwardskid@gmail.com
961 Jacqueline Pl
Nipomo, California 93444-6605

From: Sherry Fatzinger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:33:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sherry Fatzinger
sherryfatziger@gmail.com
3401 Lemon St Apt, 414
Riverside, California 92501

From: P Perry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:33:00 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

P Perry
p.perry95467@gmail.com
18911 Stonegate Rd.
Hidden Valley Lake, California 95467

From: Henry Goff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:30:11 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Henry Goff
budgoff@gmail.com
4116 Marine View Avenue
San Diego, California 92113

From: Gwen Weil
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:30:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gwen Weil
gmweil77@gmail.com
4166 Lakeshore Ave.
Oakland, California 94610

From: Ken Rosen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:27:07 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ken Rosen
krosen13@mac.com
138 S. Bedford Dr.
Beverly Hills, California 90212

From: Marshal Mckitrick
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:26:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marshal Mckitrick
marsmck@gmail.com
5120 Elmer Way
Sacramento, California 95822

From: Mimi Abers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:26:23 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mimi Abers
mimiabers2@gmail.com
1122 oxford
Berkeley , California 94707

From: Cynthia Fernandez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:25:36 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cynthia Fernandez
bales.dwell_0z@icloud.com
1400 Pinnacle Court #109
Richmond, California 94801

From: Alexander Vollmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:25:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alexander Vollmer
abvollmer@gmail.com
26 Narragansett Cove
San Rafael, California 94901

From: astr01029@yahoo.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:24:56 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

astr01029@yahoo.com
920 North Sweetzer
West Hollywood, California 90069

From: Pat Thompson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:21:50 AM

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Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pat Thompson
patthompson5@icloud.com
312 Berkeley Ave
Roseville, California 95678

From: Matt Leonard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:19:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matt Leonard
mattjosephleonard@gmail.com
981 Village Circle
Oakland, California 94607

From: Matt Leonard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:19:17 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matt Leonard
matt@oilgasaction.org
981 Village Circle oakland, ca 94607
Oakland, California 94607

From: Matt Leonard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:19:10 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matt Leonard
matt@oilgasaction.org
981 Village Circle oakland, ca 94607
Oakland, California 94607

From: Melissa Mendes Campos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:18:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations in CA and divert our resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies continue to promote this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition away from fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquake risk, pipeline safety, and animal and plant species in the region.

The depleted oil field that CRC wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified further in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns, including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences, including asphyxiation, seizures, loss of consciousness, and even death.

Further, the project threatens Kern County's fragile water supply, since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should outright reject.

For the sake of our communities, our air, water, health, and climate, I urge you to stop this

dangerous project in its tracks.

Thank you.

Melissa Mendes Campos
melissamendescampos@gmail.com
350 Riverside Ave
Ben Lomond, California 95005

From: Katie McCammon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:18:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katie McCammon
katie.mccammon@350sacramento.org
425 Lampasas Ave.
Sacramento, California 95815

From: Niko Slavin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:14:00 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Niko Slavin
slavinniko@gmail.com
66 5th Ave
San Francisco, California 94118

From: Carol Schaffer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:11:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Schaffer
cschaff@aol.com
2530 kavanagh rd
san pablo, California 94806

From: greg@greybearddesign.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:11:17 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

greg@greybearddesign.com
1525 Highland Drive
Mount Shasta, California 96067

From: David Gallardo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:10:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Gallardo
gingerr007@yahoo.com
1816 Edgewood Drive
Alhambra, California 91803

From: Tom Feldman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:09:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tom Feldman
tom@clearfiremedia.com
4648 El Camino Corto
La Canada, California 91011

From: Justin Truong
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:09:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Justin Truong
justintruong56@gmail.com
33 Junior Terrace
San Francisco, California 94112

From: suzcubbison@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:08:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

suzcubbison@gmail.com
824 Erie St.
Oakland, California 94610

From: Joanne Tenney
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:07:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joanne Tenney
joannetenney@hotmail.com
453 W El Norte Parkway, Apt 301
Escondido, California 92026-1930

From: Peggy Merizalde
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:02:02 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peggy Merizalde
mdmepeg@gmail.com
2627 State Street Apt N1
Santa Barbara, California 93105-5506

From: Mary Sullivan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:02:00 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Sullivan
mljsullivan2@gmail.com
6321 Reubens Drive
Huntington Beach, California 92647

From: John Teevan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 8:00:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Teevan
jptrugger@gmail.com
805 Hawksview Pl
Chula Vista, California 91914

From: B. E.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:59:37 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

B. E.
barerickson@gmail.com
V. Sch. Rd.
Westlake Village, California 91361

From: Louise Chegwidden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:58:30 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Louise Chegwidden
louisechegwidden@icloud.com
435 38th St
Oakland, California 94609

From: Peggy Merizalde
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:58:27 AM

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Kern County,

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Peggy Merizalde
mdmepeg@gmail.com
2627 State Street Apt N1
Santa Barbara, California 93105-5506

From: Stephanie Walkowiak
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:57:20 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Walkowiak
smw248@gmail.com
2049 sea cove lane
Costa Mesa , California 92627

From: David Wendt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:57:09 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Wendt
dvdwndt@gmail.com
430 North Civic Drive #412
Walnut Creek, California 94596

From: Paul Ramos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:56:48 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Ramos
paulrides@mac.com
1530 n Refugio rd
Santa ynez, California 93460

From: patnod@me.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:55:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

patnod@me.com
68 Nile Street
Palm Springs, California 92264

From: Catherine Cameron
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:52:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Catherine Cameron
alt.caseyc@gmail.com
1308 Greenwich Ct
San Jose, California 95125

From: marc.gordon@me.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:49:54 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

marc.gordon@me.com
Hess Ave.
Sonora , California 95370

From: joanne FANUCCHI
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:49:21 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

THIS IS GOING TO WORK ABOUT AS WELL AS THE RECYCLING PITCH FROM FOSSIL FUELS IN THE 60'S/70'S. FOOL ME ONCE..... GROW UP PEOPLE.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

joanne FANUCCHI
jfanucchi9@gmail.com
53 alvarado ave
pittsburg, California 94565

From: Jayne Cerny
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:48:23 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jayne Cerny
jaynecerny@gmail.com
12845 Sir Francis Drake Blvd
Inverness, California 94937

From: Gail McMullen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:44:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gail McMullen
gjmcm48la@gmail.com
1734 N Kingsley Dr Apt 4
Los Angeles, California 90027

From: Philip Morton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:44:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Philip Morton
pmorton.cal@gmail.com
1334 1/2 Parker St
Berkeley, California 94702

From: Joe Houde
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:33:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joe Houde
joe@ecinstitute.com
1245 Palomar Pl Apt 27, 2, 27
Vista, California 92084

From: Rebecca Eiseman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:32:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rebecca Eiseman
rebecca.eiseman@gmail.com
473 Oak St
San Francisco, California 94102

From: Amanda Bloom
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:32:35 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amanda Bloom
amandabloo@gmail.com
3214 International Blvd
Oakland, California 94601

From: Narcissa Enzmann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:29:50 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Narcissa Enzmann
cissy.enz1@gmail.com
5136 Tierra Granada Drive
Whittier , California 90601

From: mtbivey@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:29:32 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

mtbivey@gmail.com
21 Pine Valley ln
Newport Beach , California 92660

From: Huguette Bartels
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:28:19 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Huguette Bartels
huguettesbartels@yahoo.com
865 Cotton Street
Menlo Park, California 94025

From: Richard Gallo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:26:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Gallo
rg198995076@yahoo.com
2355 Brommer Street Space 41
SANTA CRUZ, California 95062

From: hlhays75@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:26:43 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

hlhays75@gmail.com
3301 Tice Cr. Dr. #6
Walnut Creek, California 94595

From: Rhonda Green
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:25:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rhonda Green
nannyg@gmail.com
P.O> Box 6100
Beverly Hills, California 90212

From: Daniel McKeighen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:23:47 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Daniel McKeighen
metalhead_hellyeah@yahoo.com
711 University Ave apt 2214
Rocklin , California 95765

From: shaunamcmanus@mac.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:23:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

shaunamcmanus@mac.com
2007 E Andreas Road
Palm Springs, California 92262-6807

From: lawmen-waisted0n@icloud.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:22:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

lawmen-waisted0n@icloud.com
5450 Beaumont Ave
La jolla, California 92037

From: Tobey Wiebe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:22:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tobey Wiebe
twiebe@sonic.net
852 Contra Costa Ave.
Berkeley, California 94707-1920

From: andrewerussell@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:21:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

andrewerussell@gmail.com
17141 Tiara St.
Encino, California 91316

From: Roidina Salisbury
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:21:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Roidina Salisbury
roi@comline.com
422 Ave. Castilla
Laguna Woods, California 92637

From: Jennifer Taw
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:20:02 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jennifer Taw
jentaw@gmail.com
348 Blythe Road
La Canada Flintridge, California 91011

From: Ace Hull
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:19:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ace Hull
yellowrabbit66@gmail.com
1153 Jefferson St, Apt. 3
San Leandro, California 94577

From: Erh-Yen To
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:18:36 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erh-Yen To
sea11wa@yahoo.com
3936 Stanwick Ave
Sacramento, California 95835

From: D. Rowe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:18:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

D. Rowe
dianamite920@gmail.com
2118 wilshire
Santa Monica, California 90403

From: Peter Menchini
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:18:17 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peter Menchini
mayamedia@gmail.com
1438 josephine st
Berkeley , California 94703

From: Aaron Chan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:18:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Aaron Chan
aaronka@gmail.com
4850 Eisenhower Ave
Alexandria, Virginia 22304

From: christrinh95@aol.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:17:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

christrinh95@aol.com
22731 Jubilo Place
Lake Forest , California 92630

From: Kristin Thigpen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:16:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kristin Thigpen
kristint@sonic.net
4039 Shadowhill Dr
Santa Rosa, California 95404

From: jayne pitchford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:13:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

jayne pitchford
ladyenyaj@gmail.com
1144 12
Santa Monica , California 90403

From: Anthony Jammal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:11:02 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anthony Jammal
rcquetbl1@hotmail.com
1601 Dana Way
Roseville, California 95661

From: Virginia Morris
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:09:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Implementing this project simply makes no sense!

Virginia Morris
giniomorris@gmail.com
2327 19th Avenue
Oakland, California 94606

From: Suzel Bertrand
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:06:58 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Suzel Bertrand
suzelbee@pacbell.net
2012 Vestal Avenue
Los Angeles, California 90026

From: Roxanne Friedenfels
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:06:23 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Roxanne Friedenfels
rfrieden@drew.edu
4900 Cedar Lake Road S
Minneapolis, Minnesota 55416

From: vlove@greenpeace.org
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:05:02 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

vlove@greenpeace.org
322 Balboa Ave
Davis, California 95616-0406

From: David Beaulieu
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:04:09 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Beaulieu
dbeaulieu50@icloud.com
1336 Edgecliffe Drive
Los Angeles, California 90026

From: meera_prahlad@yahoo.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:02:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

meera_prahlad@yahoo.com
43456 Ellsworth street
Fremont , California 94539

From: Melissa Hutchinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:02:42 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melissa Hutchinson
melhutch236@gmail.com
236 Alder St
Pacific Grove, California 93950

From: rsolick@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:00:50 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

rsolick@gmail.com
783 Estates Dr
Aptos, California 95003

From: Cheryl Davis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:00:20 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cheryl Davis
davisca2011@gmail.com
7328 24th St
Rio Linda, California 95673

From: Susan Tatsui-D"Arcy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 7:00:03 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Tatsui-D'Arcy
info@meritworld.com
PO BOX 2988
Santa Cruz, California 95063

From: Vincent De Stefano
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:59:28 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vincent De Stefano
vdestefano54@gmail.com
580 N. Sierra Madre Blvd.
Pasadena, California 91107

From: tracyshortle@yahoo.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:56:47 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

tracyshortle@yahoo.com
4627 Green Tree Lane
Irvine, California 92618

From: candice meneghin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:56:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

candice meneghin
candicemeneghin@gmail.com
239 santa susana road
camarillo, California 93010

From: Derek Fung
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:55:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Derek Fung
fungderek91@gmail.com
10732 Miloann St.
Temple City, California 91780

From: Ree Whitford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:53:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ree Whitford
reewhitford@gmail.com
36 Blue Jay Ct.
Napa, California 94558

From: Perry Gx
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:53:44 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Perry Gx
perrygxx@gmail.com
14312 Franklin Avenue
Tustin , California 92780

From: Philip Fraser
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:53:27 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Philip Fraser
natureboy92552@gmail.com
P.O. Box 818
San Juan Capistrano , California 92693

From: Rex Sanford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:52:43 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rex Sanford
sanfordfamily@gmail.com
912 Palmilla Dr.
Modesto , California 95356

From: Stephan Foley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:52:24 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephan Foley
salexfoley@gmail.com
402 S Carrillo Rd
Ojai, California 93023-3607

From: judylooby@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:52:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

judylooby@gmail.com
34650 Douglas Ranger Station Rd
North Fork, California 93643

From: Angela Barbee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 6:51:43 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Angela Barbee
ambarbee@hotmail.com
810 Corte Entrada
Chula Vista, California 91910

From: Cheri Porter-Keisner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:56:15 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Cheri Porter-Keisner
c144p@outlook.com
280 Pepperwood springs Rd.
Piercy, California 95587

From: Melodi Gulsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:26:14 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melodi Gulsen
melodi2727@yahoo.com
2014 Associated Rd
Fullerton, California 92831

From: AJ Cho
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:21:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

AJ Cho
amenoartemis@gmail.com
159 Santa Teresa
San Leandro, California 94579

From: Patricia Nadreau
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 10:20:41 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patricia Nadreau
patsavon2@gmail.com
24191 Dial Ave
Tomah, Wisconsin 54660

From: Eric Stern
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:52:05 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eric Stern
sternbychoice@gmail.com
675 Sonoma St
Richmond, California 94805

From: Susan Ryan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:38:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Ryan
susanryan2010@gmail.com
1217 S. Orange Dr.
Los Angeles, California 90019

From: Barbara Wishingrad
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage in Kern County
Date: Tuesday, February 27, 2024 7:29:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Barbara Wishingrad
seaandmts2@yahoo.com
1218 Castillo 3
Santa Barbara, California 93101

From: Terrie Smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 6:31:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Terrie Smith
sugarfootc@aol.com
1221 Portola Ave
Spring Valley, California 91977

From: I M
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:35:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

This is a project that over-promises benefits while manipulating a community that has other needs that should be addressed. Instead of supporting and restoring natural carbon sinks, like forests and wetlands, flashy newer technology is being sold to the community of Bakersfield, though the true benefits are not yet there. This technology has a long way to go. These companies are hoping the community won't see the clear flaws and therefore won't push back.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

I M
murphetrics@hotmail.com
1329 12th Ave
San Francisco, California 94122

From: Nicolas Riani
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:35:22 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

Carbon capture and storage has not been proven to be effective at preventing emissions, making it a dangerous distraction from renewable energy sources which we know have very little to no greenhouse gas emissions. I am concerned about the impacts of climate change, from wildfires to drought to extreme storms, and I implore Kern County to reject fake and dangerous solutions and promote real solutions.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nicolas Riani
nicolasriani@yahoo.com
5586 Taft Ave, Oakland
Oakland, California 94618

From: Isabella Bertaud
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:35:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I am deeply concerned about the proposed Carbon TerraVault I Elk Hills carbon capture project, which I believe presents a dangerous distraction from our urgent need to transition to clean, renewable energy sources. This project threatens to prolong the reliance on dirty fossil fuels while diverting vital resources away from sustainable solutions.

It is evident that carbon capture and storage (CCS) projects like Carbon TerraVault I have a history of over-promising and under-delivering, ultimately failing to address the root causes of climate change. Instead of investing in genuine solutions, oil companies are pushing flawed technologies that serve their interests at the expense of our environment and public health.

The deployment of outdated and costly CCS technology, as proposed in this project, will only delay our shift away from fossil fuels. Moreover, the use of a depleted oil field for carbon storage poses significant risks, particularly in a seismically active region like Kern County. The potential for leaks and other safety hazards threatens the well-being of local communities and ecosystems.

The draft Environmental Impact Report highlights unavoidable consequences on air quality, further burdening already vulnerable communities with pollution-related health risks. Additionally, the project's proximity to McKittrick Elementary School raises alarming concerns about safety, especially considering the potential dangers associated with carbon dioxide leaks.

Furthermore, the project's reliance on already strained water resources poses a grave risk to Kern County's water supply, exacerbating existing challenges of groundwater depletion.

In light of these concerns, I urge you to reject the Carbon TerraVault I project to safeguard our air, water, health, and climate.

Sincerely,
Bella Bertaud

Isabella Bertaud
oliroo15@gmail.com

110 Redwood Ave
Corte Madera, California 94925-1412

From: Paul Palmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:33:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Palmer
paulp@sonic.net
4019 Cervantes Court
Vacaville, California 95687

From: Susan Abby
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:32:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Abby
mssueabby@aol.com
2117 Judah Street
San Francisco, California 94122

From: Maninder Kaur
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:31:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. It is unacceptable that low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maninder Kaur
kmaninder88@gmail.com
238 13th St, Unit 625
Oakland, California 94612

From: Emily Guzzardi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:31:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I am a CA resident and care deeply about our state and planet's longterm health.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already

overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Emily Guzzardi
eguzzardi@gmail.com
158 Precita Ave
San Francisco , 94110

From: Madison Reichhold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:30:52 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous, falsely hopeful act that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Madison Reichhold
mareichhold@gmail.com
1016 Esther Drive
Pleasant Hill, California 94523

From: Kimberly Gronemeyer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:27:53 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kimberly Gronemeyer
kgronemeyer@gmail.com
8430 Lopez Dr
Tampa, Florida 33615

From: Joyce Mercado
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:27:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joyce Mercado
jlmercado246@gmail.com
2901 Lincoln Ave
Alameda, California 94501

From: Beth Stein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 4:25:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Beth Stein
lasirena@mardeashe.com
3787 3/4 S Centinela Ave
Los Angeles, California 90066-3134

From: Megan Shaughnessy-Mogill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 4:11:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Megan Shaughnessy-Mogill
mshaughnessymogill@gmail.com
3066 Kansas St.
Oakland, California 94602

From: Ashley Craig
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 3:37:58 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ashley Craig
ashleycraig913@gmail.com
3111 E. 1st Street
Long Beach, California 90803

From: Natalie Rios
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 2:36:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Natalie Rios
natalier1988@gmail.com
920 S St.
Sacramento, California 95811

From: Patrice Wallace
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 1:57:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Patrice Wallace
patricewallace@cruzio.com
5498 Coast RdApt 3
Santa Cruz, California 95060

From: Susan Trivisonno
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 1:51:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

As a lifelong Californian, I urge you, for the sake of our communities, our air, water, health, and climate, to reject this dangerous project.

Thank you.

Susan Trivisonno
susan_trivisonno@hotmail.com
2810 Oak Estates Court
San Jose, California 95135

From: Kirsten Moy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 1:51:28 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kirsten Moy
kmoyaspensf@gmail.com
197 Georgia Way
San Leandro, California 94577

From: Evelyn Johnson -Todd
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 1:26:35 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Evelyn Johnson -Todd
mood-regress0n@icloud.com
2056 S Willow Ave
Fresno, California 93727

From: Linda Howie
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 1:16:49 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Linda Howie
lhowie890@gmail.com
5636 Faust Ave
Woodland Hills, California 91367-4329

From: Angela Barbee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 12:20:33 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Angela Barbee
ambarbee@hotmail.com
810 Corte Entrada, Chula Vista, CA, USA
Chula Vista, California 91910

From: Barbara Speidel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 12:08:29 PM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Barbara Speidel
barbsh@mac.com
8145 Binney Place
CA, California 91942

From: Kathleen McAfee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:55:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen McAfee
km@kmcafee.com
1355 Cherry St
Richmond, California 94801

From: brian kuhn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:36:58 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

brian kuhn
briankuhn7@hotmail.com
815 Ashland Avenue
Santa Monica, California 90405

From: Genevieve Fujimoto
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:26:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Genevieve Fujimoto
fujifuji8kamo6@sonic.net
9 Landers Street
San Francisco, California 94114

From: Sarada Cleary
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 11:17:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Sarada Cleary
sdcleary2010@hotmail.com
5316 ONTARIO ST
OCEANSIDE, California 92056

From: Ryan W.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 10:42:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ryan W.
rywash23@protonmail.com
12303 Serenity Farm
San Antonio, Texas 78249

From: Perry Gx
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:48:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Perry Gx
perrygxx@gmail.com
14312 Franklin Avenue
Tustin, California 92780

From: Carl Van Dyke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:40:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Carl Van Dyke
cvd@sonic.net
PO Box 490
Monte Rio, California 95462

From: Ariana Thompson-Lastad
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage
Date: Tuesday, February 27, 2024 9:32:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

I'm writing as a health researcher and a California parent to urge you to reject the Carbon TerraVault I Elk Hills carbon capture project. This effort is a dangerous distraction that will prolong the life of fossil fuel operations and divert critical resources away from renewable energy that would improve air quality in Kern County and beyond. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ariana Thompson-Lastad
arianajl@gmail.com
1629 Julia St
Berkeley, California 94703

From: Richard Mcgowan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:30:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Richard Mcgowan
rickiejrockett@gmail.com
4436 Latimer Ave
San Jose, California 95130

From: James Gill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:26:47 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

James Gill
jgill@dimentia.com
533 Orange Grove
South Pasadena, California 91030

From: Reed Fenton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:25:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Reed Fenton
reefen@aol.com
7327 Forbes Ave
Lake Balboa, California 91406

From: Robert Burk,
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:19:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Robert Burk,
bobbajo@aol.com
611 Woodruff Ave.
Los Angeles, California 90024

From: Judith Poxon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:17:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Judith Poxon
jlpoxon@hotmail.com
3207 L Street, Apt B
Sacramento, California 95816

From: Kathy Bede
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:14:28 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Kathy Bede
kathy.bede@icloud.com
1296 Terra Nova Blvd.
Pacifica, California 94044

From: john crahan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:03:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

john crahan
jscrahan@hotmail.com
6641 w. 88th street
los angeles, California 90045

From: William Minor
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 9:01:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

William Minor
bminor@sebastiancorp.net
5517 Cold Springs Drive
Foresthill, California 95631

From: Monica Romero
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:59:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Monica Romero
fractalmonkey7@gmail.com
427 pt. lobos ave.
san francisco, California 94121

From: Michelle Fox
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:58:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Michelle Fox
mfox851842@aol.com
10632 Wiley Burke Ave
Downey , California 90241

From: Ken Rosen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:57:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, earthquakes, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities, Latine, and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Ken Rosen
krosen13@mac.com
138 S. Bedford Dr.
Beverly Hills, California 90212

From: Robert Ortiz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:55:14 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Robert Ortiz
r77ortiz@hotmail.com
25 H Lane
Novato, California 94945-2610

From: jacqueline kramer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:52:25 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

jacqueline kramer
jacquelinek@vom.com
19201 twin oaks lane
sonoma, California 95476

From: Alexis Georgiou
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:50:30 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Alexis Georgiou
alexis_georgiou_1987@hotmail.com
982 Laurie Avenue
Santa Clara, California 95054

From: Paul Ramos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:50:13 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Paul Ramos
paulrides@me.com
PO Box 728
CA, California 93460

From: Nancy Trevino
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 8:15:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Nancy Trevino
nancy@presente.org
2591 Calle Delfino
Santa Fe, New Mexico 87505

From: Matt Nelson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 7:54:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Matt Nelson
matt@presente.org
1330 Broadway Ave., #300
Oakland, California 94612

From: Nancy Trevino
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 6:49:53 AM

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Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Nancy Trevino
nancy@presente.org
2591 Calle Delfino
Santa Fe, New Mexico 87505

From: Matt Malina
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 5:23:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matt Malina
matt@nych2o.org
PO Box 20773
New York, New York 10009

From: Anthony Lewis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, February 27, 2024 3:35:13 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anthony Lewis
anthony.pglewis@gmail.com
541 Bella Drive
Newbury Park, Bayern 91320

From: Sasha Jackson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 10:29:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sasha Jackson
mssasha3@aol.com
9415 Sussex St
Detroit , Michigan 48228

From: stephen hopkins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 6:46:44 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

stephen hopkins
sdhopkins29@aol.com
6 peck ave #62b
rye, New York 10580

From: Alan Weiner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 4:44:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alan Weiner
mighty30north@gmail.com
5520 Fairgrange Dr
California, California 91301

From: Joyce Coogan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 3:41:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joyce Coogan
jjcoogan18@gmail.com
8780 W Fairview Ave
Littleton , Colorado 80128

From: diane marks
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 3:30:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

diane marks
shenyen@wavecable.com
728 caroline
port angeles, Washington 98362

From: Kathy Dervin, MPH
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 3:28:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathy Dervin, MPH
dervin.kathy@gmail.com
510 Park St
Pacific grove, California 93950

From: Suzel Bertrand
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 2:35:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Suzel Bertrand
suzelbee@pacbell.net
2012 Vestal Avenue
Los Angeles, California 90026

From: Nancy Trevino
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 12:27:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Nancy Trevino
nancy@presente.org
2591 Calle Delfino
Santa Fe, New Mexico 87505

From: Jennifer Scott
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 11:48:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jennifer Scott
jjscott9@gmail.com
13285 Heather Ridge Loop
Fort Myers, Florida 33966-1530

From: Mark Clark
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 11:48:26 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Clark
mclarkhiker@aol.com
5204 Linda Lou drive
Carmichael , California 95608

From: Rebecca Nimmons
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 11:44:48 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rebecca Nimmons
raintalk@nwlink.com
6345 138th Place SE
Bellevue, Washington 98006

From: Christopher Geukens
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 11:01:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher Geukens
cgeukens@gmail.com
16856 Marilla Street
Northridge, California 91343

From: A.L. Steiner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 10:34:42 AM

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Kern County,

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A.L. Steiner
asteinerny@gmail.com
1222 Atwood St.
Los Angeles, California 90063

From: Querido Galdo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 10:19:14 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Querido Galdo
querido@queridomundo.com
36981 Glennen Drive
Gualala, California 95445

From: Haley Ehlers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 10:15:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Haley Ehlers
haley@cfrog.org
940 E Santa Clara St., Suite 201
Ventura, California 93001

From: Jerry Bernhaut
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 8:36:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jerry Bernhaut
j3bernhaut@gmail.com
23 Woodgreen St.
Santa Rosa, California 95409

From: Paul Reddy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 8:35:36 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sincerely,

Paul Reddy.

Paul Reddy
paulandrewreddy@protonmail.com
55 Aldbury Grove
Welwyn Garden City, England AL7 2LD

From: Vicki Kruschwitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 8:01:43 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vicki Kruschwitz
kruschus@yahoo.com
3926 St Johns Village Way
Powhatan, Virginia 23139

From: Antonino Erba
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 7:07:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Antonino Erba
1poprocker@gmail.com
180 W 15th St, Apt 306, Apt 306
Dubuque, Iowa 52001

From: Linda Wuethrich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 4:42:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Linda Wuethrich
wuethy@gmail.com
7758 Bluebird Ln
Young Harris, Georgia 30582

From: janet forman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 4:31:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

janet forman
giselle351@gmail.com
351 W 24th St. #12C
New York, New York 10011

From: Michelle Varni
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 1:41:50 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michelle Varni
songslove29@gmail.com
20785 West Willow Springs Drive
Soulsbyville, California 95372

From: Ryan Dell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 1:33:16 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ryan Dell
ryancdell@gmail.com
2900 Saint Paul Dr.
Santa Rosa, California 95405

From: Jana Birch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Monday, February 26, 2024 12:32:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jana Birch
janabirch@gmail.com
2346 Wales Dr
Cardiff By The Sea, California 92007

From: George Ludwig
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 11:33:21 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

George Ludwig
geludwig2014@icloud.com
1210 Grandview Rd
Vista, California 92084

From: Niamh Moore
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 11:33:11 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Niamh Moore
78smallfry@gmail.com
42 Willow Tree Close
London, England SW183EL

From: Isabella Gross
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 11:00:12 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Isabella Gross
lycos12@aon.at
Am Sonnenhang 28
Gmunden, Oberösterreich 4810

From: Darcy Skarada
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 10:22:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Darcy Skarada
dskarada@gmail.com
10976 Rosa Trail
Kelseyville, California 95451

From: Todd Copeland
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 10:16:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Todd Copeland
tcope54@outlook.com
4282 Pomona St
Ventura , California 93003

From: Sandy Commons
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 9:48:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sandy Commons
sandygatta454@gmail.com
2703 Corabel Ln Apt 215
Sacramento, California 95821

From: Maggie Hughes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 9:39:12 PM

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Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maggie Hughes
maggiehughes@shaw.ca
2325 Channing Way
Berkeley, California 94704

From: Greg Perkins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 9:12:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Greg Perkins
gperkins@glendale.edu
343 1/2 Wisconsin Ave
Long beach, California 90814

From: Davin Peterson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 8:39:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Davin Peterson
davinsemail@gmail.com
5914 Walnut Drive
Eureka , California 95503

From: Valerie Snyder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 7:29:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Valerie Snyder
mvensnyder@yahoo.com
3311 valley crest way
forest grove, Oregon 97116

From: David Gougler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 7:14:52 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Gougler
greenchallenge@sonic.net
239 W 8th Street
Santa Rosa, California 95401

From: diane marks
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 4:44:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

diane marks
shenyen@wavecable.com
728 caroline
port angeles, Washington 98362

From: Lawrence Joe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 4:24:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lawrence Joe
lawrence.joe@gmail.com
1056 Walnut Grove Ave., Apt. G
Rosemead, California 91770

From: Nancy Caponi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 3:31:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Thank you.

Nancy Caponi
earthknwr@aol.com
225 West Figueroa Street
Santa Barbara, California 93101

From: Rita Neumann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 3:24:55 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rita Neumann
ritaeneumann@gmail.com
380 Manka Cir
Wikiup, California 95403

From: Karen McGuinness
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 3:14:57 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen McGuinness
mindgarden1112@aol.com
40 Highland Ave
Hazlet , New Jersey 07730

From: Whitney Metz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 3:08:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Whitney Metz
whitneyveganmetz@gmail.com
110 Dudley Fork Rd
Mannington, West Virginia 26582

From: Mark Grenard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 3:06:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Grenard
grenardmarkhayduke@yahoo.com
4222 E. Windrose Dr. #2009
Phoenix, Yuck, Sprawl, Arizona 85032

From: Mara Schoner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:56:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mara Schoner
maraschoner@gmail.com
53810 Pinecrest Ave po box 4245
Idyllwild, California 92549-4245

From: Patrick Carr
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:55:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I am a grandfather, within the past year, and this is a huge motivation for me to act against climate change.

I know that Carbon Capture is touted as a means of resolving the climate crisis. Sadly, I know that this technology has shown very little promise and amounts to a sham PR stunt to distract the public from concern about the use of fossil fuels.

The Carbon TerraVault I Elk Hills carbon capture project is an example: it is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patrick Carr
nedlud432@gmail.com
1704 Virginia Way
Arcata, California 95521

From: Minnea Lepola
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:29:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Minnea Lepola
minnealepola@gmail.com
Avenida de la hacineda
Benalmadena , California 26930

From: Kate Skolnick
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 11:59:26 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kate Skolnick
krs1123@gmail.com
3495 Broadway, Apt. 45
New York, New York 10031

From: Joanne Husar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 11:22:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joanne Husar
husarj@gmail.com
1622 W 25th Street, Apt 4
Los Angeles, California 90007

From: Kent Johnson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 10:44:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kent Johnson
kentj1948@gmail.com
12928 Midfield Ter
Saint Louis, Missouri 63146

From: April Parkins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 9:40:30 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

April Parkins
april@phonecoop.coop
4285 Gilbert St
Oakland, California 94611-5115

From: Margaret Lyman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 8:32:12 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margaret Lyman
marglyman51@yahoo.com
2870 Creston Road
Walnut Creek, California 94597

From: Morgan Paulus
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 8:26:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Morgan Paulus
morganpaulus@yahoo.com
6548 North Bosworth
Chicago , Illinois 60626

From: Ellen McCann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 8:16:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ellen McCann
ellenmccann63@hotmail.com
1262 Amalfi Place
Escondido, California 92027

From: Erh-Yen To
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 7:37:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erh-Yen To
sea11wa@yahoo.com
3936 Stanwick Ave
Sacramento, California 95835

From: Doris Ashbrook
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 6:37:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Doris Ashbrook
dashbrook49@gmail.com
400 South 15th Street
Richmond, Indiana 47374

From: ALEXIS LANGELOTTI
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 5:52:04 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

ALEXIS LANGELOTTI
alexis.langelotti@gmail.com
384 Roosevelt st
Fairview, New Jersey 07022

From: lynn matarelli
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 5:51:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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lynn matarelli
lam3036@me.com
2915 jody lane
Oceanside, California 92056

From: Jessica Cassidy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 4:31:43 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jessica Cassidy
jmaryc.123@gmail.com
1530 Hiddenbrook Dr
Herndon, Virginia 20170

From: Kay BRainerd
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 4:03:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kay BRainerd
klbrainerd@gmail.com
19901 Martinsville
Belleville , Michigan 48111

From: Nancy Sidebotham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 1:45:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Sidebotham
nannystu@sonic.net
6375 Hillmont Drive
OAKLAND, California 94605

From: Shanna Rojas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:19:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shanna Rojas
shanbanan20@gmail.com
11447 Maple Ave
Hesperia, California 92345

From: Probyn Gregory
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:05:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Probyn Gregory
probyngregory@gmail.com
10877 Deliban St
Tujunga, California 91042

From: Susan Perry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Sunday, February 25, 2024 12:02:44 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Perry
bigsurunified@gmail.com
670 Weymouth St
Cambria , California 93428

From: Tracy McCowan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:45:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tracy McCowan
tekmcc@yahoo.com
706 Douglas St
Bakersfield , California 93308

From: Bruce Coston
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:44:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stop the insanity . Minimum Income + CSSD. 2x condorcet compliant voting to meet udhr. 21.3 -- now !

Bruce Coston
jane_ikari@gmx.com
1055 Manhattan Court
Sunnyvale, California 94087

From: Carla Grady
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:31:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carla Grady
carladgrad@gmail.com
8166 PARK AVE
Forestville, California 95436

From: Veena Singwi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:24:23 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Veena Singwi
veenaschnitzel@yahoo.com
327 Argon
Eugene, Oregon 97404

From: Lynda Marin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:28:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lynda Marin
lmarin@cruzio.com
2830 Smith Grade
Santa Cruz, California 95060

From: Kristie Bircumshaw
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:42:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kristie Bircumshaw
kristie.bircumshaw@gmail.com
1737 Myrtle Ave, A
San Diego, California 92103

From: Stephanie Nunez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:40:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Nunez
evilbitch_13@yahoo.com
7034 Tyrone Ave
Van Nuys, California 91405

From: Nancy Martin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:24:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Martin
nancythefunkwitch@yahoo.com
7500 Alpine Rd
LA HONDA, California 94020

From: Alice Kelly
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:23:11 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alice Kelly
alicemarykelly@gmail.com
6493 Cooper St
Felton, California 95018-9409

From: Angela Cole
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:55:30 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Angela Cole
amm_greenday_fan@hotmail.com
6255 Telegraph Road, Lot 124
Erie, Michigan 48133

From: Christine Powell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:31:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christine Powell
krisztin@yahoo.com
23701 Eli Ln
Gaithersburg, Maryland 20882

From: Lindsay Pugh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:25:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lindsay Pugh
pugh.lindsay.a@gmail.com
2113 Brandonview Ave
Henrico, Virginia 23231-3908

From: Allan Campbell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:58:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Allan Campbell
allanlc16@gmail.com
3162 Isadora
San Jose, California 95132

From: Bessie Ocampo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:36:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bessie Ocampo
nbeautym06bes@gmail.com
1943 Alvina Dr
Pleasant Hill, California 94523

From: Angela Jones
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:29:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Angela Jones
amjones1971@yahoo.com
27612 E Red Fox St
Lee's Summit, Missouri 64086

From: Marie DiMassa
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:49:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marie DiMassa
medimassa@gmail.com
3725 Myrtle Ave
Long Beach, California 90807-4121

From: Becky Sillasen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:47:50 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Becky Sillasen
becky.sillasen@gmail.com
1048 Berkeley Rd Apt B
Columbus, Ohio 43206

From: Ginny Madsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:24:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ginny Madsen
madsenginny3@gmail.com
13461 Aurora Drive
San Leandro, California 94577

From: Nicholas Bridgett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:46:13 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nicholas Bridgett
nicbridgett@aol.com
1305 w hill
Champaign , Illinois 61821

From: Darcy Bergh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:27:19 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Darcy Bergh
darcybergh@gmail.com
1121 Hallam Ave N
St. Paul, Minnesota 55115

From: L.L. Wilkinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:26:44 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

L.L. Wilkinson
taosk9five@gmail.com
411 Orchard Ln
Taos, New Mexico 87571-6436

From: Richard Patenaude
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:21:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Patenaude
patnod@mac.com
68 Nile Street
Palm Springs, California 92264-0510

From: Devorah Soodak
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:06:57 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Devorah Soodak
devorah.zealot@gmail.com
1820 Hart Ln
Philadelphia, Pennsylvania 19134

From: Roberta Millstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:00:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Roberta Millstein
cbd@rlm.net
562 Reed Dr
Davis, California 95616

From: Patricia Auer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 2:46:23 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patricia Auer
patricia.auer51@gmail.com
1353 Westbrooke Meadows Ln
Ballwin, Missouri 63021

From: Thomas Blom
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 2:23:30 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Blom
thom.blom@me.com
1812 Via Isla
Palm Springs , California 92264

From: Scott Douglas Laxier
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 2:16:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Scott Douglas Laxier
scottlaxier@gmail.com
540 Quail Run Ct
Del Rey Oaks, California 93940-5727

From: Gabriel Steinfeld
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 2:11:45 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gabriel Steinfeld
gstein@sonic.net
693 Spruce St
Oakland, California 94610

From: t.decant@liftxl.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:56:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

t.decant@liftxl.com
224 Frederick Drive
Napa, California 94559

From: Laurie-Ann Barbour
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:33:39 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laurie-Ann Barbour
carrotlover@sonic.net
101 Ross St. #24
Cotati, California 94931

From: Amy Longanecker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:20:30 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amy Longanecker
alwilliams0630@gmail.com
6263 Caminito Salado
SAN DIEGO, California 92111-7226

From: Valérie Paillard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:16:09 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Valérie Paillard
tatievanile@gmail.com
1 rue de l'Ancien Collège
SAVIGNY LE TEMPLE, Île-de-France 77176

From: Stacey Cannon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:27:23 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stacey Cannon
staceycannon1313@gmail.com
1903 Stokes Ferry Rd.
Salisbury, North Carolina 28146

From: Anne Grenier
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:22:35 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anne Grenier
ag4new@gmail.com
1391 Bauer Rd
Brentwood, California 94513

From: Manny Garcia
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:08:12 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Manny Garcia
rodeobuck@rocketmail.com
2045 Rosemary St
Denver, Colorado 80207

From: Colette Winslow
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:07:43 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Colette Winslow
cwin791866@aol.com
6931 Wolff Street
WESTMINSTER, Colorado 80030

From: Alex Terry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:04:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alex Terry
alex@terryandterryarchitecture.com
1073 Euclid Ave.
Berkeley, California 94708

From: Joe Quirk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:54:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joe Quirk
jquirk66@gmail.com
147 Avenue A
New York, New York 10009

From: Rita Kovshun
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:29:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rita Kovshun
margarita.kovshun@gmail.com
3825 S Gibraltar St
Aurora , Colorado 80013

From: Andy Tomsky
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:16:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andy Tomsky
andytomsky@yahoo.com
po box 683
san marcos, California 92079

From: Stephanie Parreira
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:11:41 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Parreira
parreirastephanie29@gmail.com
2943 MARECA WAY
WEST SACRAMENTO, California 95691

From: Hugh Ballem
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:06:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Hugh Ballem
hballem@gmail.com
13 Falling Brook Lane
Cincinnati, Ohio 45241

From: Susie Cassens
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 11:03:48 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susie Cassens
susiesart56@gmail.com
PO Box 593
Fort Pierce, Florida 34954

From: Andrew Walsh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:57:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andrew Walsh
andy.walsh@blueyonder.co.uk
41 Beechdale Road
London, England SW2 2BW

From: eric pash
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:53:15 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

eric pash
epash@diamondpharmacy.com
373 degaetano road
indiana, Pennsylvania 15701

From: Anne-Lise francois
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:28:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anne-Lise francois
impshirt@gmail.com
2210A California Street
Berkeley, California 94703

From: Natalie Walsh
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:22:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Natalie Walsh
natalie@nataliewalsh.com
3246 Baker Street
San Francisco, California 94123

From: Melissa O"Rourke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:20:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melissa O'Rourke
melo1984@aol.com
2970 North Oregon Street, #11
Chandler, Arizona 85225

From: Michael Haney
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 10:06:06 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Haney
paso750@gmail.com
2925 Brookwood Drive
Napa, California 94558

From: Howard Shapiro
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:52:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Howard Shapiro
hshapiro1@gmail.com
2817 tumble brook
las vegas, Nevada 89134

From: Cheryl Militello
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:49:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cheryl Militello
militellocheryl@yahoo.com
20 Conway Drive
Greenville , South Carolina 29615

From: Laura Lyons
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:45:01 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laura Lyons
lrlyons@yahoo.com
3921 E Hansen Rd
, Michigan 49405-9785

From: Laurie Graham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:28:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laurie Graham
greylag64@gmail.com
724 Stonegate Dr
South San Francisco, California 94080

From: Megan Shumway
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:25:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death. Long pipelines have risks of corrosion by CO2 and leaks that may remain undetected until they are sever.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Megan Shumway
meganshumway@aol.com
3116 Whitney Ave
Sacramento, California 95821

From: Felicty Devlin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 9:12:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Felicty Devlin
felicitydevlin@yahoo.com
2417 N Washington
Tacoma, Washington 98406

From: Pawiter Parhar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:57:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pawiter Parhar
pawiter.parhar@gmail.com
22626 NE Inglewood Hill Rd. Apt. # 635
Sammamish, Washington 98074

From: Eliot Tigerlily
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:56:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eliot Tigerlily
eliot@organicgrace.com
11904 E Alsea Hwy
, Oregon 97390

From: Paul Palmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:50:50 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Palmer
paulp@sonic.net
4019 Cervantes Ct.
Vacaville, California 95687

From: Vasileios Grigoriou
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:48:57 AM

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Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vasileios Grigoriou
bill99998@hotmail.com
11 Radnor Place
Prenton, England CH43 4XH

From: Cheryl Militello
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:25:51 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cheryl Militello
militellocheryl@icloud.com
20 Conway Drive
Greenville , South Carolina 29615

From: John Borland
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:24:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Borland
johnborland08@gmail.com
2511 Caves Camp Rd, 2511
Williams, Oregon 97544

From: Sharon Rich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:20:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sharon Rich
sharonbrich@yahoo.com
2834 Regent Crescent
South Daytona, Florida 32119

From: Kennedy Davis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:15:36 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kennedy Davis
kennedydavis0213@gmail.com
247 E 500 N
Sharpsville, Indiana 46068

From: Sarah Hafer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:12:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sarah Hafer
sarah.hafer@gmail.com
12111 NE 4th St
Vancouver, Washington 98684

From: Claire Broome
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 8:08:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Claire Broome
cvbroome@gmail.com
26 Northgate Ave
Berkeley, California 94708-2008

From: L.L. Wilkinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 7:55:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

L.L. Wilkinson
taosk9five@gmail.com
411 Orchard Ln
Taos, New Mexico 87571-6436

From: Aimee Wyatt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 7:45:10 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Aimee Wyatt
photochk611@gmail.com
3296 Maricopa Highway
Ojai, California 93023

From: Marla Flores-Jauregui
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 7:43:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marla Flores-Jauregui
senorajauregui68@yahoo.com
6300 Denslow Way
Sacramento , California 95823

From: c clark
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 7:31:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

c clark
dr_carolyn@yahoo.com
929 N Terrace Hills Dr
Salt Lake City, Utah 84103

From: Tracy S Troth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 7:18:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tracy S Troth
moniqueleigh@gmail.com
527 Fox Run Trl
Pearl, Mississippi 39208-5710

From: Richard Star
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:54:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I don't like form letters because I imagine the recipients won't deemed them as meaningful as an original letter.
However, this letter contains all the relevant data that you need to consider.
What more could I add to this discussion than what is already presented here.
You need to pay attention to all the letters you receive whether an original or a form letter.
This letter does address my concerns on this issue.
I hope you will give it the weight that it deserves.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sincerely,
Richard Star

Richard Star
isrjstar@gmail.com
PO Box 28142
Santa Ana, California 92799-8142

From: Beth GOODE
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:38:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Beth GOODE
goodeb22@gmail.com
19787 Valley View Dr.
Topanga, California 90290

From: Nancy Enkiri
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:37:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Enkiri
nkenkiri@aol.com
4616 Olympia Avenue
Beltsville, Maryland 20705

From: Elliott Bales
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:30:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elliott Bales
esbales904@yahoo.com
1664 N Cedar St
, Wyoming 82072

From: Donna Crane
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:30:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Donna Crane
dcraneone@gmail.com
1610 Shasta St
Anderson, California 96007

From: Judith. Ackerman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:24:47 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith. Ackerman
ackerperson@yahoo.com
636west End Av
Ny, New York 10024

From: Attilio Pandolfo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:24:10 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Attilio Pandolfo
pandolfoattilio@gmail.com
5829 Franklin Ave
Los Angeles, Sicilia 90028

From: Jaedra Luke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:15:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jaedra Luke
jaedraluke@gmail.com
1320 Slick Rock Road
Brevard, North Carolina 28712

From: Christopher Weissflog
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:14:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher Weissflog
chrisw@ecogenenergy.ca
732 Heritage Drive
Merrickville, Ontario K0G 1N0

From: C. Kasey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:11:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

C. Kasey
omni_girl@hotmail.com
9317 Guenevere Pl.
Mechanicsville, Virginia 23116

From: Nichelle Virzi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 6:04:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nichelle Virzi
elegant_nichelle@yahoo.com
2115 E Northfield Ave
Kingman, Arizona 86409

From: Tim Laidman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:55:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. It’s unacceptable, unnecessary and counterproductive to CA climate goals. Please respect the health and safety of an already overburdened population and reject this and other similar projects.

Tim Laidman
timlaidman@yahoo.com
1722 Lexington Ave
El Cerrito, California 94530

From: Dennis Ledden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:46:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dennis Ledden
lcs5779@gmail.com
183 Webb Road
Sequim, Washington 98382

From: Mike McCool
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:07:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mike McCool
mike_mccool@yahoo.com
48 Dorothy Rd
Millbury, Massachusetts 01527

From: Anthony Ramey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:00:11 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anthony Ramey
anthonyramey5@gmail.com
9816 La Salle Ave
Los Angeles, California 90047

From: Brian Ainsley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 5:00:09 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brian Ainsley
brian.ainsley@gmail.com
1227 Pine Needle Ct
Altamonte Springs, Florida 32714

From: Susan Kutz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 4:50:06 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Kutz
catloversusan@gmail.com
4822 Camino Dos Vidas
Las Cruces , New Mexico 88012

From: Dorothy Anderson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 4:39:48 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dorothy Anderson
gramdot91@gmail.com
125 river St
North Weymouth, Massachusetts 02191

From: Thomas Cooper
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 4:11:20 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Cooper
thomascooper2488@gmail.com
58 Crosse Courts
Basildon, England SS15 5JE

From: Xabier Mitxelena
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:58:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Xabier Mitxelena
xabixabim@gmail.com
Iurre 22, 2.B
Tolosa, Pais Vasco 20400

From: Mary Sullivan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:31:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Sullivan
mljsullivan2@gmail.com
6321 Reubens Drive
Huntington Beach, California 92647

From: Joan Raitano
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 3:28:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joan Raitano
duffy72297@yahoo.com
3823 Arthur Drive
Seaford, New York 11783

From: Abbie Bernstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 2:30:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Abbie Bernstein
hedgebeast@aol.com
1245 N Kings Rd Apt 7
West Hollywood, California 90069-2821

From: Terrie Smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:41:16 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Terrie Smith
sugarfootc@aol.com
1221 Portola Ave
Spring Valley, California 91977

From: Jesse Calderon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:12:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jesse Calderon
ohjesse14@yahoo.com
4025 Puente Ave
Baldwin Park , California 91706

From: Ogie Strogatz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 1:04:20 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ogie Strogatz
ogstrogatz@gmail.com
189 Miramonte Road
Walnut Creek, California 94597

From: Lauren Murdock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:45:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lauren Murdock
murdock_ls@hotmail.com
3940 Via Lucero
Santa Barbara, California 93110

From: timmie smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:43:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

timmie smith
scobbydoo38@yahoo.com
PO Box 532
Erie, Pennsylvania 16512

From: David Cotner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:40:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Cotner
hertzlion@gmail.com
675 E. Santa Clara St.
Ventura, California 93001

From: Ryan Acebo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:37:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ryan Acebo
rbunson@outlook.com
2915 Carlsen St
Oakland, California 94602

From: Theodore Voth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:15:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Theodore Voth
tedvoth3@uwalumni.com
17 N. Seventh St. Apt. 2
Madison, Wisconsin 53704

From: AJ Cho
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Saturday, February 24, 2024 12:00:25 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

AJ Cho
amenoartemis@gmail.com
159 Santa Teresa
San Leandro, California 94579

From: Barbara Bondurant
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:41:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Bondurant
barbarabondurant5@gmail.com
2030 Dover Ave
La Verne, California 91750

From: Jordan Briskin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:28:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, reject this dangerous project.

Jordan Briskin
jordanbriskin8@gmail.com
2850 Middlefield Road
Palo Alto, California 94306

From: Margie Halladin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:19:10 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margie Halladin
margiehalladin@yahoo.com
454 Las Gallinas Avenue, #149
San Rafael, California 94903

From: Steven Rosenberg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:17:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steven Rosenberg
sunydays33304@gmail.com
1650 George Dieter Drive 223
El Paso, Texas 79936

From: Marilyn Price
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:07:55 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marilyn Price
marilynfrankprice@gmail.com
138 Sunnyside Ave.
Mill Valley, California 94941

From: Utkarsh Nath
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:03:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Utkarsh Nath
utkarsh.nath@yahoo.com
34462 Alberta Terrace
Fremont, California 94555

From: Barbara klucsar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:47:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara klucsar
bklucsar@yahoo.com
12625 Radisson Rd NE
Blaine, Minnesota 55449

From: Nick Byrne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:44:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nick Byrne
narbyrne@gmail.com
118 Columbus Ave.
Valhalla, New York 10595

From: Tiffany Rapplean
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tiffany Rapplean
tiffany@rapplean.net
4528 West 110th Circle
Westminster, Colorado 80031

From: Peggy Merizalde
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:40:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peggy Merizalde
mdmepeg@gmail.com
2627 State Street Apt N1
Santa Barbara, California 93105-5506

From: G. Saffren
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:39:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

G. Saffren
gsaffren@gmail.com
2100 Malcolm
LA, California 90025

From: Rita Meuer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:06 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rita Meuer
ritameuer@yahoo.com
1422 Wheeler Road
Madison, Wisconsin 53704

From: Ann Dorsey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:13:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ann Dorsey
aedorsey@hotmail.com
18042 Schoenborn St #5
Northridge, California 91325

From: Winston huang
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:04 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Winston huang
huangwm1977@yahoo.com
220 Valley West Ct
West Des Moines, Iowa 50265

From: Linda Henning
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:01:37 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Linda Henning
lindajhenning@yahoo.com
15850 SW Oak Meadow Ln
Tigard, Oregon 97224

From: Ked Garden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:53:00 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Ked Garden
kedz2garden@gmail.com
2348 Main street
Lemon Grove, California 91945

From: Ira Benedetto
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:51:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you
Sincerely
Ira Gerard

Ira Benedetto
iragerard@hotmail.com
1440 Marleigh Ln
South Elgin, Illinois 60177

From: Bonnie Burke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:49:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bonnie Burke
b_margay@yahoo.com
PO Box 601493
San Diego, California 92160

From: Natalie Clark
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:48:23 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Natalie Clark
natalieclark1296@gmail.com
6 Elkrun Cove
Little Rock, Arkansas 72211

From: Carla Holguin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:47:35 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carla Holguin
lakerjulie32@gmail.com
2228 Observatory Ave
Los Angeles , California 90027

From: Anne Barker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:42:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anne Barker
annenb@alumni.iwu.edu
567 Heather Way
San Rafael, California 94903

From: Harold Watson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:40:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Harold Watson
watsonh1956@gmail.com
2223 W Farm Road 98
Springfield, Missouri 65803-7229

From: Emily Pitner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:40:00 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Emily Pitner
widdle_washu@yahoo.com
27 North Ave
Washington , Pennsylvania 15301

From: Gabriel Steinfeld
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:39:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gabriel Steinfeld
gstein@sonic.net
693 Spruce St
Oakland, California 94610

From: Christopher Brown
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:34:30 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher Brown
racerbrown49@gmail.com
6135 Buena Vista Ave
Oakland, California 94618

From: Erin Moilanen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:27:02 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erin Moilanen
erinmoilanen@sonic.net
1585 Wright St.
Santa Rosa, California 95404

From: Ken Gibb
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:21:07 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ken Gibb
kengibb@gmail.com
PO Box 11616
Zephyr Cove, Nevada 89448

From: allison saft
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:20:44 PM

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allison saft
allison.saft2@gmail.com
315 S BROAD ST
Philadelphia, Pennsylvania 19107

From: roger schmidt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:17:06 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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roger schmidt
schmidtroger1000@gmail.com
6710 Elmwood ave #106
Middleton, Wisconsin 53562

From: Lori Bates
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:15:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lori Bates
vivaaloha@gmail.com
109 Camarillo Ave
Oxnard , California 93035

From: Jeff Reynolds
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:11:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeff Reynolds
wutsup1@yahoo.com
382 Buck St.
Bangor, Maine 04401

From: Jeffrey Spencer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:10:06 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeffrey Spencer
jeff@nilesdiscoverychurch.org
36600 Niles Blvd
Fremont, California 94536

From: George Ruiz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:05:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

George Ruiz
ruiz.george87@yahoo.com
1321 hull drive
San Carlos, California 94070

From: Larry Weingart
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:04:38 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Larry Weingart
larweing@hotmail.com
2903 Victoria Circle Unit C3
Coconut Creek, Florida 33066

From: Karen Jacques
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:02:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Jacques
threegables1819@gmail.com
1209 T St
Sacramento, California 95811

From: Ilya Turov
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:01:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ilya Turov
iturov@yahoo.com
26416 Field St
Moreno Valley, California 92555

From: Matthew Palmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 9:00:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matthew Palmer
mattpalm@gmail.com
5209 Peabody St.
Long Beach, California 90808

From: Lisa McCown
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:58:57 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lisa McCown
lkmccown@mac.com
7944 Appaloosa Ct
ALTA LOMA, California 91701

From: Stephen Whitt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:58:45 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephen Whitt
swhitt66@gmail.com
509 n madison ave
pasadena,, California 91101

From: Ana Herold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:56:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ana Herold
anarudolph@gmail.com
1021 Banyan Way
Pacifica, California 94044

From: Maureen Stubblefield
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:56:26 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maureen Stubblefield
puhpowee4me@gmail.com
2778 Marty Way
Sacramento, California 95818

From: Jeanine Weber
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:47:37 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeanine Weber
weberjea@aquinas.edu
2650 Ridgecroft Dr SE
Grand Rapids , Michigan 49546

From: Nancy Treffry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:39:26 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Treffry
nancytreffry@gmail.com
19221 Pioneer Pl
Aromas, California 95004

From: Megan Faber
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:35:58 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Megan Faber
megancatherinefaber@gmail.com
1285 S Sherman St.
Denver, Colorado 80210

From: Leroy Ikerd
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:32:06 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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Leroy Ikerd
papaike@gmail.com
PO Box 547
Garberville, California 95542

From: sharon byers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:30:31 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

sharon byers
sibyers@gmail.com
13042 Stanbridge Ave
Dowmey, California 90242

From: Igor Tandetnik
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:30:30 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Igor Tandetnik
igor@tandetnik.org
6979 113th St
Forest Hills, New York 11375

From: Terri Burgess
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:29:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Terri Burgess
terrilburgess@aol.com
7427 Wilson St
Ventura, California 93003

From: Eugene Cahill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:28:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eugene Cahill
thegenelantern@gmail.com
224 Pine Street
Hackettstown, New Jersey 07840-1710

From: Paul Licata
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:26:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Licata
pglicata18@gmail.com
1063 W Cornelia Ave
Chicago, Illinois 60657

From: John Viacrucis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:26:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Viacrucis
catchaway@yahoo.com
3002 17th St S, Apt. 206
Moorhead, Minnesota 56560

From: Virginia Jastromb
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:24:39 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Virginia Jastromb
vjastromb@yahoo.com
73 Barrett St.
Northampton, Massachusetts 01060

From: Tika Bordelon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:23:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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Tika Bordelon
tikab1@gmail.com
1400 Hubbell Pl
Seattle, Washington 98101

From: Susan Leihy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:21:37 PM

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Susan Leihy
sleihy@hotmail.com
5763 Owl Light Terrace
Santa Rosa, California 95409

From: Susan Tatro
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:18:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Tatro
silvermaven1949@gmail.com
3106 Harris St
Eureka, California 95503

From: Erik Hvoslef
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:15:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erik Hvoslef
rep2serve@gmail.com
9020 CR 150A
Salida, Colorado 81201

From: Jusef White
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 8:10:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Jusef White
whitejb2902@aol.com
1333 Peralta
Fremont, California 94536

From: Barbara Ballenger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:59:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Ballenger
baballenger1@gmail.com
336 Los Padres Dr
Westlake Village, California 91361

From: Dennis Nagel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:57:55 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dennis Nagel
damodara108@gmail.com
3095 N Score Dr
Tucson, Arizona 85719-6900

From: Christopher DiFonso
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:56:29 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christopher DiFonso
csdifonso@yahoo.com
28866 WOODCREEK
MISSION VIEJO, California 92692

From: Demetrio Tafoya
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:52:55 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Demetrio Tafoya
dtafoya55@gmail.com
3610 PERALTA Street
Emeryville, California 94608

From: Nancy Johnson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:50:57 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Johnson
nancyjhomes@gmail.com
620 Dekalb St.
Port Orchard, Washington 98366

From: charlie burns
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:49:15 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

charlie burns
charlie@envsite.com
29 Van Buren Ave
Norwalk, Connecticut 06850

From: Joseph Melvin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:47:20 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joseph Melvin
kb6wij@arrl.net
251 Hilltop Dr Apt 57
Redding CA , California 96003

From: Wendy Larson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:44:51 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Wendy Larson
walarson1959@gmail.com
11289, SW Capital Hwy
Portland, Oregon 97219-7277

From: Marie Garescher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:34:50 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marie Garescher
marfogar@gmail.com
3 Pheasant Walk
Peekskill, New York 10566

From: alicia jackson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:32:47 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

alicia jackson
lametreza@yahoo.com
491 Goheen Circle
Vallejo, California 84591

From: Lauren Linda
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:31:22 PM

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Kern County,

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Lauren Linda
laulind714@gmail.com
2376C Via Mariposa West
Laguna Woods, California 92637

From: Kristin Lewis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:30:34 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kristin Lewis
maryjane713@gmail.com
PO Box 238
Stafford, Texas 77497

From: Mary Keithler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:27:41 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Keithler
mkeithler@yahoo.com
11322 E Ida Ct
Englewood, Colorado 80111

From: Nancy Carl
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:26:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Carl
dlnlcarl2@gmail.com
1014 S Park St
Carlton, Oregon 97111

From: Sophie Rocheleau
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:25:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sophie Rocheleau
queen.of.decadence@gmail.com
1781, Stewart Avenue
Arcata, California 95521

From: Evelyn Valdez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:24:22 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Evelyn Valdez
evilyn8@gmail.com
113 E. 73rd St
Los Angeles , California 90003

From: Lacey Wozny
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:22:19 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lacey Wozny
wozny.lacey@gmail.com
1842 N Avenue 56
Los Angeles, California 90042

From: Barbara Carr
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:19:13 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Carr
barbca@aol.com
2235 W Joppa Rd
Lutherville, Maryland 21093

From: Denise Hosta
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:16:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Denise Hosta
mash.mojo88@gmail.com
12826 Ivory Stone Loop
Fort myers , Florida 33913-6810

From: Michael Tullius
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:14:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Tullius
tullius@ucla.edu
5229 Balboa Blvd. Unit 13
Encino, California 91316

From: Helen Moissant
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:14:27 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Helen Moissant
hmoissant@aol.com
2965 Ross Lane
Central Poont, Oregon 97502

From: Nikki Nafziger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:12:30 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nikki Nafziger
nikkinashmusic@gmail.com
1101 Porter St
Vallejo, California 94590

From: Dennis Schafer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:08:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dennis Schafer
sdennisofm@aol.com
701 E Pyron Ave, San Antonio, TX, USA
San Antonio, Texas 78214

From: Matthew Miller
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:08:33 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matthew Miller
millertime908@gmail.com
203 otis ln
Bay Shore, New York 11706

From: Maria Magana
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:03:52 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maria Magana
mariamagana@gmail.com
1290 Hillcrest Drive
Burlington, Washington 98233

From: John Teevan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:03:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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John Teevan
jptrugger@gmail.com
805 Hawksview Pl
Chula Vista, California 91914

From: Marley Mcdermott
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 7:02:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marley Mcdermott
marley0704@aol.com
5 Michigan Rd
Floral Park, New York 11001

From: Sasha Kay
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:59:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sasha Kay
skay0500@gmail.com
1001 Spring St. apt. 726
Silver Spring, Maryland 20910

From: PHILIP SHERMAN
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:59:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

PHILIP SHERMAN
jessephilipsherman@gmail.com
600 I St Apt 704
Sacramento, California 95814

From: Elizabeth Kelly
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:58:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elizabeth Kelly
simmygirl34@gmail.com
900 W Tyler St
Dalton, Georgia 30720

From: Carolyn Riddle
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:57:42 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carolyn Riddle
riddlegame@gmail.com
1112 NE 117th Ave
Vancouver, Washington 98685

From: Edward Fisher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:55:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Edward Fisher
eofisher@gmail.com
619 East California Boulevard
Pasadena, California 91106-3813

From: Pat Magrath
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:52:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pat Magrath
phatmcass@gmail.com
1905 N. Vallejo Way
Upland, California 91784-1674

From: Vicki Kruschwitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:48:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vicki Kruschwitz
kruschus@yahoo.com
3926 St Johns Village Way
Powhatan, Virginia 23139

From: Barbara Lowe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:45:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Lowe
garybarbaralowe@gmail.com
12-4116 Browning Road
, Alberta V7Z 0A3

From: C K
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:43:22 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

C K
winterlightningi@gmail.com
N3367 Juniper Rd
Lake Geneva, Wisconsin 53147

From: Joanna Welch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:40:21 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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Joanna Welch
jfwelch22@gmail.com
2945 Lowell St
Eureka, California 95501

From: Gerald Moore
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:38:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gerald Moore
gerry@geraldrmoore.com
462 Arlington St
SF, California 94131

From: Ken Sanford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:28:55 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ken Sanford
kenssailtime@gmail.com
2180 Amanda Ln
Escondido, California 920294307

From: Marie Garescher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:28:10 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marie Garescher
marfogar@gmail.com
3 Pheasant Walk
Peekskill, New York 10566

From: Catherine Loudis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:25:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Catherine Loudis
crloudis@gmail.com
219 Butterfield Rd.
San Anselmo, California 94960

From: Mary Bissell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:20:28 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Bissell
mcbisselli@gmail.com
525 Monterrey Rd NE
Rio Rancho, New Mexico 87144

From: Rene Bobo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:19:45 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rene Bobo
renebobo@mac.com
1982 London Carriage Grove
Colorado Springs, Colorado 80920

From: Michelle Krueger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:16:25 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michelle Krueger
orca.song10@gmail.com
6214 Johnson Street
Merrillville, Indiana 46410

From: Elliot Comunale
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:16:14 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elliot Comunale
elliotcomunale@yahoo.com
58 Menlo Park Drive
Akron , Ohio 44313

From: Stephen Rosenblum
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:15:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephen Rosenblum
pol1@rosenblums.us
212 Santa Rita Avenue
Palo Alto, California 94301

From: Nikki Wojtalik
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:10:29 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nikki Wojtalik
nwojtalik@hotmail.com
3723 Green Oak Ct.
Parkville, Maryland 21234

From: B G
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:04:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

B G
barbaran2323@gmail.com
2355 Brommer
Santa Cruz , California 96062

From: Mark Brooker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:03:08 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Brooker
brooker.mark@gmail.com
1149 E. 56th Street, #3
Chicago, Illinois 60637

From: Bridget Wyatt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 6:01:33 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bridget Wyatt
bridgetmichelle07@gmail.com
112 Ne 47th Ave
Portland, Oregon 97213

From: Miriam Harlan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:59:23 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Miriam Harlan
miriamharlan@yahoo.com
1929 Spruce
Philadelphia , Pennsylvania 19103

From: Martha Booz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:58:54 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Martha Booz
mlbooz@calnatives.com
3823 Valley Lane
El Sobrante, California 94803

From: Amy Henry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:58:40 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amy Henry
aries4455@gmail.com
22 Perkins Avenue
Northampton, Massachusetts 01060

From: Jerry Rivers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:56:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jerry Rivers
jerry.rivers13@yahoo.com
8 Gombert place
Roosevelt , New York 11575

From: Phillip Hope
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:53:45 PM

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Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Phillip Hope
phillip.hope@gmail.com
319 Avenue C
New York, New York 10009

From: Kathleen Petricca
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:53:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I agree with the Last Chance Alliance's message below. Moreover, the project of California Resources Corporation is doomed, given the Environmental Emergency we are now in. But it will save the incomes of the carbon combustion industries in our state. It might, in time, drain away tax dollars in state and federal government to repair the damages it causes in fires from escaped gas. Please read on and vote against the project.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Petricca
kpfast@aol.com
961 Lemon Street
Martinez, California 94553

From: B. Chan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:50:25 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

B. Chan
bettechan@gmail.com
9895 Scripps Westview
San Diego, California 92131

From: Jeannie Roberts
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:48:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeannie Roberts
jeannier65@gmail.com
1004 Yale Road
Madison, Wisconsin 53705

From: Monique Edwards
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:38:56 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Monique Edwards
sankhara.makare@gmail.com
3231 E Presidio Rd #301
Tucson, Arizona 85716

From: Jack Dodson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:36:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jack Dodson
jackdodson05@yahoo.com
7848 Paseo Tulipero
Carlsbad, California 92009

From: Patricia Bocanegra
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:35:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patricia Bocanegra
trishasatx@icloud.com
216 cr 6814
Natalia , Texas 78059

From: Matthew Mccollum
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:35:07 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Matthew Mccollum
discardofil@gmail.com
1556 San Andreas avenue
San Jose, California 95118

From: E P
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:30:11 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

E P
liz1952@gmail.com
PO Box 178
Talmage, California 95481

From: Mark Reback
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:26:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Reback
markreback@yahoo.com
413 SE 1st St
Battle Ground, Washington 98604

From: Evan Fulmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:25:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Evan Fulmer
efulmer44@gmail.com
5a Woodbury St
Merrimack , New Hampshire 03054

From: Erin Yip
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:24:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Erin Yip
erinyip415@gmail.com
1100 Fulton Street
San Francisco, California 94117

From: Dallas Windham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:21:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dallas Windham
medic4059@yahoo.com
2708 Country Creek Ln
Fort Worth, Texas 76123-1265

From: Andrew R.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:19:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andrew R.
arichman27@yahoo.com
7 Greene St.
Cumberland, Maryland 21502

From: Celeste Hong
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:18:25 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Celeste Hong
celestehong13@gmail.com
4758 Cromwell Avenue
Los Angeles, California 90027-1144

From: Noah Haydon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:13:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Noah Haydon
noahhaydon@gmail.com
405 91st St
Daly city , California 94015

From: Dawn Florio
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:04:44 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dawn Florio
florioski@yahoo.com
8136 Maplegrove Ave
North Royalton, Ohio 44133

From: Rick StJohn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:01:38 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rick StJohn
rinsfcausa@gmail.com
1 Daniel Burnham Court
San Francisco, California 94109

From: Margaret Weant-Leavitt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 5:01:06 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margaret Weant-Leavitt
coolincornville@yahoo.com
10655 e quail run rd
cornville, Arizona 86325

From: Constance Minerovic
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:56:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,
STOP carbon pollution NOW! Big Oil obfuscates everything!

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Constance Minerovic
clminerovic@yahoo.com
8478 Waterside Drive
Northfield Center, Ohio 44067

From: Joyce Calagos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:49:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joyce Calagos
joycecalagos1@gmail.com
1636 Geneva Ave.
San Francisco, California 94134

From: Lorraine Brabham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:47:36 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lorraine Brabham
tweety336@gmail.com
932 Bloomfield St.
Hoboken, New Jersey 07030

From: James Keenan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:46:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

James Keenan
jimkeenan48@icloud.com
108 Madison Road
Lansdowne , Pennsylvania 19050

From: Hod Gray
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:43:14 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Hod Gray
bosshod@mac.com
1000 E MAPLE AVE
LOMPOC, California 93436

From: peter Lebeck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:42:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

peter Lebeck
lebeckg1@gmail.com
10 short hill rd
New City, New York 10956-2416

From: Amber T
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:41:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amber T
amberlou611@gmail.com
608 Mclaughlin
Richmond, California 94805

From: Sue Ellen Lupien
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:41:38 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sue Ellen Lupien
sueellenlupien@yahoo.com
106 Misty Valley Lane
Maumelle , Arkansas 72113

From: Liliana Camacho
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:40:46 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Liliana Camacho
ninjaassme@gmail.com
9618 Hahn Way
Elk Grove , California 95757

From: Abigail Gindele
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:33:06 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Abigail Gindele
agindele@gmail.com
229 Clinton St
Portsmouth, New Hampshire 03801

From: Ben Martin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:31:58 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ben Martin
benmartin12@stanfordalumni.org
49 Showers Dr A340
Mtn View, California 94040

From: Jann Johnson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:30:58 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jann Johnson
jannjohnson@icloud.com
301 2nd St
Sausalito, California 94965

From: Robert Charleston
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:28:07 PM

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Robert Charleston
robertcharleston0529@gmail.com
7612 Estate Carolina
St. John, Vi 00830

From: ronnie huber
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:27:28 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

ronnie huber
redtrucker777@gmail.com
3220 mission ave
Oceanside , California 92058

From: Randi Justin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:27:26 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Randi Justin
rju7462854@aol.com
3341 NW 47th Terrace
Lauderdale Lakes , Florida 33319

From: Gail gester
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:23:54 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gail gester
ggester@jps.net
8990 Ravens Pike
Boonville, California 95415

From: Brenda Nieland
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:22:23 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brenda Nieland
brenda5155@gmail.com
27237 Lana Ln
Conroe, Texas 77385

From: Marybeth Primeau
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:21:07 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marybeth Primeau
mbprimeau@gmail.com
1081 Harrington Way
Carmichael, California 95608

From: Cristina Amarillas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:20:15 PM

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Cristina Amarillas
clamarillas@gmail.com
3109 Rocklin Drive
Santa Rosa, California 95405

From: Dale Beaver
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:19:57 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dale Beaver
beaverdale13@gmail.com
316 C St # 71
Chula Vista , California 91910

From: B. E.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:17:25 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

B. E.
barerickson@gmail.com
V. Sch. Rd.
Westlake Village, California 91361

From: Jered Cargman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:12:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jered Cargman
jered@swingin60s.com
PO Box 441
Bisbee, Arizona 85603

From: Richard Bold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:11:58 PM

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Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Bold
boldgilman@aol.com
2098 Hawley Dr
Vista, California 92084

From: Joan Scott
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:07:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joan Scott
joan.moonwatch@gmail.com
PO Box 1213,
Joshua Tree, California 92252

From: Kay Randall
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:06:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kay Randall
kmrandall64@gmail.com
520 32nd Ave S., Apt. 109
Moorhead, Minnesota 56560

From: Heath Post
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:04:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Heath Post
dragonlinch666@gmail.com
1323 W Wieland Rd
Lansing , Michigan 48906

From: Allisyn Snyder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 4:03:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Allisyn Snyder
allisynsnyder@gmail.com
7300 Lennox Ave
Van Nuys, California 91405

From: Dr Adam Lucas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:57:26 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dr Adam Lucas
alucas@uow.edu.au
8 Korrongulla Crescent
Wollongong, New South Wales 2502

From: Stephanie Walkowiak
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:56:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Walkowiak
smw248@gmail.com
2049 sea cove lane
Costa Mesa, California 92627

From: Russell Novkov
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:53:19 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Russell Novkov
rnovkov@gmail.com
602 Sawyer Terrace 308#
Madison, Wisconsin 53705

From: David Stevens
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:53:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Stevens
jdstevens355@gmail.com
3920 S. Meridian St
Indianapolis , Indiana 46217

From: Mary baville
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:51:39 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary baville
mary.baville@yahoo.com
776 Teakwood Lane
San Dimas, California 91773

From: Keith Emery
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:49:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Keith Emery
kemery@surf-ici.com
1101 N. Leland Ave.
indianapolis, Indiana 46219

From: V Evan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:49:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

V Evan
agadog@mac.com
1335 W. Rosedale Avenue
Chicago, Illinois 60660

From: Tobey Wiebe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:47:39 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tobey Wiebe
twiebe@sonic.net
852 Contra Costa Ave.
Berkeley, California 94707-1920

From: Maria Ramirez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:46:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maria Ramirez
ramirezmer@gmail.com
1696 Marisol Dr
Ventura, California 93001

From: Daniel polley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:45:11 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Daniel polley
dannypolley@gmail.com
6201 N Wayne Ave, 2
Chicago, Illinois 60660

From: Alexander Fierro-Clarke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:42:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alexander Fierro-Clarke
alexfierro.film@gmail.com
1427 McDuff Street
Los Angeles, California 90026

From: Anthony Jammal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:41:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anthony Jammal
rcquetbl1@hotmail.com
1601 Dana Way
Roseville, California 95661

From: Mary Myers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:40:26 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Myers
mlmyers@sonic.net
2338 B Street
Eureka, California 95501

From: Michael Russell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:39:59 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Russell
cardcat57@gmail.com
630 N 9th St
Santa Paula, California 93060

From: Elena Engel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:39:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elena Engel
elenajengel@gmail.com
2289 Bryant St
San Francisco, California 94110

From: Susan Dickerson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:38:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Dickerson
lola2danz@gmail.com
6012 woodland lane
clinton, Maryland 20735-1542

From: Aloysius Wald
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:36:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Aloysius Wald
ajwaldtwo@yahoo.com
523 East Lincoln Avenue
Columbus, Ohio 43214

From: P. Davis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:35:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

P. Davis
mrprdavis@hotmail.com
1054 43rd Street
Emeryville , California 94608

From: Beverly Mitchell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:34:39 PM

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Beverly Mitchell
bevrosam@aol.com
1812 S Watersilk Pl
Boise, Idaho 83709

From: Tami Myers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:33:57 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tami Myers
doglvr916@yahoo.com
4321 65th street
Sacramento, California 95820

From: Cara Vallot
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:30:41 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cara Vallot
purplecat0804@gmail.com
P. O. Box 188168
Sacramento, California 95818

From: Lara Whiting
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:30:09 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lara Whiting
bucketsforest@gmail.com
67 Setting Sun lane
Travelers Rest, South Carolina 29690

From: Winke Self
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:28:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Winke Self
w_self@yahoo.com
8935 Caminito Fresco
La Jolla, California 92037

From: Katie McCammon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:26:30 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katie McCammon
katie.mccammon@350sacramento.org
425 Lampasas Ave.
Sacramento, California 95815

From: Bettina Goodall
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:22:37 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bettina Goodall
urbanark9@aol.com
2562 west Brutus
Weedsport , New York 13166

From: David Undlin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:18:51 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Undlin
davidu03@frontiernet.net
6670 133RD ST W
Apple Valley, Minnesota 55124

From: Katherine Bongfeldt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:18:15 PM

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Katherine Bongfeldt
kbongfeldt@hotmail.com
2034 via del rey
south pasadena, California 91030

From: edward drinkwater
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:13:18 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

edward drinkwater
skipdrink@gmail.com
730 Monument Road
Malvern, Pennsylvania 19355

From: Robert Reed
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:10:20 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Robert Reed
robtsreed@gmail.com
8251 La Palma Ave #443
Buena Park, California 90620

From: perry harris
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:08:31 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

perry harris
perryharris1@gmail.com
3163 rt 94
chester, New York 10918

From: Candice Cassato
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:07:15 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Candice Cassato
cand47@aol.com
6417 54th Ave. NW
Olympia , Washington 98502

From: Marilyn Shepherd
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:06:26 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marilyn Shepherd
marilynshepherd@gmail.com
PO Box 715
Trinidad, California 95570

From: Nancy Kurshan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:03:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Kurshan
nancykurshan44@gmail.com
755 65th Street
Oakland, California 94609

From: Leslie Gonzales
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 3:03:13 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Leslie Gonzales
lesliedan25@gmail.com
45556 60th St W
Lancaster, California 93536-8321

From: Jo Harvey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:59:58 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jo Harvey
cailinfili@yahoo.com
204 Eastgate Ave N
Pacific, Washington 98047

From: Barbara Giorgio
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:57:07 PM

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Kern County,

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Barbara Giorgio
barbgiorgio@gmail.com
14 Jeff Rd
Largo, Florida 33774

From: Eileen Langan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:56:25 PM

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Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eileen Langan
e21langan@gmail.com
1629 Tulip Circle, Auburn, CA
Auburn, California 95603

From: Lara Ingraham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:55:21 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lara Ingraham
laraingraham@gmail.com
800 N Las Palmas Ave Apt 105
Los Angeles , California 90038

From: Kristin Laughtin-Dunker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:52:08 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kristin Laughtin-Dunker
klaughtin@gmail.com
1515 Riviera Drive
Santa Ana, California 92706

From: Kenneth Lapointe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:51:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kenneth Lapointe
incredistical@outlook.com
2781 Mozart
Los Angeles, California 90031-0032

From: Pedro Rabacal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:49:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pedro Rabacal
pedrorabaal@gmail.com
Dona Estefania Street, Number 26, 4th Left
Lisbon, Lisboa 1150-134

From: Jon Kiesling
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:48:14 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jon Kiesling
kieslingje@gmail.com
819 Greeley Ave
Saint Louis, Missouri 63119

From: James Mulcare
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:46:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

James Mulcare
jsmulcare52@gmail.com
1110 Benjamin St
Clarkston, Washington 99403

From: Lidia Perdomo
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:42:19 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lidia Perdomo
latinlids@gmail.com
160 3rd Street
Richmond, California 94801

From: Jamie Thomas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:41:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jamie Thomas
jamiedt2003@gmail.com
2003 Eclipse Dr
Middleburg, Florida 32068

From: Judith Cooper
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:36:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Cooper
judith.cooper17@icloud.com
2701 Ashby Ave
Des Moines, Iowa 50310

From: maureen rogers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:35:34 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

maureen rogers
gemeroym@gmail.com
316 W Columbia Dr
Newberg, Oregon 97132

From: Lisa L Smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:35:14 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lisa L Smith
llauritzen@bresnan.net
735 Rodeo Dr
, Wyoming 83001

From: Claire Bekker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:34:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Claire Bekker
ckbekker72@g.ucla.edu
3827 Prospect Ave Apt A
Culver City, California 90232

From: k. eggers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:31:48 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

k. eggers
lullabyguy@yahoo.com
2353 Addy-Gifford rd
Addy, Washington 99101

From: Carrie Swank
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:31:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carrie Swank
caswank1@gmail.com
69 Michigan Drive
Sinking Spring , Pennsylvania 19608

From: Chris Dacus
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:30:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Chris Dacus
chriscat2014@hotmail.com
3353 Fairfield Pike
BELL BUCKLE, Tennessee 37020

From: joseph dadgari
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:27:51 PM

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joseph dadgari
dadgarijm@gmail.com
PO Box 492205
Los Angeles , California 90049

From: Karylee Feldman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:26:51 PM

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Karylee Feldman
karyleebm@gmail.com
2627 C Street Unit 9
San Diego, California 92102

From: Kandice Bilisoly
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:26:00 PM

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Kandice Bilisoly
kandicebilisoly@gmail.com
4581 N Carefree Cir
Colorado Springs, Colorado 80917-2181

From: Sharon Bunch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:24:20 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sharon Bunch
ssbunch10@gmail.com
103 Sunnyside Ave
Piedmont, California 94611

From: Jim Malone
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:23:00 PM

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Kern County,

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Jim Malone
ritajim12@gmail.com
12 Turvey Drive
Donabate, Fingal

From: Diana Bohn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:21:25 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Diana Bohn
nicca@igc.org
618 San Luis Rd
Berkeley, California 94707-1726

From: Candace Rocha
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:20:10 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Candace Rocha
candace8027@gmail.com
4423 Alpha St
Los Angeles, California 90032

From: Kate Kenner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:20:00 PM

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Kate Kenner
faunesiegel@gmail.com
3539 Weatherhead Hollow Rd.
Guilford, Vermont 05301

From: Gary Ammirati
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:16:27 PM

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Kern County,

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Gary Ammirati
rdkl713@mac.com
89 N Hill Rd
Ventura, California 93003

From: Stephen Boletchek
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:12:29 PM

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Kern County,

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Stephen Boletchek
sboletchek@gmail.com
1106 Elbury Drive
Apex, North Carolina 27502

From: james kawamura
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:10:37 PM

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james kawamura
kawamurakzextion@aol.com
16415 Basswood Ln
Fontana, California 92336

From: Sara Bakker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:09:37 PM

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Kern County,

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Sara Bakker
judacia1978@gmail.com
3107 East Zeering Rd
Denair, California 95316

From: John Schenck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:08:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Schenck
johnbschenck@yahoo.com
115 Sycamore Ct
, South Carolina 29302

From: rich c
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:06:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

rich c
crich00@hotmail.com
1689 b'way
, California 91910

From: Rina Rubenstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:06:00 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rina Rubenstein
houseofrina@hotmail.com
2537 13th Ave
Los Angeles, California 90018

From: William Dodson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:05:55 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

William Dodson
rudolphthered1949@gmail.com
16220 Oak Springs Dr
Ramona, California 92065-4221

From: Dr. Stephen DeCesare
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:05:49 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dr. Stephen DeCesare
sdecesare@gmail.com
66 North Williams
Johnston, Rhode Island 02919

From: Ellen Leng
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:03:27 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ellen Leng
lengedmd@gmail.com
71 Picardy Ct.
Walnut Creek, California 94597

From: Sharon Barbee
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:03:03 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sharon Barbee
barbees@sonic.net
250 Prune Tree Drive
Healdsburg, California 95448

From: Susanne Varlese
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:02:38 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susanne Varlese
suvarlese@yahoo.com
3190 Eastwood Court
Boulder, Colorado 80304

From: Beth Darlington
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:02:34 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Beth Darlington
bedarlington@vassar.edu
16 Vassar Lake Dr
Poughkeepsie, New York 12603-3120

From: Joseph A Flasch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:01:38 PM

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Respectfully, USN-Ret
P.S. For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.
Thank you

Joseph A Flasch
linmindah@yahoo.com
511 Egret Lane
Zimmerman, Minnesota 55398/8824

From: Maureen McCarthy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 2:00:28 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maureen McCarthy
mscribe9@yahoo.com
32 South St
Marblehead , Massachusetts 01945

From: Giovannina Fazio
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:58:27 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Giovannina Fazio
fazio@sndden.org
1520 Ralston Ave, 1520 Ralston Ave
Belmont, California 94002

From: Sharon Paltin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:58:13 PM

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About a decade ago I met people from Kern Co. who could not drink the water because it was contaminated by fracking. As an agricultural area, it is also important not to contaminate crops with contaminated water.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sharon Paltin
bluetoothfairy18@gmail.com
po box 18
Laytonville, California 95454

From: Steve Lustgarden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:56:08 PM

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Kern County,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Lustgarden
slustgarden@gmail.com
28 Hanover Court
Santa Cruz, California 95062

From: F Corr
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:54:00 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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F Corr
newhotar@gmail.com
1353 Melendy Hill Rd
Guilford, Vermont 05301

From: Michael Burg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:53:22 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Burg
msburg22@gmail.com
7266 Tiburon Dr
Eastvale, California 92880

From: Madelaine Georgette
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:52:36 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Madelaine Georgette
studiogeorgette@mac.com
2922 Saklan Indian Drive
Walnut Creek, California 94595

From: Green Greenwald
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:46:58 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Green Greenwald
green@greengreenwald.com
14121 Buttner Rd
Guerneville, California 95446

From: jonathan weinstock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:45:12 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

jonathan weinstock
jstock522@yahoo.com
2208 7th Sylt
Berkeley , California 94710

From: Jane Mcmill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:40:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jane Mcmill
janayamcmillan123@gmail.com
6706 N Chestnut Ave
Fresno, California 93710

From: Massimiliano Urso
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:37:37 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Massimiliano Urso
maurso@gmail.com
colonia jardines del valle,, primera avenida, n.5
San Pedro Sula, Indiana 00000

From: Keith D"Alessandro
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:36:47 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Keith D'Alessandro
keith_dalessandro@outlook.com
42486 Saratoga Road, Canton, MI, USA
Canton, Michigan 48187

From: Karen Spradlin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:36:28 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Spradlin
wohlbold_2000@yahoo.com
307 Wilson Dr SW
Jacksonville, Alabama 36265-2751

From: Ray Moody
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:34:43 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ray Moody
typeandculture@mac.com
PO Box 11099
Honolulu, Hawaii 96828

From: Peter Schneider
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:34:41 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peter Schneider
pschneid@gmail.com
398A Ninth St.
Brooklyn, New York 11215

From: glen deardorff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:32:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

glen deardorff
guitarride@gmail.com
18250 crest
castro valley, California 94546

From: Lawrence Hager
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:32:15 PM

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Kern County,

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Lawrence Hager
lchager@gmail.com
3611 Pinetree Terr.
Falls Church VA, Virginia 22041

From: Samantha BeuMaher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:31:16 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Samantha BeuMaher
sambeumaher@gmail.com
12790 Los Coches Ct
Lakeside, California 92040

From: Paula Morgan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:26:41 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paula Morgan
paulaymorgan@gmail.com
1595 Eagle Wind Terrace
Winter Springs, Florida 32708

From: Mark Grossman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:26:28 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Grossman
grossman_mark@yahoo.com
2063 Byron St
Palo Alto, California 94301

From: Derek Gendvil
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:23:42 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Derek Gendvil
dgendvil@gmail.com
9030 W Sahara Ave Apt 360, #360
Las Vegas, Nevada 89117

From: George Schneider
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:23:06 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

George Schneider
grs92138@gmail.com
2029 Tulip St
San Diego, California 92105

From: Susan Babbitt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:23:04 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Babbitt
philad49@gmail.com
1010 Pine St Apt 2R
Philadelphia, Pennsylvania 19107

From: Maria Angelini
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:22:15 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maria Angelini
monique.baby@gmail.com
1612 1/2 N Harvard Blvd.
LOS ANGELES, California 90027

From: Rita O"Sullivan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:21:38 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rita O'Sullivan
osullivan.rita@gmail.com
12 Turvey Drive
Donabate, Fingal

From: Marco Pardi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:20:13 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marco Pardi
mpardi@aol.com
2195 Sandown court
Lawrenceville, Georgia 30043

From: Barbara Sorgeler Sorgeler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:19:05 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Sorgeler Sorgeler
baskas@verizon.net
26435 Creekwood Circle
Millsboro , Delaware 19966

From: Darrell Clarke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:16:29 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Darrell Clarke
darrell@dclarke.org
1309 Ontario Ave
Pasadena, California 91103

From: tammy bullock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:14:13 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

tammy bullock
tamibullock@yahoo.com
255 east Bradley ave spc 5
El Cajon, California 92021

From: Richard Boyce
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:13:58 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman:

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sincerely,
Richard L. Boyce

Richard Boyce
richard_l_boyce@icloud.com
7061 Grantham Way
Cincinnati, Ohio 45230

From: Nicole Beeck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:12:57 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nicole Beeck
whole_woman@yahoo.com
643 E Saint James st
San Jose, California 95112

From: Cindy Phillips
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:10:18 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cindy Phillips
drckphillips@gmail.com
6609 N Shadow Run Drive
Tucson, Arizona 85704

From: William Welkowitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:06:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

William Welkowitz
bwelkowitz@gmail.com
1600 S. Eads St., Apt. 526N
Arlington , Virginia 22202

From: joanna.leary28@gmail.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:06:41 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

joanna.leary28@gmail.com
140 Halidon Road
Westbrook , Maine 04092

From: Nina Greenberg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:06:08 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nina Greenberg
nina@utla.net
2705 Armstrong Ave
Los Angeles, California 90039

From: Soraya Barabi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:05:00 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Soraya Barabi
musiclover2478@yahoo.com
1240 Brockton Ave
Los Angeles, California 90025

From: D Sizemore
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:03:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

D Sizemore
sandrat56@me.com
111 2nd
Muscle Shoals , Alabama 35661

From: Marina Salmon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:03:33 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marina Salmon
marinasalmon1992@gmail.com
811 N Minter St, Apt B
Santa Ana, California 92701

From: Tyson Martin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 1:00:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tyson Martin
tysonjmartin@gmail.com
4426 W Kling St
Burbank, California 91505

From: Patrice Wallace
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:57:29 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patrice Wallace
patricewallace@cruzio.com
5498 Coast Rd
Santa Cruz, California 95060

From: Elizabeth Olson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:56:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elizabeth Olson
nekoni_6@yahoo.com
270 Littleton Rd, Trlr 24
Chelmsford, Massachusetts 01824

From: Karen McCaw
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:55:25 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen McCaw
mccaw.karen@yahoo.com
4526 Mount Vernon Dr
Los Angeles, California 90043

From: Nancy Trevino
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:53:54 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Trevino
nancy@presente.org
2591 Calle Delfino
Santa Fe, New Mexico 87505

From: Christie Decker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:53:09 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christie Decker
christie424@gmail.com
786 Geary St., Apt. 401
San Francisco, California 94109

From: Karla Devine
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:51:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karla Devine
kjdevine99@yahoo.com
1406 11th Street
Manhattan Beach, California 90266

From: Ronald Harkov
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:51:01 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ronald Harkov
rharkov1953@gmail.com
81 Coppermine Road
Princeton, New Jersey 08540

From: Natalie Bailey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:49:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Natalie Bailey
nataliebailey80@yahoo.co.uk
5 greymont road bury Lancashire
Manchester, England Bl9 6PN

From: Joy Rosenberry Chase
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:45:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joy Rosenberry Chase
joycarolrose@gmail.com
6521 Westin
Madison, Wisconsin 53719

From: Arthur Schurr
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:40:23 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Arthur Schurr
bulaas@aol.com
100 W. 94th St., Apt. 6F
New York, New York 10025

From: Catherine Houtakker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:38:43 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Catherine Houtakker
choutakk@sinsinawa.org
585 County Road Z
Sinsinawa, Wisconsin 53824

From: Nejat Duzgunes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:36:32 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nejat Duzgunes
nduzgunes@pacific.edu
508 Pixie Trail
Mill Valley, California 94941

From: Emmet Ryan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:36:03 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Emmet Ryan
hopeldehoy@aol.com
373 Plainfield Ave.,
Floral Park, New York 11001

From: Rhonda Green
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:35:46 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rhonda Green
nannyg@gmail.com
P.O> Box 6100
Beverly Hills, California 90212

From: D. Rowe
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:35:04 PM

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D. Rowe
dianamite920@gmail.com
2118 wilshire
Santa Monica, California 90403

From: Dan and Lilly Kittredge
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:34:40 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Dan and Lilly Kittredge
dan.kittredge@gmail.com
7620 Eastridge Drive
La Mesa, California 91941-7881

From: Sandra Levine MD
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:32:52 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sandra Levine MD
sacljunk@gmail.com
1160 IDYLBERRY RD
San Rafael, California 94903

From: Kristine Carraway
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:32:45 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kristine Carraway
biloxiwill2@yahoo.com
16916 Hierba Drive
San Diego, California 92128

From: Steve Metzger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:31:58 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Metzger
onemetzgersteve@gmail.com
6002 Hardwick Cir
Huntington Beach, California 92647

From: Prisca Gloor
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:31:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Prisca Gloor
priscagloor@gmail.com
4055 Coolidge Ave, Los Angeles, CA, USA
Los Angeles, California 90066

From: Karen Thomas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:30:04 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Thomas
ktcatlover@verizon.net
126 Garden St
Garden City, New York 11530

From: Daniel L Harris
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:29:55 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Daniel L Harris
youthgoji@yahoo.com
142 Richmond Ave
Medford , New York 11763

From: Donna Harrison
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:27:54 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Donna Harrison
dhkanga@aol.com
6686 S. Lafayette St.
Centennial, Colorado 80121

From: Richard Klett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:27:37 PM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Klett
richardklett@gmail.com
4245 Little fork cove road
Denver , North Carolina 28037

From: Dita Škalič
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:27:17 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dita Škalič
dita.skalic@gmail.com
Levstikova ulica 4
Moravske Toplice, 9226

From: Edward Hubbard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:27:08 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Edward Hubbard
edhubbard@gmail.com
210 S. Whitney Way
Madison, Wisconsin 53705

From: Susan P. Walp
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:26:52 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrawn water source. Compromising groundwater supply in a county where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan P. Walp
susanwalp@gmail.com
1234 El Mirador
Pasadena, California 91103

From: Jessica Cresseveur
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:26:34 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jessica Cresseveur
jmcress@gmail.com
3305 Laclede Ave.
New Albany, Indiana 47150

From: Janice Porter
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:26:07 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Janice Porter
porterwj20191@gmail.com
2374 Branleigh Park
Reston, Virginia 20191

From: Jane Moad
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:24:57 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jane Moad
janemoad11@gmail.com
4760 Hillsboro Circle
Santa Rosa, California 95405

From: Martin Schnur
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:24:20 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Martin Schnur
mar2une.fschnur@yahoo.com
525 Bayberry Pointe Dr NW
Walker, Michigan 49534

From: Dorothy Li Calzi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:23:40 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dorothy Li Calzi
dmlicalzi@gmail.com
6609 Lincoln dr
Philadelphia, Pennsylvania 19119

From: Pat Pire
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:23:20 PM

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Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pat Pire
birdeyepat@aol.com
10200 W. Blue Mound Rd
Wauwatosa , Wisconsin 53226

From: Rachel Henning
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:22:50 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rachel Henning
dacho217@gmail.com
408 E. Plainview Ave.
Indianola, Iowa 50125

From: Anne Kazlauskas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:22:44 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anne Kazlauskas
alkalinelilac@gmail.com
22 Curve Street
Lexington, Massachusetts 02420

From: Laureen Coughlin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:22:31 PM

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Kern County,

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Laureen Coughlin
coughlinsmfs@yahoo.com
8566 Usher Rd. Olmsted Twp, OH 44138
Olmsted Falls, Ohio 44138-2140

From: Megan Whitman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:21:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Megan Whitman
mhwhitman@gmail.com
2669 Blackburn Dr
Davis, California 95618

From: Sasha Silverstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:21:21 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sasha Silverstein
sashasilverstein@gmail.com
235 lincoln place
brooklyn, New York 11217

From: Liz Dyer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:21:09 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Liz Dyer
melizabeth.dyer@gmail.com
115 Edisto Court
Chapel Hill, North Carolina 27514

From: Lisa Kellman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:20:15 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lisa Kellman
s-sage@sonic.net
474 Day St.
San Francisco, California 94131

From: Laurie Kinnings
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:18:47 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laurie Kinnings
lkinnings@gmail.com
9521 Lambert Circle
Garden Grove, California 92841

From: Lill Rubinstein
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:18:10 PM

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Lill Rubinstein
lillrubinstein033@gmail.com
Odonstigen 4 c
Mora , Dalarna 792 52

From: Mark Schroeder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:17:55 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Schroeder
taqdeermachen@yahoo.com
202 Hoegh Ave SW
Spring Grove, Minnesota 55974

From: Randy Guthrie
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:17:43 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Randy Guthrie
r_guth7@yahoo.com
7102 77th Ave se
Snohomish, Washington 98290

From: Ian Mullen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:17:39 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ian Mullen
ianmullen88@gmail.com
380 Manka Circle
Santa Rosa, California 95403

From: C. Brian Stevens
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:16:55 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

C. Brian Stevens
cbrianstevens@gmail.com
1544 Maryan Ave
, Ohio 45102-1987

From: Sharon Longyear
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:16:00 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sharon Longyear
sharonmlongyear@gmail.com
21 Rondout Harbor
Port Ewen, New York 12466

From: Mary Steele
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:15:49 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Steele
online-activist@alumni.stanford.edu
24561 La Hermosa Avenue
Laguna Niguel, California 92677

From: I. Engle
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:15:38 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

I. Engle
1ieengle@gmail.com
605 Bosque St.
Village of Tularosa, New Mexico 88352

From: David Kaskowitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:15:28 PM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Kaskowitz
dkasko@gmail.com
306 PARK ST
SAN FRANCISCO, California 94110

From: Ben Wiener
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:12:34 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ben Wiener
brw565@gmail.com
429 Lambert Rd
Carpinteria, California 93013

From: Sara Celiberti
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:08:51 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sara Celiberti
saraceliberti@gmail.com
Kdoshei Damesek 6,
Haifa, Southern 3551206

From: Susan Brisby
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:08:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Brisby
sabrisby@gmail.com
43130 30th St W Apt 133
Lancaster, California 93536-1616

From: Grant Sorrell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:08:00 PM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Grant Sorrell
quitepiraty2@gmail.com
Flat 2, 59 High Street
Great Barford, England MK44 3JJ

From: J.B. Ciesielski
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:07:07 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

J.B. Ciesielski
jbc@bridges4edu.org
2331 Harrison Drive
Dunedin, Florida 34698

From: Veronica Bourassa
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:06:22 PM

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Veronica Bourassa
rorlowske@gmail.com
212 Key West Ave
Fairview, Georgia 30741

From: Stephanie Meacham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:06:02 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Meacham
smeacham@adrian.edu
740 Koula Road
Marysville, Michigan 48040

From: Kelly Wright
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:05:35 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kelly Wright
kellynwright@gmail.com
1784 S Hayworth Ave
Los Angeles, California 90035

From: Shawn Troxell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:05:35 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shawn Troxell
sbrown3348@yahoo.com
487 Dallas Street
New Braunfels, Texas 78130

From: Avi Shaprut
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:05:07 PM

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Kern County,

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Avi Shaprut
sdsurfer72-generic@yahoo.com
7050 El Fuerte St
Carlsbad , California 92009

From: Joel Masser
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:04:10 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joel Masser
joelmasser@pm.me
5327 Romford Drive
San Jose , California 95124

From: Sheila Tran
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:03:50 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sheila Tran
sheilabearry@yahoo.com
1766 Serpentine Dr.
Eagan , Minnesota 55122

From: Maria Asteinza
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:03:46 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Maria Asteinza
asteim@verizon.net
7337 Austin Street
Forest Hills, New York 11375

From: Martha Gorak
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:02:44 PM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Martha Gorak
martha2503@gmail.com
22502 Downdale Cir
Katy, Texas 77450

From: Julianne Gould
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:01:04 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Julianne Gould
eagleslady73@gmail.com
124 Rosewood Ln
East Stroudsburg, Pennsylvania 18301-7719

From: Don Rodes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:00:19 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Don Rodes
dwrodes1@gmail.com
132 Darrington Drive
Follow , California 95630

From: Craig Barry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 12:00:18 PM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Craig Barry
craig@actionwrks.com
12115 Culver Dr
Culver City, California 90230

From: Brucker Ben
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:59:54 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brucker Ben
bbrucker2@gmail.com
34509 Calle Carmelita
Capistrano Beach , California 92624

From: Peter Gruber
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:58:30 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peter Gruber
pgruber628@gmail.com
18369 Siesta Drive
Penn Valley , California 95946

From: Frances m
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:56:09 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Frances m
conquerthisgreatdivide3@aol.com
332 Campbell Dr
Rogersville, Tennessee 37857

From: Beverly Carman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:55:55 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Beverly Carman
beverlycarman@hotmail.com
2961 Motor Avenue
Los Angeles , California 90064

From: Amy M
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:55:55 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amy M
tearingitdown3@yahoo.com
332 Campbell Dr
Rogersville, Tennessee 37857

From: Diana North
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:54:29 AM

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Kern County,

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Diana North
northcarmel@gmail.com
236 highway 1
carmel, California 93923

From: JOELYN LUTZ
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:53:37 AM

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Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

JOELYN LUTZ
wonheart1@gmail.com
418 EAST ROSE AVENUE
SANTA MARIA, California 93454

From: Alan Wojtalik
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:53:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alan Wojtalik
alan_wojtalik@hotmail.com
3723 Green Oak Court
Baltimore, Maryland 21234

From: Shirley Swan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:52:47 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shirley Swan
starryshirley@hotmail.co.uk
84 station rd
birmingham, England b14 7sr

From: Dan Bacher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:52:32 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dan Bacher
danielbacher53@gmail.com
3201 Eastwood Road
Sacramento, California 95821

From: Anthony Ricciardi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:51:53 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anthony Ricciardi
ricciard8@aol.com
783 Harold Ave SE
Atlanta, Georgia 30316

From: Nancy Gowani
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:50:37 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Gowani
nancyg900@gmail.com
20543 Tiara street
Woodland Hills, California 91367

From: Gregory Besnak
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:50:13 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gregory Besnak
g.besnak@gmail.com
13016 1/2 Burbank Blvd.
VAN NUYS, California 91401

From: Shoshana Wechsler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:48:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Shoshana Wechsler
swechs@sonic.net
59 Kenyon Ave., Kensington CA
Kensington, California 94708

From: Leila Salazar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:48:35 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Leila Salazar
leila@amazonwatch.org
520 3rd Street, Suite 108
OAKLAND, California 94607

From: Laura Colston
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:48:14 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laura Colston
laura.colston@gmail.com
603 Wooster Pike
Terrace Park, Ohio 45174

From: Ryan Baka
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:47:35 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ryan Baka
ryan.baka@gmail.com
3107 North Knox Avenue
Minneapolis, Minnesota 55411

From: Kahlil Goodwyn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:45:49 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Kahlil Goodwyn
ktgoodwyn@gmail.com
30 Montrose Ave Apt 22Q
Brooklyn, New York 11206

From: Diana Saxon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:44:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Diana Saxon
moondaughter72@hotmail.com
4098 Market St NE, Apt 23
Salem, Oregon 97301

From: Bob Moyer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:44:17 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Bob Moyer
bmoyer1952@gmail.com
713 Scenic Drive
Harleysville, Pennsylvania 19438

From: Vanessa Gray
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:42:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vanessa Gray
vanessagray007@btinternet.com
12 George St
Annfield Plain, England DH9 9HD

From: Amit Shoham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:41:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Amit Shoham
amit@tarantic.com
5413 El Camile Avenue
Oakland, California 94619

From: Peter Menchini
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:41:39 AM

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Peter Menchini
mayamedia@gmail.com
1438 josephine st
Berkeley , California 94703

From: Alicia Salazar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:40:56 AM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Alicia Salazar
lola.salazar@gmail.com
3740 Collis Ave
Los Angeles, California 90032

From: meg beeler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:40:45 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Water sources and aquifers in Kern County are already stressed and falling. Adding compressed CO2 to the ground will exacerbate this and threaten people who live nearby.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

meg beeler
support@megbeeler.com
16100 sobre vista court
sonoma, California 95476

From: Judy Shively
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:38:55 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judy Shively
jashively01@gmail.com
1475 Imperial Ave
San Diego, California 92101

From: Andrea Schulz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:38:55 AM

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Andrea Schulz
dreadreas22@yahoo.com
5070 E Ashlan Ave
Fresno, California 93727

From: Barbara Porter
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:38:54 AM

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Barbara Porter
bporter315@yahoo.com
910 J St Lot C22
Salida, Colorado 81201

From: James Longman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:37:54 AM

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James Longman
longers1@gmail.com
132 N Arden Blvd
Los Angeles, California 90004-3713

From: Lisa Gherardi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:37:47 AM

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Lisa Gherardi
gherardi2@aol.com
435 Alberto Way
Los Gatos, California 95032

From: Linda Prostko
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:37:39 AM

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Linda Prostko
lprostko@gmail.com
7875 Marsh Hollow Dr
, Michigan 49333

From: Elizabeth D.
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:37:15 AM

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Elizabeth D.
jersey1074@yahoo.com
72 Edgefield Dr
Morris Plains, New Jersey 07950-1969

From: Lisa Jackson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:35:39 AM

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Lisa Jackson
67jacksonl@gmail.com
105 Las Juntas Way
Walnut Creek, California 94597

From: Kate Harder
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:35:10 AM

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Kate Harder
kateharder3@outlook.com
1N186 Main St
Glen Ellyn, Illinois 60137

From: Brian Boies
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:34:55 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brian Boies
briankboies@gmail.com
622 Fremont Way
Sacramento, California 95818

From: Kathleen Brown
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:34:17 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Brown
bkate7679@gmail.com
1245 CALIFORNIA ST
San Francisco, California 94109

From: Lyndal Daniels
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:33:45 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lyndal Daniels
lynda6367@yahoo.com
4547 Piccadilly
Carlsbad , California 92010

From: Carol Schaffer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:32:52 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Schaffer
cschaff@aol.com
2530 kavanagh rd
san pablo, California 94806

From: Nancy Schimmel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:31:05 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

I experienced Kern County's air pollution problem when I performed in Bakersfield some years ago. I thought I was coming down with the flu, but it was drift from aerial crop spraying. This project will just produce more pollution.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Schimmel
nancyschimmel@mac.com
1639 Channing Way
Berkeley, California 94703

From: Cynthia Cunningham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:30:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cynthia Cunningham
cccunningham@mac.com
2435 Glenwood Drive
Boulder, Colorado 80304

From: Lisa Hammermeister
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:29:25 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Take it out of the ground then put it back in, dirty and dangerous. More greed and cheap solutions.

Lisa Hammermeister
necrohead56@gmail.com
16456 Shamhart Drive
Granada Hills, California 91344

From: Jessica Pate
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:28:50 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jessica Pate
jlpate79@gmail.com
465 Taylor Ave
Akron, Ohio 44312

From: Wolfgang Vermeer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:28:13 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Wolfgang Vermeer
wvermeer@yahoo.com
1226 Grant Ave. #34
San Francisco, California 94133

From: Jason Nardell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:27:54 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jason Nardell
jason.nardell@gmail.com
1484 Meeker Drive
Longmont, Colorado 80504

From: Crystal Couch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:27:54 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Crystal Couch
cmewander@gmail.com
621 S. Orange Street, Apt. A, Apt. A
Orange, California 92866-3046

From: Patricia Luck
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:27:48 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Patricia Luck
pat.luck2701@gmail.com
2701 Pinelog Ln
Johns Island, South Carolina 29455

From: Yolanda Berumen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:27:40 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Yolanda Berumen
yolandaberumen12@gmail.com
3505 Mangum St Baldwin Park
Baldwin Park, California 91706

From: edward necker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:27:02 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

edward necker
ednecker5@gmail.com
173 E Hatton Ave
Eugene, Oregon 97404

From: Michelle Mondragon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:26:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michelle Mondragon
mishka.mondragon@gmail.com
601 Hermits Trail
Altamonte Springs, Florida 32701

From: Georgeanne Samuelson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:25:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Georgeanne Samuelson
bgsamuelson@gmail.com
47525 Perkins St
Oakridge, Oregon 97463

From: Kit Long
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:23:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kit Long
kittylong00@gmail.com
25 Cove Court
Napa. , California 94559

From: Paul Cheney
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:22:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Cheney
cheneyp@cruzio.com
237 Kearney St
Watsonville, CA, California 95076

From: Amir Baum
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:22:25 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amir Baum
amir.baum@gmail.com
7 Blue Heron Ln.
Aliso Viejo, California 92656

From: Nancy Schneider
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:22:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nancy Schneider
hnschneider@astound.net
600 Edinburgh St.
San Mateo, California 94402

From: Scott Sesher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:20:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Scott Sesher
ssesher@acm.org
703 S. Sunset Lane
Raymore, Missouri 64083

From: Laura Caseley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:18:44 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Laura Caseley
lacaseley@gmail.com
23-85 Crescent St.
Astoria, New York 11105

From: Deborah Carroll
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:18:12 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Deborah Carroll
carrolldeborah8@gmail.com
522 West 157th Street
New York , New York 10032

From: Kathy Simington
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:18:09 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathy Simington
bellarose4ever@yahoo.com
412 e. J st.
Ontario, California 91764

From: Alisa Reich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:16:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alisa Reich
ap.reich@verizon.net
4037 BERRYMAN AVE
Los Angeles, California 90066

From: Joy LaClaire
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:15:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joy LaClaire
forthrightradio@gmail.com
3018-B W. Villard St.
Bozeman, Montana 59718-3658

From: William Malmros
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:14:06 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

William Malmros
phishbill@aol.com
134 Thimbleberry Rd
Ballston Spa, New York 12020-4377

From: Vic Bostock
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:13:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Vic Bostock
care4animals@hotmail.co.uk
1612 Woodglen Ln
Altadena, California 91001

From: Dee Grady
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:13:36 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dee Grady
daltoncontests@hotmail.com
7580 Columbia St
Vancouver, British Columbia V5X 4S8

From: James Bengel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:13:08 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

James Bengel
jbengel@brandenburg3.com
20 Canterbury Ct
Wendell, North Carolina 27591

From: Brenda Michaels
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:12:01 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Brenda Michaels
brenda@conscioustalk.net
353 S. Edwards Rd. Port Townsend, WA 98368
string:PORT TOWNSEND, Washington 98368

From: Michael Rynes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:10:19 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Rynes
discubs697@hotmail.com
570 Harlowe Ln
Naperville, Illinois 60565

From: Daniel Weinberger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:10:08 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Daniel Weinberger
dannymax123@gmail.com
17a south valley Rd, #16
West Orange, New Jersey 07052

From: Paul Winstanley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:09:35 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Winstanley
edengully@gmail.com
517 19th Ave
San Francisco, California 94121

From: Darren Strain
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:08:19 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Darren Strain
strainteam@yahoo.com
4824 Shepherd Street
Brookhaven, Pennsylvania 19015

From: Shannon Joyner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:08:10 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy - the thing our economy and our environment desperately need. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon. It's astonishing that anyone would consider this an appropriate place to try to store CO2.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety. How is this considered just or appropriate - or even efficient?!

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death. Putting lives at risk for a fossil-fuel industry boondoggle is unacceptable.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

Carbon TerraVault I is a terrible plan, for so many reasons. For the sake of our air, water, health, and climate, I urge you to reject this dangerous greenwash project.

Thank you for the work you do to keep us all safe, to (hopefully) help us stop the devastating effects of climate change.

Shannon Joyner
sjoyner@saber.net
PO BOX 1045, Laytonville, CA 95454
Laytonville, California 95454

From: Samuel Dickson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:08:06 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Samuel Dickson
samuelrdickson@gmail.com
1217, Birch St
Montara, California 94037

From: Gabriel Gomes
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:07:53 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gabriel Gomes
nayanagar2@gmail.com
192 Stony Brook Road
Fishkill, New York 12524

From: Charlotte Bear
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:07:13 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Charlotte Bear
bearcoastalgirl@gmail.com
643 Stanford Avenue
Salinas, California 93901

From: larrylohmann@gn.apc.org
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:06:58 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

larrylohmann@gn.apc.org
Fl 4 Pharmacy Burton St
Marnhull Dorset, DT10 1PH

From: Marianna Mejia Contact
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:06:47 AM

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Kern County,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marianna Mejia Contact
mspillover@gmail.com
1009 Hidden Valley Rd
Soquel, California 95073

From: Katherine Hutchins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:05:59 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katherine Hutchins
kdhutchins@gmail.com
19426 N 36th Place
Phoenix, Arizona 85050

From: Kathryn Burns
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:05:44 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

True, I'm an outsider -- from Texas, your polar political opposite. But I often wish our "leaders" thought more like California's.

For the sake of your air, water, health, and climate, I urge you to reject this dangerous project.

Kathryn Burns
kathrynburn@gmail.com
2300 Chalet Trail, Apt. O-4
Kerrville, Texas 78028

From: Kenny Mullen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:04:59 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kenny Mullen
kennymullen@gmail.com
380 Manka Circle
Santa Rosa, California 95403

From: Adrianne Aron
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:04:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Adrianne Aron
adriannearon@gmail.com
1807 Vine Street
Berkeley, California 94703

From: Lazuli Trujano
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:03:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lazuli Trujano
lazuli@cbecal.org
616 40TH St
Richmond, California 94801

From: Katherine Patterson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:03:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Katherine Patterson
katpatt1969@gmail.com
1184 N.Main
, California 95437

From: Todd Olk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:02:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Yes, very strongly agree.
Now please. (TAO)

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Todd Olk
tolk836@gmail.com
6700 S Glencoe St
Centennial , Colorado 80122

From: Kimberly Derwent
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:01:35 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kimberly Derwent
krmderwent@gmail.com
7110 Fodor Rd
New Albany, Ohio 43054

From: Jaszmene Smith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:01:33 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jaszmene Smith
smith.jaszmene9@gmail.com
1017 School Vlg
Millville, New Jersey 08302

From: Elsa Petersen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:00:46 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elsa Petersen
tracksnrhythm@aol.com
2475 Kola Way
Melbourne, Florida 32940

From: Robert Burk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:00:27 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Robert Burk
bobbajo@aol.com
611 Woodruff Ave.
Los Angeles, California 90024

From: MJ Baumann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 11:00:17 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

MJ Baumann
feenieb@gmail.com
1301 Walnut St
Berkeley, California 94709

From: Pamela Shaw
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:59:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pamela Shaw
pamelas51@yahoo.com
6419 Vine Street
Cincinnati , Ohio 45216

From: John Peeters
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:58:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

John Peeters
peeterscsv@yahoo.com
428 S Indiana Ave
Kankakee, Illinois 60901-5114

From: Paula Buel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:57:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

On behalf of all Californians, I request that you reject a dangerous carbon capture project. Kern County and indeed, our entire state, is already inundated with toxic sites as a result of fossil fuel projects.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paula Buel
paulabuel@gmail.com
1334 1/2 Parker St.
Berkeley, California 94702

From: Reina Robinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:57:37 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Reina Robinson
tisreina@gmail.com
18583 Carlton Avenue
Castro Valley, California 94546

From: Thomas Kirk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:57:12 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Kirk
tskirk53@yahoo.com
P.O. Box 252
Palenville, New York 12463

From: Guy Taylor
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:56:24 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Guy Taylor
whaddaluckyguy@aol.com
19111 Angling
Livonia, Michigan 48152

From: Sheila Thorne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:55:38 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sheila Thorne
sheilathorne5@gmail.com
1326 Spruce St.
Berkeley, California 94709-1435

From: Carol Wagner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:55:35 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Wagner
carol@craftedbycarol.com
350 Timber Ridge St NE , Apt 232
Albany, Oregon 97322

From: Kevin McKelvie
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:55:34 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kevin McKelvie
krmckelvie@aol.com
2646 W La Condesa
Palm Springs , California 92264

From: Irini Dieringer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:55:30 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Irini Dieringer
nyx@alchemicalfire.com
18695 Pony Express Drive
Parker, Colorado 80134

From: LAURA CHIN
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:55:07 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

LAURA CHIN
lzchin@hotmail.com
422 WENDY RD
SOUTHAMPTON, Pennsylvania 18966

From: Daniel van Kammen MD
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:54:26 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Daniel van Kammen MD
dpvk2004@yahoo.com
187 Hamilton Ave
Princeton, NJ, New Jersey 08540

From: Andrew Reich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:54:12 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Andrew Reich
andrewlreich@gmail.com
140 S Irving Blvd
Los Angeles, California 90004

From: Gilda Levinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:53:45 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gilda Levinson
gld54.lev.d@gmail.com
8183 NW 14th Street
Coral Springs , Florida 33071

From: Joanne Oliver
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:53:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joanne Oliver
joanneolivernb@gmail.com
6 Ambroise
Newport Coast , California 92657

From: Susanne Groenendaal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:53:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susanne Groenendaal
stargazerlilly1@verizon.net
1313 Old Boalsburg Rd
State College PA , Pennsylvania 16801

From: Karen Cotterell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:52:28 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Karen Cotterell
karenjcotterell@gmail.com
128 MacDougal St Apt 4C
New York, New York 10012

From: Esther Lerman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:52:10 AM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Esther Lerman
estherlermanmft@gmail.com
2644 Etna St
Berkeley, California 94704

From: dairyqueen@uwalumni.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:52:10 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

dairyqueen@uwalumni.com
2249 E. 2nd St.
Tucson, Arizona 85719

From: Dolores Arndt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:52:02 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dolores Arndt
dolores3206@yahoo.com
7565 W Lockhart Rd
Dafter, Michigan 49724

From: Dan Ress
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:52:02 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dan Ress
dress@crpe-ej.org
238 Avenida Castro
Delano, California 93215

From: Jan Lowrey
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:51:43 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jan Lowrey
jlowrey828@gmail.com
15263 N Tucker School Rd
Hallsville, Missouri 65255

From: Jeri Fergus
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:50:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Protect the People and the Planet, not the corporations!

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overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeri Fergus
jeri.fergus@gmail.com
PO BOX 511
REDWAY, California 95560

From: Cindy Jensen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:50:47 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cindy Jensen
csjensen58@gmail.com
1505 SW 192 Ave.
Beaverton, Oregon 97003

From: Mark Haim
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:50:36 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Carbon capture is a false solution to the climate crisis. We need, instead, to be phasing out fossil fuel use ASAP by investing in clean, abundant and affordable wind and solar power. These are true renewables and, along with storage, provide a truly sustainable future for our progeny.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Haim
mhaim@riseup.net
804 E. Broadway Ste. C
COLUMBIA, Missouri 65201

From: Sandra Lynn
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:50:09 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Sandra Lynn
cresorchid@gmail.com
100 Commons Road
Dripping Springs, Texas 78620

From: Stephen Dutschke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:48:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephen Dutschke
sdutschke@gmail.com
4306 Darbrook Rd
Louisville, Kentucky 40207

From: Annika von Bartheld
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:48:00 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Annika von Bartheld
annikavb1000@gmail.com
2886 plumb lane
Reno, Nevada 89502

From: Michael King
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:47:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael King
kingms@jmu.edu
51 Hillandale Drive
Staunton, Virginia 24401

From: K C
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:47:00 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

K C
soundsgood2me13@hotmail.com
757 barsby st
Vista, California 92084

From: Peter Townsend
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:46:37 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Peter Townsend
k9townsend@gmail.com
85 Metropolitan Avenue
Ashland, Massachusetts 01721

From: Kevin Rennie
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:46:34 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kevin Rennie
kmrennie@gmail.com
220 Concord dr
Menlo Park , California 94025

From: Rick Mitton
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:46:18 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rick Mitton
rick.mitton1@gmail.com
3625 Regal Place
Los Angeles, California 90068

From: Ronald Zurawski
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:46:14 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ronald Zurawski
drron@pids.net
N2240 County Road 577
Menominee, Michigan 49858

From: D C
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:46:05 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

D C
dcuffor@gmail.com
2512 melrose loop, eugene, or
Eugene, Oregon 97402

From: Kathleen Wheeler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:45:53 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Wheeler
kawheeler100@gmail.com
458 Dorothy Ave
Ventura, California 93003

From: Judith Plenty
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:45:46 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Plenty
judy@rodborough.net
41 Spinners House
Stroud, England GL5 1DS

From: Andrew Donahue
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:45:35 AM

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Andrew Donahue
adonahue14@gmail.com
1410 36th Avenue
San Francisco, California 94122

From: Roger Plenty
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:45:03 AM

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Roger Plenty
roger@rodborough.net
41 Spinners House
Stroud, England GL5 1DS

From: Wendy Lohman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:45:01 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Wendy Lohman
wlohman@support.ucla.edu
1260 Veteran Ave, Apt 324
Los Angeles, California 90024-4849

From: Charles Dineen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:44:48 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Charles Dineen
charles.dineen@wmich.edu
80490 28th Street
Lawton, Michigan 49065-9644

From: John Kirchner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:44:40 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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John Kirchner
train462@aol.com
7510 Hope Farm Road
Fort Wayne, Indiana 46815

From: Marian Scena
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:44:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marian Scena
mangua.mrs63@gmail.com
179 Highland Ave.
Somerville, Massachusetts 02143

From: michael bordenave
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:43:02 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

michael bordenave
mbordenave1016@gmail.com
951 N Adoline Ave
Fresno, California 93728

From: Janet Handford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:42:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Janet Handford
handfordjn@gmail.com
55 Kristee Circle
West Warwick , Rhode Island 02893

From: MariRose Taruc
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:42:34 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

MariRose Taruc
mrtaruc@gmail.com
2145 17th Ave
Oakland, California 94606

From: Seth Picker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:42:26 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Seth Picker
droors.no.43@gmail.com
PO Box 1252
Diamond Springs, California 95619

From: Larry Weingart
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:42:23 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Larry Weingart
larweing@hotmail.com
2903 Victoria Circle Apt C3
Coconut Creek , Florida 33066

From: Dave Lutz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:42:23 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dave Lutz
davglutz@gmail.com
715 Avery Rd
Claremont, California 91711-4225

From: shawn Johnson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:40 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

shawn Johnson
shawninbarca@gmail.com
951 Stratford Dr
Encinitas, California 92024

From: Tracey katsouros
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:33 AM

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Tracey katsouros
traceycsmallwood@gmail.com
1322 Harwich Dr
Waldorf, Maryland 20601

From: Scott Bishop
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:26 AM

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Scott Bishop
sbishop@oly-wa.us
1710 Giles NW
Olympia, Washington 98502

From: Mari Mennel-Bell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:25 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mari Mennel-Bell
mari471@aol.com
1440 S. Ocean Blvd., 12D
Lauderdale by the Sea, Florida 33062-7372

From: William Grgurich
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:16 AM

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Kern County,

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On the one hand, this industry is aware of and concerned about the problems inherent in our overproduction of obnoxious and detrimental waste is encouraging, but this solution lacks the reality other options should be considered. For example, capture and filter all this waste before it leaves the industry's site.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

William Grgurich
01wilgmp@gmail.com
33 Encina Avenue, # 519
Palo Alto, California 94301

From: Lynn Ricci
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,
My heart hopes SO much that the RIGHT thing is done so that ALL living can live their life. The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lynn Ricci
lynnricci@gmail.com
431 Stageline Road
Hudson, Wisconsin 54016

From: Judith Poxon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:07 AM

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Kern County,

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Poxon
jlpoxon@hotmail.com
3207 L St Apt B
Sacramento, California 95816-5250

From: LAWRENCE BROWN
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:41:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

LAWRENCE BROWN
leb2006@gmail.com
126 MOHAWK LN
ABSECON, New Jersey 08201

From: CHRIS OMALLEY
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:40:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

CHRIS OMALLEY
Info@utilityincentive.com
PO BOX 90902
San Diego, California 92126

From: Kathleen Jaissle
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:39:45 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Jaissle
kathyj3715@gmail.com
1508 Yorkshire Dr, Apt 17
Howell, Michigan 48843

From: Gary Warner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:39:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gary Warner
gwarner@sisqtel.net
4326, Hurds Gulch Road
Fort Jones, California 96032

From: Barbara Wasserman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:39:00 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Wasserman
sarasmommy12@gmail.com
10201 Mason Ave Unit 117
Chatsworth, California 91311

From: Kathleen Bond
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:38:42 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Bond
kathleenbond3225@gmail.com
493 Bluerock Dr
San Luis Obispo, California 93401

From: Eleanor Jones
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:38:09 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eleanor Jones
joneseleanor6@gmail.com
2 Sacramento St,, Apt 2
Cambridge, Massachusetts 02138-1887

From: Jared Cornelia
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:37:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jared Cornelia
jaredc1200@gmail.com
125 Denn Place
Wilmington, Delaware 19804

From: Kathryn Thomas
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:37:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathryn Thomas
katie.r.thomas@gmail.com
800 Buchanan St.
Taft, California 93268

From: Lurlie Edgecomb
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:36:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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Lurlie Edgecomb
lurlie@zero3nine.com
6010 E. Stearns St.
Long Beach, California 90815

From: Eugene Howard
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:36:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Eugene Howard
gene.howard246@gmail.com
3267 Winter Wood Ct
Marietta , Georgia 30062

From: Meredith Kent-Berman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:36:14 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Meredith Kent-Berman
mjkentberman@gmail.com
235 East 22 Street, Apt# 12E
New York, New York 10010

From: Elinor Davis
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:36:11 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Elinor Davis
elinordvs@yahoo.com
1114 E 33rd Street, Apt A
Oakland, California 94610

From: Margret Cifaldi
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:35:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Margret Cifaldi
ms925lining@gmail.com
9050 W Tropicana Ave Unit 1121, Bldg 21
Las Vegas, Nevada 89147

From: Candace Rocha
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:35:48 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Candace Rocha
candace@kaimanlaw.com
4423 Alpha St, Los Angeles, CA, USA
Los Angeles, California 90032

From: Hugh Moore
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:35:36 AM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Hugh Moore
hmpeace1@yahoo.com
1720 S Hobart Blvd
Los Angeles, California 90006

From: Yves Decargouet
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:34:32 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Yves Decargouet
countzero100@gmail.com
6824 Virginia Drive
Lucerne, California 95458

From: Frances Goff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:34:19 AM

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For the sake of our air, water, health, and climate, I demand you to reject this dangerous project.

Frances Goff
franthony68@gmail.com
37 S Sierra Madre Blvd
Pasadena, California 91107

From: karen Langelier
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:34:10 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

karen Langelier
klang4678@gmail.com
3613a Saint John'S Ct
Wilmington, North Carolina 28403

From: S. Andregg
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:34:10 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

S. Andregg
missandregg@gmail.com
1054 43rd St.
Emeryville, California 94608

From: Jan Hall
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:33:58 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jan Hall
j29hall@gmail.com
995 Ravine Ridge Dr
Columbus, Ohio 43085

From: Richard Youatt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:33:28 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Richard Youatt
richard.youatt@gmail.com
958 MERCEDES AVE
Los Altos, California 94022

From: Timothy Raymond
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:33:22 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Timothy Raymond
timraymond@frontiernet.net
45 1/2 Marshall St
Rochester, New York 14607

From: Mary Ann Rudy
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:33:18 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mary Ann Rudy
maryannrudy@gmail.com
2545 SW Terwilliger Blvd., #1025, Portland, OR 97201
Portland, Oregon 97201

From: Hal Harrower
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:33:15 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Hal Harrower
halharrower@gmail.com
146 Mayfair
Aliso Viejo, California 92656

From: KENTON LANE
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:32:23 AM

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Kern County,

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KENTON LANE
kentonlane@kentonlane.com
904 SILVER SPUR ROAD, SUITE 203
ROLLING HILLS ESTATES, California 90274

From: Mimi Abers
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:32:10 AM

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mimi Abers
mimiabers2@gmail.com
1122 oxford
Berkeley , California 94707

From: Al Krause
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:32:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Al Krause
akguiness@aol.com
19 Pomander Walk
NYC, New York 10025-6931

From: Donald Schwartz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:32:00 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Donald Schwartz
dschwartz@ccbcmd.edu
2414 Sugarcone Road
Baltimore, Maryland 21209

From: Alan Bosch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:31:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Alan Bosch
boschfamilyb@gmail.com
5865 Labath Avenue, Unit #9
Rohnert Park, California 94928-2061

From: Melissa Shaffer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:31:19 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melissa Shaffer
melissa.shaffer@pobox.com
324 MEADOW CREEK DR
WESTMINSTER, Maryland 21158-4434

From: Nathan Campbell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:31:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nathan Campbell
nathan.h.campbell@gmail.com
237 Athol Ave
Oakland, California 94606

From: debic743@mac.com
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:31:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

debic743@mac.com
2432 Harrington Drive
Decatur, Georgia 30033-4923

From: Arlene Encell
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:29:58 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Arlene Encell
arleneenc@gmail.com
2535 Armacost Ave.
Los Angeles, California 90064

From: Carl Van Dyke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:29:58 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carl Van Dyke
cvd@sonic.net
PO Box 490
Monte Rio, California 95462

From: Carlos Arnold
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:29:58 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carlos Arnold
carlos.arnold39@gmail.com
499 Fair Oaks Dr
Santa Maria, California 93455

From: Father William Connor
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:29:55 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Father William Connor
frwillconnor@gmail.com
2500 E 2nd St
Long Beach, California 90803

From: Audrey Hanson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:29:20 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Audrey Hanson
audreyhanson21@gmail.com
2951Derbt St.
Berkeley, California 94705

From: Ellen Middleditch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:28:27 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ellen Middleditch
middleditch.ellen@gmail.com
621 Paige Loop
White Rock, New Mexico 87547

From: Betty Kissilove
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:28:24 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Betty Kissilove
cacaogal@gmail.com
1401 10th Ave.
San Francisco, California 94122

From: Majda Jones
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:28:16 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Majda Jones
majdajones@gmail.com
501 Portola road, #71
Portola valley, California 94028

From: Lucy Garcia
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:28:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Plus, most CO2 captured is used to stimulate production of more oil. Is this the plan? Will it be a plan sneaked in later.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lucy Garcia
lucy.rea.garcia.lg@gmail.com
20725 Lemarsh St Unit F,
Chatsworth, California 91311-7352

From: Debra Bass
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:28:00 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Debra Bass
dbass.esq@gmail.com
#208 12291 Carmel Vita Rd
San Diego, California 92130

From: Francisco Velez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:27:35 AM

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Francisco Velez
fjvelez73@gmail.com
824 Palmer Road
Yonkers, New York 10708

From: Paul Paz y Mino
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:26:25 AM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Paz y Mino
paz@amazonwatch.org
3217 Knowland Ave.
Oakland, California 94619

From: Justin Truong
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:26:15 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Justin Truong
justintruong56@gmail.com
33 Junior Terrace
San Francisco, California 94112

From: Benjamin Martin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:59 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Benjamin Martin
bendicoot@yahoo.com
10 Aiken Ct
Plattsburgh, New York 12903

From: Steve Hoelke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:55 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Steve Hoelke
s.hoelke@verizon.net
615 South Bucknell Avenue
Claremont, California 91711

From: Wayne Schwartz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:48 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Wayne Schwartz
schwartzw42@verizon.net
11275 Westminster Ave. #306
Los Angeles, California 90066

From: Victoria Allen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:45 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Victoria Allen
vallendc2017@gmail.com
174 Alta Bista Way
Daly City, California 94014

From: Lauren Bouyea
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:37 AM

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Lauren Bouyea
laurenbouyea@gmail.com
39171 Tassajara Rd.
Carmel Valley, California 93924

From: Paula Fougere
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:21 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paula Fougere
auntiewitch1@yahoo.com
12 Magnolia Lane Apt 1
Exeter, New Hampshire 03833

From: Jenna Beales
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:25:02 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jenna Beales
keen2read@gmail.com
2051 Leese Lane
Novato, California 94945

From: Simone Fonseca
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:24:30 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Simone Fonseca
piteu36@yahoo.com
14584 Woodworth Way
Victorville, California 92394

From: steven nasir
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:23:33 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

steven nasir
sbnasir@hotmail.com
43837 Tattinger Ter.
Ashburn, Virginia 20148

From: Susan Castelli-Hill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:23:25 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Castelli-Hill
joyoussafefree@yahoo.com
518 Sweet Hollow Rd., Melville, New York 11747
Melville , New York 11747

From: Cynthia Bernett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:23:25 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cynthia Bernett
cvalderrey@gmail.com
10636 Rippling Stream Dr
Concord, North Carolina 28027

From: Abigail Rome
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:23:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Abigail Rome
abirome2@gmail.com
605 Ray Drive
Silver Spring, Maryland 20910

From: Roxann Schaubhut
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:23:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Roxann Schaubhut
roxann@hughes.net
1900 Stagecoach Canyon Rd.
Pope Valley, California 94567

From: Tia Ja
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:22:51 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tia Ja
pandabluu@gmail.com
14938 Camden Ave.
San Jose, California 95124-2801

From: Michael Parsons
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:22:50 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Parsons
weezyblossom@gmail.com
18205 County Rd. 54.2
Aguilar, Colorado 81020

From: Jayne Cerny
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:21:38 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jayne Cerny
jaynecerny@gmail.com
12845 Sir Francis Drake Blvd
Inverness, California 94937

From: Chris Scholl
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:21:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Chris Scholl
christopherscholl007@gmail.com
514 Prospect Ave
Neptune City, New Jersey 07753

From: Daniel Laemmerhirt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:20:59 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of OBSOLETE, dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but dying oil companies are promoting this flawed technology to keep themselves in business for another couple years. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Remember: "The Age of Fossil Fuels" is OVER, despite what three or four obsolete billionaires think.

Daniel Laemmerhirt
dlaemmerhirt999@gmail.com
15 Dolphann dr
Tonawanda, New York 14150

From: Lori Williams Philipsen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:20:54 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lori Williams Philipsen
bluskyzahead4me@aol.com
1812 N Whitney Dr
Appleton, Wisconsin 54914

From: alvaro garza
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:20:40 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

alvaro garza
garlicy2@sbcglobal.net
1721 morning dove circle
modesto, California 95354

From: Gabe Smalley
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:20:08 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gabe Smalley
gabesmalley@hotmail.com
624 Locust St
Los Angeles, California 90065

From: Susan Jordan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:57 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Jordan
honeygirl2361@gmail.com
2361 Unity Ave. N.
Minneapolis , Minnesota 55422

From: Lana Henson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lana Henson
lanarh@aol.com
2009 N Gatewood
Oklahoma City , Oklahoma 73106

From: Kyra Rice
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:13 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kyra Rice
kyradear@gmail.com
3450 Ridgewood Road
Willits, California 95490

From: Pablo Voitzuk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:13 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Pablo Voitzuk
pablovoitzuk@yahoo.com
5405 Broadway
Oakland, California 94618

From: Doug Couchon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:07 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Doug Couchon
dcouchon@yahoo.com
109 Foster Avenue
Elmira, New York 14905

From: janet maker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:19:01 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

janet maker
janet29018@gmail.com
925 Malcolm Ave
Los Angeles, California 90024

From: Carolyn Villanova
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:18:56 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carolyn Villanova
cvillanova820@gmail.com
820 W. Housatonic St
Pittsfield, Massachusetts 01201

From: janna piper
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:18:47 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

janna piper
jaqalthehybrid@yahoo.com
po box 15072
Portland, Oregon 97293

From: Melissa Hutchinson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:18:17 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Melissa Hutchinson
melhutch236@gmail.com
236 Alder St
Pacific Grove, California 93950

From: Victoria Patterson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:58 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Victoria Patterson
vickyreneepatterson@gmail.com
17099 W Bernado Dr, 102
San Diego, California 92127

From: Claudia Van Gerven
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:47 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Claudia Van Gerven
vangervc@colorado.edu
727 Ithaca Drive,
Boulder, Colorado 80305

From: Julie Adelson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:44 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Stop wasting time and our money on bullshit carbon capture schemes that dont work and in the meantime you could be putting solar and wind to work now and save us on earth.

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Julie Adelson
jpadelson@gmail.com
910 W Paseo Del Mar
San Pedro, California 90731

From: Alex Terry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:32 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alex Terry
alex@terryandterryarchitecture.com
1073 Euclid Ave.
Berkeley, California 94708-1639

From: Wendy Caesar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:29 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Wendy Caesar
wcaesar5@gmail.com
183 Hubert Humphrey Dr
Chestnut Ridge, New York 10977

From: Diana Kliche
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Diana Kliche
klichediana@gmail.com
3351 Ridge Pk Ct
Long Beach, California 90804

From: Paul Desjardins
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:05 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Paul Desjardins
paul.desjardins2@gmail.com
31 Bristol Road
Windsor Locks, Connecticut 06096-2046

From: David Luu
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:17:01 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Luu
david_luu16@yahoo.com
1191 Leeward Drive,
San Jose, California 95122

From: Thomas Gross
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:40 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Gross
vlachus@hotmail.com
23190 Willard Ave
Warren, Michigan 48089

From: Grayson Henderson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:22 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Grayson Henderson
graysonhenderson@yahoo.com
96022 OCEAN BREEZE WAY
Fernandina Beach, Florida 32034-8489

From: Ms Lilith
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:20 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ms Lilith
ladycat76@hotmail.com
3060 Channel Dr Apt 8
Ventura, California 93003

From: Jennifer Kirsch
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:19 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jennifer Kirsch
jennyk.kirsch@gmail.com
1237 Channing Way
Berkeley, California 94702

From: claudia fischer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:19 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

claudia fischer
taraxa2002@gmail.com
aptos. taraxa 44
tarajalejo, Canarias 35629

From: Chris Brunner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:16:19 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Chris Brunner
mimiathome@yahoo.com
403 Spring Leaf Ct
Allen , Texas 75002

From: Robert Duke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:15:19 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Robert Duke
rdukelaw@gmail.com
903 Arch Hill Pl
N. Chesterfield, Virginia 23236

From: Cody Goin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:15:07 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cody Goin
codygoin2021@gmail.com
3073 State Highway 73
Buffalo, Missouri 65622

From: Emily Morris
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:54 AM

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Kern County,

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Emily Morris
emilys.morris21@gmail.com
128 N Humboldt St
San Mateo, California 94401

From: Ree Whitford
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:49 AM

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Kern County,

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Ree Whitford
reewhitford@gmail.com
36 Blue Jay Ct.
Napa, California 94558

From: Anita Kasbarian
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:42 AM

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Kern County,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anita Kasbarian
amkasbarian@aol.com
178 boulevard
kenilworth, New Jersey 07033-1423

From: Heather Tang
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Heather Tang
hamstyaug08@yahoo.com
PO Box 3051
Fremont, California 94539

From: Modell McEntire
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:14:05 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Modell McEntire
mmcentire2689@gmail.com
2380 Muscupiabe Dr
San Bernardino, California 92405

From: Mo Swa
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:13:24 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mo Swa
kitty.angler0m@icloud.com
PO Box 308
Donnelly, Idaho 83615

From: Doug Bender
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:13:20 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Doug Bender
alfabender@verizon.net
261 Vista del Parque
Redondo Beach, California 90277

From: Ava Torre-Bueno
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:13:04 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ava Torre-Bueno
avatb3@gmail.com
1818 Tulip Street
San Diego, California 92105

From: Jose Rodriguez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:12:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jose Rodriguez
branemm1014@icloud.com
15829 Landmark Drive
Whittier , California 90604

From: sherrri hodges
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:12:38 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

sherrri hodges
hodgessherria@gmail.com
3916 W Solar Dr
Phoenix, Arizona 85051

From: Judith Borcz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:12:31 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Borcz
judy@norquay.com
75 Fox Hollow Ln
Redwood City, California 94062

From: Scott Van Fossen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:12:17 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Scott Van Fossen
scottdvanfossen@gmail.com
1255 Cramer Circle
Carpinteria, California 93013

From: P Perry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:12:10 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

P Perry
p.perry95467@gmail.com
18911 Stonegate Rd.
Hidden Valley Lake, California 95467

From: Carol Borota
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:57 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Borota
carolborota@bellsouth.net
1609 Gettysburg Place
Atlanta, Georgia 30350

From: Thomas Burt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:55 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Thomas Burt
tom@californiasolarelectric.com
3863 Center Avenue
Santa Barbara, California 93110

From: Mark Grotzke
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mark Grotzke
garagekey2001@yahoo.com
77 Parliament Drive East
Palos Heights, Illinois 60463

From: Barbara Abraham
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:51 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Barbara Abraham
abrahambarbara326@gmail.com
34 Cumberland Rd
Leominster, Massachusetts 01453

From: Gary Thaler
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gary Thaler
4gary4thaler4@gmail.com
84 Bradstreet Ave
Revere, Massachusetts 02151

From: Julie Hansen
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:11:15 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Julie Hansen
julieellen56@gmail.com
325 S Juniper St
Freeman , South Dakota 57029

From: Marcus Maloney
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:10:15 AM

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Kern County,

Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman:

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy.

The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but greedy oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the "safe" storage of carbon.

According to its draft Environmental Impact Report, the project also will have "significant and unavoidable" impacts on air quality in an air basin already considered one of the most polluted in the country. Low-income communities and communities of color, who already bear the brunt of environmental injustice, once again will pay the price with their health and safety.

The project poses other serious safety concerns including more than 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is

already limited is an impermissible risk that your agency must reject.

For the sake of our air, water, health, and climate, reject this dangerous project.

Marcus Maloney
maloney_marc@yahoo.com
5802 Shadow Creek Dr Apt 2
Sacramento, California 95841

From: Kent Hallam
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:10:03 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kent Hallam
kenthallam@aol.com
4955 Escapardo Way
Colorado Springs, Colorado, Colorado 80917

From: Jerry Swarzman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:10:03 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jerry Swarzman
jswarz@aol.com
1857 N Cleveland Ave
Chicago, Illinois 60614

From: Amanda Gordon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:53 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Amanda Gordon
gordonsgoods407@gmail.com
828 Lighthouse Cove, Sanford, FL, USA
Sanford, Florida 32773

From: Carl Prellwitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:49 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carl Prellwitz
ccp.nhlife@gmail.com
125 Main Street
Newmarke, New Hampshire 03857

From: Martin Horwitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Martin Horwitz
martin7ahorwitz@yahoo.com
1326 23rd Ave
San Francisco, California 94122-1608

From: Alberto Saavedra
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:37 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Alberto Saavedra
alsaavedra@yahoo.com
14155 Magnolia Blvd, Ap 318
Sherman Oaks, California 91423

From: Michael Madden
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:33 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Michael Madden
myke907@gmail.com
50 Germonds Road
New City, New York 10956

From: Stephanie Ciancio
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:28 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephanie Ciancio
stephanieciancio@gmail.com
6 Gaiser ct
San Francisco, California 94110

From: David Carlson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

David Carlson
dnjcarlson@gmail.com
7835 Rush Rose Dr
Carlsbad, California 92009

From: michele rule
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:09:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

michele rule
mtjbrsdr2@gmail.com
15 pitman st apt 205
Concord, New Hampshire 03301

From: Lisa Cubeiro
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:08:54 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Lisa Cubeiro
lisacubeiro@gmail.com
213 Cutter Lane
Stafford Township, New Jersey 08050

From: Doreen McCammon
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:08:41 AM

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Doreen McCammon
wood@superaje.com
14330 Quaker Hill Crossroad
Nevada City, California 95959

From: jana Mariposa Muhar
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:08:27 AM

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jana Mariposa Muhar
janarosa@sonic.net
672 Piezzi Rd
Santa Rosa, California 95401

From: Kathleen Moraski
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:08:11 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Kathleen Moraski
kmoraski45@gmail.com
7611 TEAL BAY
WOODBURY, Minnesota 55125

From: Yvonne Segal
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:49 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Yvonne Segal
yvonne@promolife.com
3656 S Dead Horse Mountain Rd
Fayetteville, Arkansas 72701

From: Judith Turner
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:43 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Judith Turner
jeturn2@gmail.com
POBOX 24403
Cleveland, Ohio 44124

From: Peter Belmont
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:40 AM

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Peter Belmont
pabelmontlaw@123pab.com
166 Columbia Hts
Brooklyn, New York 11201-2105

From: Joaquin Veleta
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:40 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joaquin Veleta
jveleta9017@gmail.com
9017 Winter Ln
Lamont , California 93241

From: Donna Freiermuth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:37 AM

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Donna Freiermuth
donnafr@gmail.com
410 Church Rd., Unit 28
Ojai, California 93023

From: susan davies
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:28 AM

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susan davies
susandavies54777@gmail.com
547 Dorchester Road
Weymouth, England DT3 5BT

From: Candace Berry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:27 AM

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Candace Berry
jazzee2@gmail.com
10250 HIGHWAY 9
BEN LOMOND, California 95005

From: Sharon Baker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:25 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

When ALL the air, land and water are polluted and ALL the trees and birds are dead you will then realize you and your progeny can’t eat money…..
Water is our liquid gold. Protect it!!!!

Sharon Baker
skb38goshen@gmail.com
123 The Willows
Goshen, Indiana 46526

From: Henry Goff
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:21 AM

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Henry Goff
budgoff@gmail.com
4116 Marine View Avenue
San Diego, California 92113

From: Susan Vogt
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:20 AM

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Susan Vogt
bias@alaska.net
269 Bias Dr
Fairbanks, Alaska 99712

From: Georgia Brewer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:12 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Georgia Brewer
georgiabrewer@gmail.com
5518 Ventura Canyon Avenue
Sherman Oaks, California 91401-5228

From: Jennifer Wilson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:11 AM

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Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jennifer Wilson
jwilson@44blue.com
11955 Weddington St., 216
Valley Village, California 91607

From: Gail Fleischaker
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:04 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Gail Fleischaker
gailflei1@gmail.com
62 W Pelham Rd
Shutesbury, Massachusetts 01072-9785

From: Carol Ellenberger
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:07:00 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Carol Ellenberger
carol_ell@yahoo.com
16155 Jackson Oaks Dr
Morgan Hill , California 95037

From: Debbie Knuth
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:52 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Debbie Knuth
meknuth@sbcglobal.net
16744 Valle Verde Rd.
Poway, California 92064

From: Anne Autry
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:41 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Anne Autry
anne116911@aol.com
821 Eastland Dr
Villa Hills, Kentucky 41017

From: joyce banzhaf
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:35 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

joyce banzhaf
joycebanzhaf@gmail.com
112 Anita Street
Santa Cruz, California 95060

From: Jeff Kulp
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:32 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jeff Kulp
jskulp1@gmail.com
5417 Oldtowne Rd
Raleigh, North Carolina 27612-6111

From: Freddie Sumilhig
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:10 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Freddie Sumilhig
fasumilhig@yahoo.com
203 White Water Way
Yuba City, California 95991

From: Frank Lahorgue
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:06:04 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Frank Lahorgue
frank@lahorgue.com
12 Mount Susitna Court
San Rafael, California 94903

From: Nina Wouk
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:44 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nina Wouk
nwouk@ix.netcom.com
643 Bair Island Road
Redwood City , California 94063

From: BC Shelby
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:35 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

BC Shelby
bcshelby@gmail.com
1040 NW 10th Ave #525
Portland, Oregon 97209

From: ian Bosserman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:28 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

ian Bosserman
ianbosserman@hotmail.com
2270 Juniper Ave.
Morro Bay, California 93442

From: Nalei Kahakalau
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:24 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Nalei Kahakalau
haloa@kalo.org
POBox 1764
Honokaa, Hawaii 96727

From: Virgene Link-New
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:16 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project. Thank you.

Virgene Link-New
linkerwan@yahoo.com
2004 10th St
Anacortes, Washington 98221

From: Deborah Lee Chill
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:09 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Deborah Lee Chill
bubbalee58@yahoo.com
34480 County Line Rd
Yucaipa, California 92399

From: Stuart Weiss
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:05:07 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stuart Weiss
mbluesman31@gmail.com
4901 E.Kentucky Cir. Apt. 211
Denver, Colorado 80246

From: Ariana Thompson-Lastad
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:55 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ariana Thompson-Lastad
arianajl@gmail.com
1629 Julia St
Berkeley, California 94703

From: Mike Kehl
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:48 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Mike Kehl
mdkehl@yahoo.com
1707 Lafayette Street
Alameda, California 94501

From: Jamie Green
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:44 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jamie Green
springhead.jg@gmail.com
9727 Sweetwater Ln
ventura , California 93004

From: Philip Snelling
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:41 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Philip Snelling
philipksnelling@gmail.com
100 Hilltop Drive Apt. #44
Redding , California 96003

From: Cori Lopez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:38 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cori Lopez
cori.isaura@gmail.com
1228 Darwin St.
Seaside, California 93955

From: Isaiah Plovnick
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:37 AM

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Isaiah Plovnick
stagethane@gmail.com
263 Walnut St, 2 brookline MA
Brookline, Massachusetts 02445

From: Marc Silverman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:21 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Marc Silverman
dhalgrn@gmail.com
6030 Graciosa Dr
Los Angeles, California 90068-3071

From: wes weaver
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:19 AM

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Kern County,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

wes weaver
weaverwm@bellsouth.net
342 dogwood knoll
boone, North Carolina 28607

From: Sophia Lehmann
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:14 AM

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Kern County,

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Sophia Lehmann
sophialehmann@gmail.com
1014 Mariposa
Berkeley, California 94707

From: Ld Anderson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:12 AM

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ld Anderson
linda@ucsc.edu
PO Box 139
Felton, California 95018

From: Charles Byrne
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:07 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Charles Byrne
charles-byrne@rocketmail.com
374 E. 2nd Street, #3
Brooklyn, New York 11218

From: Phyllis Chavez
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:07 AM

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Phyllis Chavez
phyllis@phyllischavez.com
2112 Ocean Park Blvd Apt 5
Santa Monica, California 90405

From: Greg Puppione
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:04:07 AM

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Greg Puppione
gpuppione@gmail.com
563 Kamoku St, A5
Honolulu, Hawaii 96826

From: Jessica Dardarian
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:53 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Jessica Dardarian
jessicadardarian@gmail.com
1274 Humbug Creek Court
Folsom, California 95630

From: Ronald Drahos
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:53 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Ronald Drahos
rdrahos@indiana.edu
3805 S Woods Edge Bnd
Bloomington, Indiana 47401-8436

From: Barbara Jeske
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:50 AM

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Kern County,

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Barbara Jeske
barbaj1949@yahoo.com
3215 nez perce trail
Riverside , California Ca 92503

From: Perry Gx
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:45 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Perry Gx
perrygxx@gmail.com
14312 Franklin Avenue
Tustin , California 92780

From: Cherie Garrett
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:17 AM

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Cherie Garrett
dreamlover405@hotmail.com
5069 colony dr.
camarillo, California 93012

From: Alexander Vollmer
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:13 AM

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Alexander Vollmer
abv5@cornell.edu
26 Narragansett Cove
San Rafael , California 94901

From: Tobey Thatcher
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:07 AM

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Tobey Thatcher
thtaz2011@gmail.com
1170 W Quiet Glen Ct
Sahuarita , Arizona 85629

From: Lisa Chipkin
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:05 AM

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Lisa Chipkin
lisachipkin@gmail.com
13319 Crescent St
North San Juan , California 95960

From: Elsy Shallman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:03:01 AM

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Kern County,

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Elsy Shallman
gomerlu11@gmail.com
17294 37th Place North
Loxahatchee , Florida 33470

From: Cornelia Teed
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:51 AM

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Kern County,

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Cornelia Teed
joteed2000@yahoo.com
1201 13th St unit 201
Bellingham,WA, Washington 98225

From: Tracy Kanno
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:47 AM

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Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

For example, the depleted oil field that California Resources Corporation wants to use to store the carbon dioxide has hundreds of old drilling sites that have not been properly sealed, which increases the risk of dangerous leaks from the storage site. These risks are amplified in a seismically active region like Kern County, where frequent earthquakes threaten the safe storage of carbon.

According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Tracy Kanno
bavarianprincesshelga@yahoo.com
23 Barrett St
Cranston, Rhode Island 02910

From: Joseph Naidnur
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:46 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Joseph Naidnur
jnaidnur@gmail.com
3031 W Larchmont Ln
Peoria, Illinois 61615

From: Dominique Edmondson
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:39 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dominique Edmondson
dedmondson@cwa-union.org
10706 Wyld Drive
Upper Marlboro, Maryland 20772

From: Stephan Donovan
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:29 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Stephan Donovan
stephandonovan@aol.com
11900 N Labyrinth Dr
Oro Valley, Arizona 85737-3451

From: Janet Saevitz
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:22 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Janet Saevitz
saevitzj@gmail.com
5752 Ayala Avenue
Oakland, California 94609

From: Terrill Maguire
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Terrill Maguire
terrill@yorku.ca
61 St. Clair West
Toronto, Ontario M4V 2Y8

From: Dana Palka
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:21 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Dana Palka
beezel2216@gmail.com
1040 N Maddux Dr, Apt C
RENO, Nevada 89512

From: James Adams
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Friday, February 23, 2024 10:02:18 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

James Adams
jsadams.4910@yahoo.com
9394 Mira Del Rio Drive
Sacramento, California 95827

From: Mark Bartleman
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I Carbon Capture and Storage Scheme
Date: Wednesday, February 28, 2024 11:13:05 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Kern County Planning and Natural Resources Department:

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Thank you.

Mark Bartleman
mbartleman86@gmail.com
1984 Del Mar Ave
Laguna Beach, California 92651

From: Rosario Sandel
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I carbon capture and storage scheme
Date: Tuesday, March 5, 2024 1:52:23 AM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Rosario Sandel
rgopezsandel@yahoo.com
8215 Zelzah Avenue
Reseda, California 91335

From: Adrianne Micco
To: CTV1EIRComments
Subject: Reject Carbon TerraVault I Scheme
Date: Saturday, February 24, 2024 5:41:02 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

The Carbon TerraVault I Elk Hills carbon capture project is a Dangerous Distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will Threaten Public Health and Kern County's limited Water supplies while doing nothing to protect our climate.

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For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Adrianne Micco
yahv50am@gmail.com
467 Manchester Way
Vacaville, California 95687

From: Christina Farver
To: CTV1EIRComments
Subject: REJECT Carbon TerraVault
Date: Friday, February 23, 2024 12:31:45 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Science tells us the best ways to reduce and capture carbon are:
1. STOP burning fossil fuels
2. PROTECT old growth & plant new trees

The greedy fossil fuel industry tells us to build and burn.

Who will you believe?

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Christina Farver
cfarver16@gmail.com
16 Fenton Wood
Sterling, Virginia 20165

From: Bruce Coston
To: CTV1EIRComments
Subject: Reject the Carbon TerraVault I carbon capture and storage scheme
Date: Wednesday, February 28, 2024 4:40:24 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County Planning and Natural Resources Department,

Dear Kern County Planning and Natural Resources Department,

The Carbon TerraVault I Elk Hills carbon capture project is a dangerous distraction that will prolong the life of dirty fossil fuel operations and divert critical resources away from truly clean, renewable energy. The project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

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The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and even death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our communities, our air, water, health, and climate, I urge you to reject this dangerous project.

Stop all the insanity . Implement minimum income and CSSD. 2x condorcet voting by Marcus S. to meet UDHR. 21.3 .

Thank you.

Bruce Coston
jane_ikari@gmx.com
1055 Manhattan Court
Sunnyvale, California 94087

From: Casey Columbus
To: CTV1EIRComments
Subject: The carbon capture and storage "project"
Date: Friday, February 23, 2024 7:49:15 PM

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Kern County,

Dear Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman,

Please do not proceed with this project. It is nothing more than a dangerous distraction that will prolong the fossil fuels and divert critical resources away from renewable, sustainable energy. Not only that, but the project will threaten public health and Kern County's limited water supplies while doing nothing to protect our climate.

Carbon capture and storage (CCS) projects have consistently over-promised and under-delivered, but oil companies are promoting this flawed technology to keep themselves in business. Carbon TerraVault I is no exception: The project will deploy expensive and failed CCS technology that will only serve to delay our transition off fossil fuels, while leading to harmful impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species in the region.

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According to its draft Environmental Impact Report, the project will also have "significant and unavoidable" impacts on air quality in an air basin that is already considered one of the most polluted in the country. Low-income communities and communities of color, who are already bearing the brunt of environmental injustice, will once again pay the price with their health and safety.

The project poses other serious safety concerns including over 13 miles of pipeline to transport carbon dioxide, portions of which pass dangerously close to McKittrick Elementary School. Carbon dioxide leaks can have devastating consequences including asphyxiation, seizures, loss of consciousness, and potentially death.

The project also threatens Kern County's fragile water supply since it will rely on an already overdrafted water source. Compromising groundwater supply in a County where water is already limited is an impermissible risk that your agency should reject.

For the sake of our air, water, health, and climate, I urge you to reject this dangerous project.

Casey Columbus
caseycolumbus@gmail.com
1313 East Burnside Street
Portland, Oregon 97214

Keith Alvidrez

From: Dennis O <the_dent2001@yahoo.com>
Sent: Tuesday, January 30, 2024 5:30 PM
To: CTV1EIRComments
Subject: Stop the CCS Project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

I am against this project. Please do not waste money on unproven technologies.

Thanks,
Dennis

Keith Alvidrez

From: Ellen Beans <ellen.beans@gmail.com>
Sent: Tuesday, January 30, 2024 5:30 PM
To: CTV1EIRComments
Subject: re: Kern County

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i do not support the carbon capture project. It is far too dangerous and the money spent should go to renewable energy projects.

Ellen Beans

Ellen Beans
925-376-7306

Keith Alvidrez

From: nancycampbell323 <nancycampbell323@proton.me>
Sent: Tuesday, January 30, 2024 6:02 PM
To: CTV1EIRComments
Subject: I oppose the Kern County Carbon Capture project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Dear Kern County Planning and Natural Resources Department,

I am writing to oppose the Kern County Carbon Capture project. As someone who lives in rural California (Amador County), I am afraid that this project will set a dangerous precedent for residents across the state.

Not only is CCS unsafe for our neighbors (CO_2 Storage and pipelines are notoriously dangerous - In the event of a carbon pipeline rupture or leak, an explosive plume of CO_2 gas can emerge, odorless and colorless, which would suffocate all beings within range and prevent combustion vehicles like cars from starting to enable an escape to safety) BUT ALSO... CSS is not actually a climate solution!!! It regularly fails to live up to its promises.

For example in Australia, Chevron promised its CCS project would capture 80% of CO_2 emissions but captured less than half—only 30%. A Canadian CCS plant actually emitted more greenhouse gases than it captured. The uncaptured CO_2 is emitted into the air, making the climate crisis worse. The project also won't capture emissions from sourcing, transporting and storing the CO_2, and those emissions add up.

The money you would allocate to this project is better spent on phasing out oil & gas projects, investing in renewable energy and biodiversity initiatives.

Thank you for your consideration.
N

Keith Alvidrez

From: pavle cajic <cajicpaja@gmail.com>
Sent: Tuesday, January 30, 2024 5:33 PM
To: CTV1EIRComments
Subject: I do not support the Carbon Capture project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

To the Kern County Planning and Natural Resources Department,

I am writing to voice my opposition to the Kern County Carbon Capture project.

First and foremost, there are criticisms regarding the effectiveness of CCS. No plant has achieved promised carbon capture levels, and significant amounts are used to extract more oil, diverting funds from proven climate solutions.

Secondly, there are safety issues associated with CO2 storage and pipelines, including the potential for explosive plumes that can be harmful and impede escape routes.

Lastly, the project's financial risks are troubling, given the owner's previous bankruptcy filing in 2020. Another bankruptcy could burden taxpayers with environmental cleanup costs.

This project must not be allowed to go ahead and pose as a climate solution when it is in fact nothing of the sort.

Thank you for your attention.

Best regards,
Pavle Cajic

Sent from Mail for Windows

Keith Alvidrez

From: Stephanie Stewart <steph.stewart02@gmail.com>
Sent: Tuesday, January 30, 2024 6:02 PM
To: CTV1EIRComments
Subject: Regarding the Kern County Carbon Capture Project

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

To Whom It May Concern:

I am writing regarding the planned Kern County Carbon Capture Project. There are a number of elements of the project that deeply concern me as a California resident, a young person, and a research professional in the field of environmental economics.

Carbon capture is far from the most cost effective method for mitigating emissions, and merely enables prolonged extraction of fossil fuels when the only known avenue for averting the worst effects of climate change is through decarbonizing the economy. CC projects routinely capture less carbon than promised, and the unknown potential knock-on effects are manifold. Carbon captured and stored underground can seep back into the atmosphere, contaminate groundwater, and induce seismic activity. This risks investing in entirely ineffective–even deleterious–projects all while allowing the California Resource Corporation to incorrectly include the supposedly sequestered carbon in any accounting of their progress on emissions, thereby enabling them to misrepresent their environmental impact even when the long term efficacy is unknown.

Moreover, the California Resource Corporation recently filed for bankruptcy, introducing the distinct possibility that the financial liability for the project will fall to taxpayers. This allocation of potential profit to private corporations and risk to the public lies at the heart of the private sector's inaction on the climate crisis, and so long as local governments enables this dynamic, the private sector will be shielded from the market forces that should be forcing them to decarbonize due to concerns over long term profits and stranded assets.

Best,
Stephanie Stewart

Keith Alvidrez

From: Susan Sepanik <ssepanik@gmail.com>
Sent: Tuesday, January 30, 2024 6:06 PM
To: CTV1EIRComments
Subject: comment about Kern County Carbon Capture

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Hello,

I would like to post a comment on the plan for the Kern County Carbon Capture. CO2 storage and pipelines are dangerous in the event of a rupture or leak could suffocate animals and humans in the area. This is not a smart solution given its safety issues and likelihood that it will capture the amount of carbon pledged. Also, the carbon captured should not be used to extract more oil which is often the case. This directs money away from more effective climate solutions like moving toward renewable energy sources which is an imperative to protect our planet from climate catastrophe.

Thank you for your consideration,
Susan Sepanik
Oakland, CA

Keith Alvidrez

From: Chris Lish <lishchris@yahoo.com>

Sent: Saturday, February 10, 2024 7:36 PM
To: CTV1EIRComments
Subject: Reject CCS proposal -- Carbon TerraVault I (Kern County) CCS Project by California Resources Corporation Draft Environmental Impact Report

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

Saturday, February 10, 2024

Kern County Planning and Natural Resources Department
ATTN: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100, Bakersfield, CA 93301

Subject: Reject CCS proposal -- Carbon TerraVault I (Kern County) CCS Project by California Resources Corporation Draft Environmental Impact Report

To Kern County Planning and Natural Resources Department Director Lorelei Oviatt:

I strongly urge the Kern County Planning and Natural Resources Department to reject the proposed Carbon Capture Project. There are many reasons the Planning and Natural Resources Department should not allow this project to proceed, including:

Continued oil drilling worsens air quality and harms public health. Oil and gas production generates toxic air pollutants such as fine particulate matter (PM2.5) which causes an estimated 1200 premature deaths in the Valley every year. PM2.5 is also linked to heart disease and stroke, and they worsen asthma.

The CCS project is unsafe for nearby communities. It will store 40–50 million metric tons of carbon dioxide (CO_2) near Buttonwillow. If this CO_2 leaks, it could cause suffocation and death. A CO_2 pipeline leak in Mississippi led to the hospitalization of hundreds of people living in a town about half a mile away. And Buttonwillow is in a remote area. If there is a pipeline leak, residents would have to make a long journey to get to a hospital.

If a CO_2 leak comes into contact with groundwater, the water can be contaminated because CO_2 reacts chemically with water to become more acidic, so contaminants dissolve into it. Injecting CO_2 underground can also trigger earthquakes.

CCS is not a climate solution. It regularly fails to live up to its promises. For example in Australia, Chevron promised its CCS project would capture 80% of CO_2 emissions but captured less than half—only 30%. A Canadian CCS plant actually emitted more greenhouse gases than it captured. The uncaptured CO_2 is emitted into the air, making the climate crisis worse. The project also won't capture emissions from sourcing, transporting and storing the CO_2, and those emissions add up.

The project is a major financial risk. The project promises that it will store the captured carbon permanently. But the project owner, California Resources Corporation, has already filed for bankruptcy once, in 2020. There is a risk that the company could file for bankruptcy again, leaving environmental cleanup bills to taxpayers.

Thank you for your consideration of my comments. Please do NOT add my name to your mailing list. I will learn about future developments on this issue from other sources.

Sincerely,
Christopher Lish
San Rafael, CA

Keith Alvidrez

From: Nora Privitera <noraprivitera@comcast.net>
Sent: Monday, February 12, 2024 3:21 PM
To: CTV1EIRComments
Cc: Kdervin; Marcia Liberson; mary ann furda; Barbara Rhine; Zoe Jonick; Kathy Kerridge; Valerie Ventre-Hutton; Laura Neish; Mary Ruth Gross
Subject: Carbon TerraVault I (Kern County) CCS Project (PP22405);

CAUTION: This email originated from outside of the organization. Do not click links, open attachments, or provide information unless you recognize the sender and know the content is safe.

I am writing to you today on behalf of 350 Bay Area Action to oppose the approval of the Carbon TerraVault I (Kern County) CCS Project, for the following reasons:

The Central Valley, and Kern County in particular, is already heavily impacted by the oil and gas industry, and as a result, has the some of the worst air quality in California due to greenhouse gas emissions produced by that industry.

In addition, Kern County is also a significant agricultural region. The potential effect of this project on the agricultural sector is therefore an important consideration.

The EIR's Executive Summary, Table 1.1, states that this project would have a cumulative effect on:

1. Air Quality:

The project's total emissions would exceed the San Joaquin Valley Air Pollution Control District thresholds for nitrogen oxides (NOX), particulate matter with a diameter of 10 micrometers or less (PM10), and particulate matter with a diameter of 2.5 micrometers or less (PM2.5), for which the project region is nonattainment under an applicable federal or State ambient air quality standard. With the implementation of Mitigation Measure (MM) 4.3-1 and MM 4.3-8, the impact would remain **significant and unavoidable.**

2. Greenhouse gas emissions:

The project has the potential to generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment and conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs. With the implementation of MM 4.8-1 and MM 4.8-2, the impact would remain **significant and unavoidable.**

The project's cumulative contribution to GHG emissions after implementation of the recommended mitigation measures would remain **cumulatively significant and unavoidable.**

3. Agricultural Resources:

The project, in combination with other existing or reasonably foreseeable projects, could result in cumulative impacts on agricultural resources. Because of the importance of the region's agricultural resources, the potential impacts related to the project's incremental contribution to the cumulative farmland conversion would be cumulatively considerable. The cumulative impacts of the project when combined with other known and unknown projects are **cumulatively significant and unavoidable**. All reasonable and feasible mitigation measures have been evaluated and included.

4. Hydrology and Water Quality:

The project, in combination with other existing or reasonably foreseeable projects, could result in cumulative impacts on hydraulic resources as they relate to groundwater supply. The Kern County Subbasin is currently overdrawn and the West Kern Water District's Groundwater Sustainability Plan has been deemed inadequate, along with the other Kern subbasin plans where other similar known and unknown projects could occur. The cumulative impacts of any use of groundwater in the area are considered **cumulatively significant and unavoidable** after all feasible and reasonable mitigation.

3. Biological Resources:

The project, in combination with other existing or reasonably foreseeable projects, could result in cumulative impacts on biological resources. Although the cumulative impacts from CCS projects would be less because of the CCS Surface Land Use restrictions, other clean energy projects that are sited in the valley portion of Kern County have the potential to impact species and reduce habitats. The cumulative impacts of the project when combined with other known and unknown projects are **cumulatively significant and unavoidable**. All reasonable and feasible mitigation measures have been evaluated and included.

All of these impacts show that the implementation of this Carbon Capture project would have a deleterious effect on Kern County's residents, its farmers and its ecosystem. In addition, carbon capture technology is notoriously expensive, dangerous, and ineffective. For these reasons too, this project must be rejected.

The following resources demonstrate why CCS is not a technology that should be implemented, whether in Kern County or anywhere:

A. **Over-Promising and Under-Delivering for Half a Century: CCS is still a risky and unproven technology:** Geoengineering Monitor, January 18, 2024. This report begins with a section titled Critical Updates on CCS (copied below), which are then explained in more detail in the body of the report.

1. Critical updates on CCS:

-
- **CCS**
- **is still far from being a viable climate solution:**
- Fossil fuel and other polluting industries are marketing CCS as a safe and effective, whilst hiding the real risks, long-term costs, and high failure rate associated with many CCS projects.
-
-
- **Flagship**
- **projects show that**
- **CCS is risky**:
- CCS is often presented as proven technology by referencing flagship projects, but the unforeseen problems and challenges they have encountered are rarely mentioned.
-
-
- **Larger**
- **CCS**
- **projects may cause larger problems:**

- Extensive research into numerous small-scale CCS projects has shown that subsurface conditions are unpredictable. It is therefore doubtful that CO2 will remain effectively and safely contained whatever it is injected into in larger CCS projects with significantly
- higher CO2 injection volumes.
-
-
- **Potential**
- **for GHG leaks remains a serious risk:** There
- is no evidence that CO2 injected into geological formations will remain there in the long term, and many of the companies developing CCS projects and claiming that it is safe are also
- releasing
- large amounts of methane,
- a potent GHG, from abandoned oil and gas fields.
-
-
- **Lack**
- **of clear responsibility for high follow-up costs:**
- A common theme in many new CCS projects currently being planned is the lack of clarity over how CO2injection sites will be monitored, and who will foot the costs in the event of leaks and other problems.
-
-
- **Huge**
- **number of projects in the pipeline do not prove the efficacy of the technology:**
- According to industry, the fact that there are hundreds of planned CCS projects shows that CCS is a functioning as a climate solution. However, the
- hundreds
- of CCS projects that have
- been cancelled or (prematurely) terminated are being ignored.
-
-
- ***"50-year***
- ***track record of over-promising and under-delivering"***:
- Despite the fact that research into CO2 capture and CCS has been around
- for 100 and 50 years respectively,
- and the billions
- of taxpayers' money that has been investedin
- CCS, companies claiming to be experts in the field still have little to show in terms of results. On top of this, emissions from fossil fuels
- reached
- a new record high in 2023,
- with CCS playing no visible role in mitigation efforts.
-
-
- **Inefficient,**
- **energy-hungry and costly**:
- Many of the large-scale CCS projects currently being planned will capture only a fraction of global CO2 emissions, whilst ignoring the additional emissions created by energy-intensive CCS processes. It is also still much more
- expensive
- to remove carbon from the atmosphere
- than to avoid emitting it in the first place.
-
-
- **Only**
- **viable if taxpayer-funded or used to generate additional revenue:**CCS

- projects are often only implemented by emission-intensive industries if they receive substantial taxpayer support, earn carbon credits, or increase oil production through Enhanced Oli Recovery (EOR).
-
-
- No
- **contribution to the 1.5°C target:**
- Many of the CCS projects that have been announced to date are only due to begin operations from the 2030s and onwards, and most have not yet received final investment decisions. In addition to the unproven effectiveness of CCS, the timing and scale of these
- projects mean that they cannot contribute
- to the Paris Agreement's 1.5°C target
- in any meaningful way.
-

B. The Cost of Carbon Capture is Staggering:

1. The Hill, 12/25/24l: https://thehill.com/opinion/energy-environment/4374061-the-environment-and-economy-cant-afford-trillion-dollar-carbon-capture/

C. Safeguards are needed: Leaks can kill, whether from ruptured pipelines or transit accidents: Hear from first responders to the Satartia, MS accident, Feb. 2020: https://www.youtube.com/watch?v=RfRytGe3tis

D. CCS projects should not be built before PHMSA issues regulations.
See this letter by several Congress members regarding PHMSA regulations: https://omar.house.gov/sites/evo-subsites/omar.house.gov/files/evo-media-document/rep.-omar-and-rep.-garcia-letter-to-pres.-biden-urging-co2-pipeline-moratorium-letter.pdf

E. See this Analysis of the pros and cons of CCS from One Earth Review:https://www.cell.com/one-earth/fulltext/S2590-3322(22)00044-6?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2590332222000446%3Fshowall%3Dtrue

Thank you for your consideration of these comments.

Very truly yours,

Nora Privitera, Chair
Federal Climate Team
350 Bay Area Action

March 1, 2024

Kern County Planning and Natural Resources Department
ATTN: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100
Bakersfield, CA 93301

U.S. Environmental Protection Agency, Region 9
ATTN: Martha Guzman, Regional Administrator
75 Hawthorne Street
San Francisco, CA 94105

Re: Carbon TerraVault I Carbon Capture and Storage Project at Elk Hills Oil Field

To the Attention of the Kern County Planning and Natural Resources Department and EPA Region 9 Administrator Guzman:

The undersigned 77 organizations write to express our strong opposition to the Carbon TerraVault I carbon capture and storage (CCS) project at the Elk Hills oil field in Kern County.[1] We are deeply concerned that Carbon TerraVault I will deploy expensive, dangerous, and ultimately failed CCS technology to extend the life of dirty fossil fuel facilities in frontline communities that cannot afford any more pollution. Kern County already experiences the worst pollution in the nation due to intensive oil and gas activity and this project threatens to prolong that activity for decades longer–at the expense of local residents and California's transition to clean energy. As the first CCS project to undergo environmental review in the state, the inadequate analysis of potential impacts and appropriate mitigation measures for the project sets an unacceptable precedent that must not be rubber stamped. **We urge you to reject this project and invest in <u>real</u> clean energy solutions that advance California's air, climate, public health, and environmental justice goals.**

The Carbon TerraVault I project will derail California's transition away from fossil fuels: The project intends to capture millions of metric tons of carbon dioxide from numerous polluting sources for injection underground in a depleted oil and gas field over 26 years. While Kern County has stated the project will capture CO_2 from the Elk Hills field's operations, including the gas-fired plant that powers drilling activity at the field, EPA has indicated the project could also source carbon from a new blue hydrogen facility (or hydrogen derived from fossil gas) at the field.[2] The project will therefore extend the life of existing fossil fuel facilities and lead to the build-out of new facilities that will exacerbate the climate crisis and create more pollution in nearby Kern County communities including Buttonwillow, Taft, Tupman, and Bakersfield. By keeping the oil field and gas plant operating decades longer, this project flies in the face of California's climate goal of 85% direct emissions reductions by 2045.

Real world examples prove that CCS technology has not worked as promised despite decades of development and billions of dollars of investment. Carbon capture projects have repeatedly over-

[1] CEQA Project 2022030180 / Kern County PP22405; EPA docket number EPA-R09-OW-2023-0623.
[2] https://www.regulations.gov/docket/EPA-R09-OW-2023-0623

promised and under-delivered[3] on their capture rates while providing cover for polluting industries.[4] In addition to its repeated failures, carbon capture is *not necessary* as a climate solution, according to the Intergovernmental Panel on Climate Change.[5] Frontline communities in Kern County should not be used as a testing ground for flawed and unnecessary techno-fixes like carbon capture. In order to rapidly reduce greenhouse gas emissions and actually decarbonize–first and foremost in historically overburdened areas like Kern County–California must stop permitting projects that further entrench fossil fuels that are driving the climate crisis.

The Carbon TerraVault I project poses serious risks to public health, safety, and the environment in Kern County: The project will lead to a host of harmful impacts to the region, including impacts to air, climate, water, health and safety, seismicity, pipeline safety, and animal and plant species.

To name just a few examples, Elk Hills is one of the oldest and largest oil and gas fields in the state, with a large number of old wells that increase the potential for dangerous leaks from the storage site. The project's total air emissions would also exceed the San Joaquin Valley Air Pollution Control District's limits for nitrogen oxides, particulate matter with a diameter of 10 micrometers or less, and particulate matter with a diameter of 2.5 micrometers or less, for which the region is in nonattainment under an applicable federal or State ambient air quality standard. The project would also threaten local groundwater supplies by drawing groundwater from the Kern County subbasin for its operational needs, despite the fact water levels are already compromised in the subbasin and throughout the Central Valley.[6] And by relying on 13.2 miles of pipelines that will be as close as a few miles of sensitive locations like a local elementary school for transportation of the CO_2, the project is increasing the risk of dangerous leaks and ruptures that could harm nearby residents. These impacts have not been fully considered and mitigated.

The public and decisionmakers are still missing critical details about the Carbon TerraVault I project, which prevents a full accounting of potential impacts: Despite multiple requests from the public, neither the oil company or Kern County have clarified all the sources of CO_2 for the project. In addition to the Elk Hills field's operations, the gas plant that

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[3] IEEFA, "The Carbon Capture Crux" (Sept. 2022), https://ieefa.org/resources/carbon-capture-crux-lessons-learned.

[4] *See, e.g.*, The Guardian, "Carbon capture project is 'Band-Aid' to greenwash $10bn LNG plant, locals say" (Feb. 3, 2023), https://www.theguardian.com/environment/2023/feb/03/carbon-capture-gas-exports-rio-grande-lng-nextdecade. For example, in July 2021, Chevron admitted that its commercial-scale carbon capture project in Australia failed to meet its five-year capture target of 80% CO_2, and instead only captured 30%. IEFFA, "If Chevron, Exxon and Shell Can't Get Gorgon's Carbon Capture and Storage to Work, Who Can?" (April, 2022), https://ieefa.org/articles/if-chevron-exxon-and-shell-cant-get-gorgons-carbon-capture-and-storage-work-who-can.

[5] The IPCC-modeled pathway with the best chance of keeping warming at or below the target of 1.5°C makes no use of fossil fuels with carbon capture and storage (CCS) or bioenergy with carbon capture and storage (BECCS). IPCC, Summary for Policymakers in Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty (2018) at 14, Section C.1.1., Figure SPM 3b (Pathway 1); *see also id.* at Ch. 2.3.3 and Table 2.SM.12. *See also* Center for International Environmental Law, Confronting the Myth of Carbon Free Fossil Fuels at 2, https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf.

[6] According to the draft EIR, the subbasin, as a whole, has an overdraft of 324,326 acre-feet per year. Draft EIR at 4.19-2.

powers the field, and the new blue hydrogen facility, the oil company and County are moving forward with plans to build additional new sources of CO_2 for capture and storage at Elk Hills, including a renewable dimethyl ether production facility, a gasoline plant, and a waste-to-energy production facility.[7] Additional sources may further include CO_2 captured from a new hydrogen facility in Tulare County and transported via tanker trucks 65 miles south to Elk Hills.[8] While the list of potential sources continues to grow, none of these facilities are disclosed or analyzed in the environmental review documents available to the public.

Other important missing details include the state of the CO_2 during transport (e.g. liquid or supercritical), the location of compressor equipment, and wellbore data including well plugging information for the hundreds of existing wells in the Elk Hills field. Without these basic details, it is impossible to support key assumptions and conclusions underlying the project.

Conclusion

The Carbon TerraVault I CCS project would prolong the life of dirty fossil fuel facilities, threaten California's progress toward its climate and clean energy goals, and put frontline communities at risk in order to benefit one of the largest oil and gas companies in the state with a history of financial failures. This project sets the wrong precedent for our state. We urge you to reject this dangerous project.

Sincerely,

1. Central California Environmental Justice Network
2. The Center on Race, Poverty, and the Environment
3. Central Valley Air Quality Coalition
4. Building Healthy Communities Kern
5. Dolores Huerta Foundation
6. Leadership Counsel for Justice and Accountability
7. Greenaction for Health and Environmental Justice
8. Little Manila Rising
9. Valley Improvement Projects
10. VISIÓN (Voices in Solidarity Against Oil in Neighborhoods)
11. Earthjustice
12. Center for Biological Diversity
13. The Climate Center
14. Clean Water Action
15. California Environmental Voters
16. San Joaquin Valley Democratic Club
17. Fresnans against Fracking
18. Presente.org
19. Labor Network for Sustainability
20. Friends of the Earth
21. Food & Water Watch
22. Consumer Watchdog
23. Center for Community Action and Environmental Justice
24. Oil Change International
25. Physicians for Social Responsibility - Los Angeles
26. Elected Officials to Protect America
27. Azul

[7] https://www.crc.com/carbon-terravault/vaults/default.aspx

[8] Padre Associates, Inc., *Operating Statement: Golden State Hydrogen Plant Project, Pixley, Tulare County, California*, prepared for Proteum Energy (Oct. 2023) at 9.

28. 350 Bay Area
29. 350 Conejo / San Fernando Valley
30. 350 Humboldt
31. 350 Sacramento
32. 350Marin
33. Active San Gabriel Valley
34. Bay Area-System Change not Climate Change
35. Biodiversity First!
36. Biofuelwatch
37. CleanEarth4Kids.org
38. Climate Action California
39. Climate Action Team of the Unitarian Universalist Fellowship of Corvallis
40. Climate First: Replacing Oil & Gas (CFROG)
41. Climate Hawks Vote
42. Climate Health Now
43. Community Energy reSource
44. Elders Climate Action
45. Elders Climate Action (ECA) Northern California (NorCal) Chapter
46. Elders Climate Action (ECA) Southern California (SoCal) Chapter
47. Extinction Rebellion San Francisco Bay Area
48. Food Empowerment Project
49. Fossil Free California
50. Glendale Environmental Coalition
51. Good Neighbor Steering Committee of Benicia
52. Indivisible California, GREEN TEAM
53. Indivisible Marin
54. Indivisible San Jose
55. Interfaith Climate Action Network of Contra Costa County
56. Manhattan Beach Huddle
57. Oil and Gas Action Network
58. Planning and Conservation League
59. Queers X Climate
60. San Benito County Democratic Central Committee
61. San Francisco Bay Physicians for Social Responsibility
62. San Francisco Baykeeper
63. SanDiego350
64. Santa Barbara Standing Rock Coalition
65. Santa Cruz Climate Action Network
66. Science and Environmental Health Network
67. SEE (Social Eco Education)
68. SoCal 350 Climate Action
69. Society of Native Nations
70. SolidarityINFOService
71. Stand.earth
72. Sunflower Alliance
73. Sustainable Mill Valley
74. The Climate Alliance of Santa Cruz County
75. USC Environmental Student Assembly
76. Vote Solar
77. West Berkeley Alliance for Clean Air and Safe Jobs

728 Caroline St.
Port Angeles WA 98362
March 22, 2024

Kern Co. Planning & NRD
2700 M Street, Suite 100
Bakersfield CA 93301

Re: Carbon TerraVault 1 (Kern Co.) CCS Project

Dear Planning Dept:

I received 2 Notices of Public Hearing and Opportunity to Comment on this project from Kern Co. in the mail here in WA. Since I now live out of CA, I checked with the State Clearing House of the CA Governor's Office to confirm that I could submit comments on the EIR on the above project. The employee read the CEQA regs and asked some questions and called me back to tell me that I could submit comments on this potential environmental disaster in CA because I am "a member of the public". I lived in CA for 80 years before I moved up here, so I have submitted comments on many EIRs in several counties in CA during that time, including your county. Please include my comments in the EIR documents on this project now.

ENVIRONMENTAL ARGUMENTS AGAINST PROJECTS

Carbon capture trades off with other critical climate solutions

Carbon capture extends the fossil fuel era instead of ending it. By now, everyone who reads knows that fossil fuel pollution in the atmosphere is the major cause of this planet's current climate crisis. Therefore, stopping the use of fossil fuels and building up alternative environmental sources actually will be the causes for stopping global warming. KEEP ALL FOSSIL FUELS IN THE GROUND!!

Carbon capture is energy intensive

Such systems require building a new power plant to run the system, creating yet another source of air and carbon pollution. That undermines the whole goal of capturing carbon in the first place. Please include in your EIR on this project exactly what studies and data you have done that refutes this specific argument against CCS. Do you have any that are not funded or provided by CA Resources Corp. or Aera Energy or Chevron or Occidental Petroleum? Show them.

Carbon capture actually increases emissions

Environmental organizations report that, due to the larger amount of energy required to power carbon capture, plus the life cycle of fossil fuel, carbon capture in this country has actually put more CO2 into the atmosphere than it has removed. Please include this argument against CCS in your EIR evaluations and, if any, what facts and arguments have been published to refute it. These published refutations are there; your planning dept. needs to include them in a fair EIR.

Storage presents significant risks

Health risks to populations is a serious safety concern. Leaks from wells and pipes can contaminate the surrounding air (depending on direction of wind) and create serious health problems for residents (or visitors) – such as asphyxiation, seizures, loss of consciousness, and potentially death. A section of the 13 miles of CO2 pipeline to transport carbon dioxide passes dangerously close to McKittrick Elementary School. Kern Co. already has permitted many fossil fuel projects that have caused documented health problems for its residents, i.e. oil wells & drilling and "produced water", particularly near small town areas like McKittrick. How many Notices of Public Hearing on this project have been sent to the families living in McKittrick? Indicate your compliance with notice of this serious notification of potential health problems and what the McKittrick population said.

Well failure during injection or a blowout could result in a release of large amounts of CO2. Storage locations can leak CO2 when they are located near fossil fuel reservoirs which can and do provide ways for CO2 to escape to the surface and contaminate air, water, and ground. Drilling and injections can cause earthquakes. Kern Co. has a history of severe earthquakes already.

Carbon capture is an expensive failure

Environmental organizations report that in public and private investments over decades, there are no carbon capture successful projects – only huge failures. This is an reason for not starting yet another likely carbon capture project failure. Two of these failures are Petra Nova plant in TX and the San Juan Generating Station in NM. Include comparisons in the EIR that would show how this project could more likely be profitable (both in being cheaper and decreasing climate change).

PROCEDURAL ERRORS IN EIR REVIEW

It is procedure that spells much of the difference between rule of law and rule by whim.
Supreme Court Justice William O. Douglas, 1951

There is an error in Kern Co.'s procedures re notification. It says "We encourage the submittal of written comments by March 12, 2024, so that those comments may be considered when Staff formulates its recommendations ..." However, your 2 letters to me were postmarked on the very same day, March 12, 2024. This notification doesn't make sense. Is it timely? You do attempt to remedy the error somewhat by adding that "written comments may be submitted any time prior to, or at, the public hearing". So here are my timely comments.

There is no mention of Alternative 3 – Nature-Based Carbon Storage Alternative - as an Environmentally Superior Alternative on pages 1-22 to 1-23. Why not? Alternative 3 would both decrease CO2 emissions and at the same time build up alternative green energy sources.

Please include an analysis examining the Alt.3 Nature-Based Carbon Storage Alternative as the Environmentally Superior Alternative. Please be sure to display this analysis in charts for the public to see when they attend community meetings.

It is a hopeful action that you have actually created this Green Alternative. I certainly hope that Alternative 3 can win out in the end of this process as it actually would help to diminish the climate crisis instead of adding to it.

Sincerely yours,

Diane Marks

Diane Marks

Blind copy

EARTHJUSTICE

Via Fed-Ex

RECEIVED
JUL 25 2024
Kern County Planning &
Natural Resources Dept.

July 24, 2024

Kern County Planning and Natural Resources Department
Attn: Keith Alvidrez, Planner II
2700 "M" Street, Suite 100
Bakersfield, CA 93301

Re.: Submission of Comments on the Recirculated Draft Environmental Impact Report for Carbon TerraVault I

Dear Mr. Alvidrez:

Please see the enclosed thumb drive and attachment with regards to the above-referenced comments submitted by our office on July 18, 2024. Please contact me with any questions.

Sincerely,

Firenze Rodriguez

Firenze Rodríguez
Sr. Litigation Assistant

CALIFORNIA OFFICE 50 CALIFORNIA STREET, SUITE 400 SAN FRANCISCO, CA 94111
T: 415.217.2000 F: 415.217.2040 CAOFFICE@EARTHJUSTICE.ORG WWW.EARTHJUSTICE.ORG

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VIEW ALL NEWS

Carbon TerraVault Announces Two New Storage-Only Carbon Dioxide Management Agreements and Submission of Another Class VI Permit to the EPA

01 May, 2023

LONG BEACH, Calif.--(BUSINESS WIRE)-- California Resources Corporation (NYSE: CRC) today announced a storage-only Carbon Dioxide Management Agreement (CDMA) between Carbon TerraVault Holdings, LLC (CTV), a subsidiary of CRC that provides services including the capture, transport and storage of carbon dioxide (CO_2), and Yosemite Clean Energy, LLC (Yosemite). CRC also announced a second storage-only CDMA between CTV and InEnTec Inc. (InEnTec).

“2023 began on a good note for Carbon TerraVault as we continued to expand our carbon management storage capacity by submitting another Class VI permit to the EPA and entering into two additional Carbon Dioxide Management Agreements with reputable partners who are committed to energy transition in California,” said Mac McFarland, Chairman of the CTV Board. “We expect to receive a draft Class VI permit for CTV I by the end of the year and plan to further expand and diversify CTV’s portfolio of customers across the energy spectrum in the state of California.”

Francisco Leon, CRC’s President and Chief Executive Officer, added, “We are evaluating the strategic positioning of our carbon management business which could include a potential separation from our legacy oil and gas business. We are excited about CTV’s progress to date and believe a future separation could unlock additional value for our shareholders while continuing to help California achieve its climate goals.”

Primary Highlights

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- Submitted a Class VI permit to the EPA for 34 million metric tons (MMT) of CO_2 storage for CTV IV, bringing CTV's total potential permitted storage to 174 MMT
- Signed storage-only CDMAs with Yosemite Clean Energy, LLC and InEnTec Inc. for 40,000 and 100,000 metric tons per annum (MTPA) of CO_2 injection, respectively, bringing the total CTV injection rate to 610,000 MTPA with 200,000 MTPA targeted to Elk Hills reservoir and 410 MTPA targeted in the Sacramento basin area

Yosemite Clean Energy, LLC CDMA

In April 2023, CTV entered into a CDMA with Yosemite, a bioenergy development company that specializes in transforming farm and forest wood waste into carbon-negative hydrogen and renewable fuel, to sequester at least 40,000 MTPA of CO_2 at CTV carbon storage vaults from a new hydrogen plant to be constructed in Oroville, Northern California. Called the Yosemite Hydrogen Facility, the plant is expected to produce 24,000 kilogram (KG) per day of hydrogen. Over the next 10 years, Yosemite plans to construct two additional hydrogen facilities in California with similar technical and production characteristics.

The initial Yosemite Hydrogen Facility will utilize dual bed gasification technology to sustainably convert woody biomass waste from local forest and agricultural producers into syngas while the generated CO_2 will be captured and then stored permanently underground by CTV. Syngas is a combination of hydrogen, methane, CO_2, carbon monoxide, and other trace gases that is used to produce other fuels. California generates an estimated 50 million tons of forest and farm woody biomass waste annually, which when left to burn, decay, and decompose, emits immense amounts of greenhouse gases and black carbon, or soot, which is part of fine particulate air pollution. Yosemite's plans to sustainably convert biomass into syngas, from which carbon negative hydrogen is produced, is in line with California's leading emission targets as it transitions to a carbon neutral economy.

"We are excited to work with such an experienced renewable fuels partner that is dedicated to powering California's future," said Francisco Leon, CRC's President and Chief Executive Officer. "This new agreement underscores the need for CCS services to help reduce emissions in the state's rapidly growing new energy economy. It also expands CRC's carbon management business in Northern California and meaningfully demonstrates our dedication to helping decarbonize California across the full spectrum of the energy value chain."

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"California continues to lead the country in the development of innovative, sustainable and economically feasible solutions that help reduce its carbon emissions and transition to a carbon neutral economy," added Thomas Hobby, Yosemite's Chief Executive Officer. "Our green hydrogen facilities will not only help to sustainably convert existing biomass into commercial scale carbon negative hydrogen for the California fuel markets but will also support local farmers and forest landowners to further enhance their operations and better position them for the future. CTV's unique value proposition, leading CO_2 storage permitting process, storage asset position, and expertise provides us with confidence that we have found a solid partner in our quest for a sustainable, cleaner, more resilient environment for all Californians."

Highlights of the Yosemite CDMA include:

- The Yosemite Hydrogen Project is expected to produce 24,000 KG per day of hydrogen. This translates to an initial 80,000 MTPA of associated CO_2,40,000 MTPA of which will be used for Yosemite's internal needs and the other half will be permanently sequestered at CTV locations
- Yosemite has entered into a letter of intent for a master offtake agreement with Gunvor USA in an amount up to the facility's total hydrogen production
- The project is expected to be commercial by the beginning of 2026, aligning with CTV's goal of 5 million MTPA by the end of 2027
- Yosemite plans to deliver produced CO_2 to a CTV location via a fleet of low emissions trucks
- The project's location and CO_2 transportation method provides a unique opportunity for CTV to deliver CO_2 to various sequestration locations across California
- CTV will provide a CO_2 truck offloading facility and permanent CO_2 storage site in exchange for an injection fee on a per MT basis that fits within the previously disclosed economic type-curve for projects that require a storage-only solution
- CO_2 capture capital will be effectively eliminated as CO_2 capture equipment, the most capital-intensive portion of CCS projects, is incorporated into the base design of the new Yosemite hydrogen facility
- CTV will have the right to take a stake in the total outstanding equity of the project company that holds the hydrogen project
- CTV will have a right of first look to provide storage services for subsequent Yosemite hydrogen projects in California
- The CDMA frames the contractual terms between parties by outlining the material economics and terms of the project and includes conditions precedent to close. The

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CDMA provides a path for the parties to reach final definitive documents and a final investment decision (FID).

InEnTec, Inc. CDMA

In April 2023, the CTV entered into a CDMA with InEnTec, an industry leader in gasification systems that economically and responsibly turns the world's waste into valuable green products, fuels and energy.

The CDMA contemplates that InEnTec will build a new renewable dimethyl ether (rDME) production facility at CRC's Net Zero Industrial Park in Kern County California, and CTV will sequester initially at the minimum 100,000 MTPA of CO_2 from InEnTec's facility in the CTV I carbon storage vault. The rDME facility is expected to produce 80 to 100 tons per day of rDME from biomass and other waste materials to help support the decarbonization of California's economy and its transportation sector.

"This promising agreement between CTV and InEnTec provides an innovative approach to production of renewable fuel at the heart of the Kern County energy hub," said Francisco Leon, CRC's President and Chief Executive Officer. "Doubling our CO_2 supply commitments at CTV I in a matter of four months at our groundbreaking Elk Hills Net Zero Industrial Park further underscores the rising need for our carbon management solutions in California."

"InEnTec's proprietary technology will reduce CO_2 emissions from the production and use of transportation fuels and help California achieve its critically important climate goals," added Jeffrey E. Surma, InEnTec's President and Chief Executive Officer. "This facility will benefit from many synergies with CTV and solidify InEnTec's company growth plans as we work to help decarbonize both the transportation and industrial sectors of the U.S. economy."

Highlights of the InEnTec CDMA include:

- The rDME facility will use InEnTec's proprietary gasification technology to convert waste materials into high quality synthesis gas, and then convert the syngas into rDME using technology expected to be supplied by InEnTec's partner Verde Clean Fuels (NASDAQ: VGAS). The facility is expected to produce 80 to 100 TPD of rDME for use as transportation fuel and subsequently at the minimum 100,000 MTPA of associated CO_2 that will be permanently sequestered at CTV I
- InEnTec entered into a master offtake agreement with Superior Plus Energy Services Inc. (Superior) to supply Superior with rDME. Superior is a U.S. operating subsidiary of

Skip to main content

Superior Plus Corp. (TSX: SPB)

- Project FID is targeted in late 2024, with operations expected to begin in the first half of 2026
- The CDMA also provides InEnTec with a lease for 50 acres at the Elk Hills Net Zero Industrial Park to construct its facility
- CTV will provide infield transportation and a permanent CO_2 sequestration site at CTV I in exchange for an injection fee on a per ton basis that fits within the previously disclosed economic type-curve for projects that require a storage-only solution
- The project's location at the Elk Hills Net Zero Industrial Park will eliminate the need for long haul CO_2 transportation and certain midstream capital requirements
- CTV and InEnTec are discussing CRC's potential financial participation in the rDME facility, including potentially a significant equity stake
- The CDMA frames the contractual terms between parties by outlining the material economics and terms of the project and includes conditions precedent to close. The CDMA provides a path for the parties to reach final definitive documents and FID

About Carbon TerraVault

Carbon TerraVault Holdings, LLC (CTV), a subsidiary of CRC, provides services that include the capture, transport and storage of carbon dioxide for its customers. CTV is engaged in a series of CCS projects that inject CO_2 captured from industrial sources into depleted underground reservoirs and permanently store CO_2 deep underground. For more information about CTV, please visit www.carbonterravault.com.

About California Resources Corporation

California Resources Corporation (CRC) is an independent energy and carbon management company committed to energy transition. CRC produces some of the lowest carbon intensity oil in the US and is focused on maximizing the value of its land, mineral and technical resources for decarbonization efforts. For more information about CRC, please visit www.crc.com.

About Yosemite

Yosemite Clean Energy, LLC (Yosemite) is a bioenergy development company that specializes in transforming farm and forest wood waste into carbon-negative biofuels, including green hydrogen and renewable natural gas. Yosemite provides renewable solutions to California's transportation and broader energy sectors while reducing risk of wildfires, raising air quality, and creating jobs and economic stimulus in underserved rural

Skip to main content

communities. Over the last decade, these areas have experienced a significant rise in catastrophic wildfire due to mismanagement of the forests, causing billions of dollars of property and environmental damage. Yosemite is developing a network of biofuels plants that are partially owned by the forest and agricultural communities they serve. The company is at various stages of development planning on biofuels plants across the state of California. For further information, visit yosemiteclean.com.

About InEnTec

InEnTec Inc.(InEnTec) is an industry leader in gasification systems that provides solutions to economically and responsibly turn the world's waste into valuable green products, fuels, and energy. To learn more about InEnTec, please visit www.inentec.com.

Forward-Looking Statements

This document contains statements that CRC believes to be “forward-looking statements” within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. All statements other than historical facts are forward-looking statements, and include statements regarding CRC's future financial position, business strategy, projected revenues, earnings, costs, capital expenditures and plans and objectives of management for the future. Words such as "expect," “could,” “may,” "anticipate," "intend," "plan," “ability,” "believe," "seek," "see," "will," "would," “estimate,” “forecast,” "target," “guidance,” “outlook,” “opportunity” or “strategy” or similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those expressed in, or implied by, such statements.

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- CRC’s ability to finalize definitive documents and reach a final investment decision with respect to Yosemite’s and InEnTec’s projects contemplated by their respective CDMAs;
- the ability of Yosemite’s and InEnTec’s projects to achieve expected production volumes and associated CO_2 generation and the ability of the CTV to sequester such CO_2 volumes, respectively;

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- CRC's ability to successfully execute on the construction of Yosemite's and InEnTec projects and other aspects of infrastructure projects and enter into third party contracts on contemplated terms;
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- availability or timing of, or conditions imposed on, permits and approvals necessary for drilling or development activities and carbon management projects;
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Carbon TerraVault Provides Second Quarter 2023 Update

31 Jul, 2023

CTV Doubles the Storage Reservations at the CRC's Net Zero Industrial Park at Elk Hills Field and Announces the Submission of Another Class VI permit to the U.S. EPA

LONG BEACH, Calif.--(BUSINESS WIRE)-- California Resources Corporation (NYSE: CRC) today announced a storage-only Carbon Dioxide Management Agreement (CDMA) between Carbon TerraVault JV HoldCo, LLC (CTV JV), a subsidiary of CRC that provides services including the capture, transport and storage of carbon dioxide (CO_2), and Verde Clean Fuels Inc. (Verde), a company that utilizes an innovative and proprietary liquid fuels technology to produce renewable and lower-carbon intensity gasoline and other liquid fuels from feedstocks such as biomass, agricultural waste, or flared natural gas. CRC also more than doubled the expected sequestration volume of its previously announced Lone Cypress Energy Services, LLC, (Lone Cypress) blue hydrogen project.

"The Carbon TerraVault team continued to make substantial progress through the first half of the year, with four administratively complete EPA Class VI permit applications and 191 million metric tons (MMT) of CO_2 storage capacity submitted to EPA for Class VI permits to date. The team has executed five CDMAs with promising greenfield projects that can accelerate the new energy economy in California and leverage Carbon TerraVault's decarbonization solutions," said Francisco Leon, CRC's President and Chief Executive Officer. "The most recent expansion of the Lone Cypress blue hydrogen facility and our new partnership with Verde Clean Energy further demonstrates the benefits CRC's unique asset position and carbon management strategy can deliver to California's energy transition goals."

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Primary Highlights

- Signed storage-only CDMA with Verde for minimum volume commitment of 100 thousand metric tons per annum (KMTPA) of CO_2 injection
- Expanded its previously announced Lone Cypress blue hydrogen project to 205 KMTPA of associated CO_2 that will be permanently sequestered at CTV I reservoir
- CTV's total projected CO_2 injection rate under CDMAs now stands at 815 KMTPA with targeted 405 KMTPA in the San Joaquin Basin and 410 KMTPA in the Sacramento basin
- Submitted a 17 MMT Class VI permit to the EPA for CTV V CO_2 reservoir in the Sacramento Basin bringing CTV's total projected storage capacity with Class VI permits submitted the EPA to 191 MMT

Verde Clean Energy, LLC CDMA

In July 2023, CTV JV entered into a CDMA with Verde to sequester a minimum of 100 KMTPA of CO_2 at the CTV I carbon storage vault from a new renewable gasoline plant to be constructed at CRC's Net Zero Industrial Park at Elk Hills in Kern County, California. This new facility is expected to produce 21,000 gallons per day of renewable gasoline from biomass and other agricultural waste feedstock to help support decarbonization of California's economy and its transportation sector.

"Doubling the CO_2 storage opportunities under CDMAs at our CRC's Net Zero Industrial Park at Elk Hills field in a matter of eight months further underscores CRC's carbon management strategy and dedication to energy transition in California," said Leon. "This new agreement between CTV JV and Verde Clean Fuels provides an innovative approach to renewable fuels at the heart of energy development in the state, and further validates CRC's decarbonization efforts by a publicly traded company looking to expand in California."

"Traditional gasoline used today is refined from crude oil and makes up over half of greenhouse gas emissions from the U.S. transportation sector. We believe our proprietary technology and our scientific approach will further enable California's consumers of gasoline to seamlessly and materially participate in the decarbonization of our atmosphere and help achieve California's climate goals," said Ernest Miller, Verde Chief Executive Officer. "Our agreement with CTV solidifies our domestic growth ambitions and provides a concrete pathway to the decarbonization of the transportation sector with the leading carbon management business in the US."

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Highlights of Verde CDMA include:

- The renewable gasoline facility will employ Verde proprietary and innovative liquid fuels technology to convert synthetic gas (syngas) produced by InEnTec's gasification system, into renewable gasoline. The project is expected to produce more than 7.5 million gallons per year of renewable gasoline for use as transportation fuel. A minimum of 100 KMTPA of associated CO_2 is expected to be permanently sequestered at CTV I
- Project Final Investment Decision (FID) is targeted for 2025, with operations expected to begin in 2027
- The CDMA also provides Verde with a lease for 50 acres at CRC's Net Zero Industrial Park at Elk Hills field on which to construct its facility
- CTV JV will provide in-field transportation and a permanent CO_2 sequestration site at CTV I in exchange for an injection fee on a per MT basis that fits within the previously disclosed economic type-curve for projects that require a storage-only solution
- The project's location at the CRC's Net Zero Industrial Park will eliminate the need for long haul CO_2 transportation and reduce certain midstream capital requirements
- CTV JV and Verde are discussing CRC's potential financial participation in the RG facility, including potentially a significant equity stake
- The CDMA frames the contractual terms between parties by outlining the material economics and terms of the project and includes conditions precedent to close. The CDMA provides a path for the parties to reach final definitive documents and FID

About Carbon TerraVault

Carbon TerraVault Holdings, LLC (CTV), a subsidiary of CRC, provides services that include the capture, transport and storage of carbon dioxide for its customers. CTV is engaged in a series of CCS projects that inject CO_2 captured from industrial sources into depleted underground reservoirs and permanently store CO_2 deep underground. For more information about CTV, please visit www.carbonterravault.com.

About Carbon TerraVault Joint Venture

Carbon TerraVault Joint Venture is a carbon management partnership focused on carbon capture and sequestration development, and was formed between Carbon TerraVault, a subsidiary of CRC, and Brookfield Renewable. The CTV JV develops both infrastructure and storage assets required for CCS development in California. CRC owns 51% of the CTV JV with Brookfield Renewable owning the remaining 49% interest.

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About California Resources Corporation

California Resources Corporation (CRC) is an independent energy and carbon management company committed to energy transition. CRC has some of the lowest carbon intensity production in the US and it is focused on maximizing the value of its land, mineral and technical resources for decarbonization by developing CCS and other emissions reducing projects. For more information about CRC, please visit www.crc.com.

About Lone Cypress Energy Services

Lone Cypress Energy Services, LLC is an independent energy company focused on the development and operation of infrastructure across the entire energy value chain. Headquartered in Tulsa, OK, Lone Cypress offers a full suite of technology-enabled solutions including project development, project management, EPC contracting, and asset operations. Lone Cypress specializes in the development of hydrogen generation and distribution projects, waste to energy plant solutions, and traditional oil and gas midstream facilities. For more information, please visit www.lonecypressenergyservices.com.

About Verde Clean Fuels, Inc

Verde Clean Fuels, Inc. (Verde) is a renewable energy company focused on the development of commercial production plants to convert syngas, derived from diverse biomass feedstocks, such as yard waste, agricultural waste, and sorted municipal solid waste, as well as stranded or flared natural gas (including renewable natural gas) into gasoline through its innovative and proprietary liquid fuels technology, the STG+® process. Through its STG+® process, Verde converts syngas into fully finished fuels that require no additional refining, such as Reformulated Blend-stock for Oxygenate Blending (“RBOB”) gasoline. To learn more about Verde, please visit www.verdecleanfuels.com.

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CLIMATE CHANGE AND ENERGY

The world's on the verge of a carbon storage boom

Hundreds of looming projects will force communities to weigh the climate claims and environmental risks of capturing, moving, and storing carbon dioxide.

By James Temple

June 12, 2024

The Elk Hills oil field in Kern County, California.

ALAMY

Pump jacks and pipelines clutter the Elk Hills oil field of California, a scrubby stretch of land in the southern Central Valley that rests above one of the nation's richest deposits of fossil fuels.

Oil production has been steadily declining in the state for decades, as tech jobs have boomed and legislators have enacted rigorous environmental and climate rules. Companies, towns, and residents across Kern County, where the poverty rate hovers around 18%, have grown

increasingly desperate for new economic opportunities.

Late last year, California Resources Corporation (CRC), one of the state's largest oil and gas producers, secured draft permits from the US Environmental Protection Agency to develop a new type of well in the oil field, which it asserts would provide just that. If the company gets final approval from regulators, it intends to drill a series of boreholes down to a sprawling sedimentary formation roughly 6,000 feet below the surface, where it will inject tens of millions of metric tons of carbon dioxide to store it away forever.

They're likely to become California's first set of what are known as Class VI wells, designed specifically for sequestering the planet-warming greenhouse gas. But many, many similar carbon storage projects are on the way across the state, the US, and the world—a trend driven by growing government subsidies, looming national climate targets, and declining revenue and growth in traditional oil and gas activities.

Since the start of 2022, companies like CRC have submitted nearly 200 applications in the US alone to develop wells of this new type. That offers one of the clearest signs yet that capturing the carbon dioxide pollution from industrial and energy operations instead of releasing it into the atmosphere is about to become a much bigger business.

Proponents hope it's the start of a sort of oil boom in reverse, kick-starting a process through which the world will eventually bury more greenhouse gas than it adds to the atmosphere. They argue that embracing carbon capture and storage (CCS) is essential to any plan to rapidly slash emissions. This is, in part, because retrofitting the world's massive existing infrastructure with carbon dioxide–scrubbing equipment could be faster and easier than rebuilding every power plant and factory. CCS can be a particularly helpful way to cut emissions in certain heavy industries, like cement, fertilizer, and paper and pulp production, where we don't have scalable, affordable ways of producing crucial goods without releasing carbon dioxide.

Related Story

The growing signs of trouble for global carbon markets

Corporations are backing away from one of their favorite climate remedies as greenwashing concerns steadily mount.

"In the right context, CCS saves time, it saves money, and it lowers risks," says Julio Friedmann, chief scientist at Carbon Direct and previously the principal deputy assistant secretary for the Department of Energy's Office of Fossil Energy.

But opponents insist these efforts will prolong the life of fossil-fuel plants, allow air and water pollution to continue, and create new health and environmental risks that could disproportionately harm disadvantaged communities surrounding the projects, including those near the Elk Hills oil field.

"It's the oil majors that are proposing and funding a lot of these projects," says Catherine Garoupa, executive director of the Central Valley Air Quality Coalition, which has tracked a surge of applications for carbon storage projects throughout the district. "They see it as a way of extending business as usual and allowing them to be carbon neutral on paper while still doing the same old dirty practices."

A slow start

The US federal government began overseeing injection wells in the 1970s. A growing number of companies had begun injecting waste underground, sparking a torrent of water pollution lawsuits and the passage of several major laws designed to ensure clean drinking water. The EPA developed standards and rules for a variety of wells and waste types, including deep Class I wells for hazardous or even radioactive refuse and shallower Class V wells for non-hazardous fluids.

In 2010, amid federal efforts to create incentives for industries to capture more carbon dioxide, the agency added Class VI wells for CO_2 sequestration. To qualify, a proposed well site must have the appropriate geology, with a deep reservoir of porous rock that can accommodate carbon dioxide molecules sitting below a layer of nonporous "cap rock" like shale. The reservoir also needs to sit well below any groundwater aquifers, so that it won't contaminate drinking water supplies, and it must be far enough from fault lines to reduce the chances that earthquakes might crack open pathways for the greenhouse gas to escape.

The carbon sequestration program got off to a slow start. As of late 2021, there were only two Class VI injection wells in operation and 22 applications pending before regulators.

But there's been a flurry of proposals since—both to the EPA and to the three states that have secured permission to authorize such wells themselves, which include North Dakota, Wyoming, and Louisiana. The Clean Air Task Force, a Boston-based energy policy think tank keeping track of such projects, says there are now more than 200 pending applications.

What changed is the federal incentives. The Inflation Reduction Act of 2022 dramatically boosted the tax credits available for permanently storing carbon dioxide in geological formations, bumping it up from $50 a ton to $85 when it's captured from industrial and power plants. The credit rose from $50 to $180 a ton when the greenhouse gas is sourced from direct-air-capture facilities, a different technology that sucks greenhouse gas out of the air. Tax credits allow companies to directly reduce their federal tax obligations, which can cover the added expense of CCS across a growing number of sectors.

The separate Bipartisan Infrastructure Law also provided billions of dollars for carbon capture demonstration and pilot projects.

A tax credit windfall

CRC became an independent company in 2014, when Occidental Petroleum, one of the world's largest oil and gas producers, spun it off along with many of its California assets. But the new company quickly ran into financial difficulties, filing for bankruptcy protection in 2020 amid plummeting energy demand during the early stages of the covid-19 pandemic. It emerged several months later, after restructuring its debt, converting loans into equity, and raising new lines of credit.

The following year, CRC created a carbon management subsidiary, Carbon TerraVault, seizing an emerging opportunity to develop a new business around putting carbon dioxide back underground, whether for itself or for customers. The company says it was also motivated by the chance to "help advance the energy transition and curb rising global temperatures at 1.5 °C."

CRC didn't respond to inquiries from *MIT Technology Review*.

In its EPA application the company, based in Long Beach, California, says that hundreds of thousands of tons of carbon dioxide would initially be captured each year from a gas treatment facility in the Elk Hills area as well as a planned plant designed to produce hydrogen from natural gas. The gas is purified and compressed before it's pumped underground.

The company says the four wells for which it has secured draft permits could store nearly 1.5 million tons of carbon dioxide per year from those and other facilities, with a total capacity of 38 million tons over 26 years. CRC says the projects will create local jobs and help the state meet its pressing climate targets.

"We are committed to supporting the state in reaching carbon neutrality and developing a more sustainable future for all Californians," Francisco Leon, chief executive of CRC, said of the draft EPA decision in a statement.

Those wells, however, are just the start of the company's carbon management plans: Carbon TerraVault has applied to develop 27 additional wells for carbon storage across the state, including two more at Elk Hills, according to the EPA's permit tracker. If those are all approved and developed, it would transform the subsidiary into a major player in the emerging business of carbon storage—and set it up for a windfall in federal tax credits.

Carbon sequestration projects can qualify for 12 years of US subsidies. If Carbon TerraVault injects half a million tons of carbon dioxide into each of the 31 wells it has applied for over that time period, the projects could secure tax credits worth more than $15.8 billion.

That figure doesn't take inflation into account and assumes the company meets the most stringent requirements of the law and sources all the carbon dioxide from industrial facilities

and power plants. The number could rise significantly if the company injects more than that amount into wells, or if a significant share of the carbon dioxide is sourced through direct air capture.

Chevron, BP, ExxonMobil, and Archer Daniels Midland, a major producer of ethanol, have also submitted Class VI well applications to the EPA and could be poised to secure significant IRA subsidies as well.

To be sure, it takes years to secure regulatory permits, and not every proposed project will move forward in the end. The companies involved will still need to raise financing, add carbon capture equipment to polluting facilities, and in many cases build out carbon dioxide pipelines that require separate approvals. But the increased IRA tax credits could drive as much as 250 million metric tons of additional annual storage or use of carbon dioxide in the US by 2035, according to the latest figures from the Princeton-led REPEAT Project.

"It's a gold rush," Garoupa says. "It's being shoved down our throats as 'Oh, it's for climate goals.'" But if we're "not doing it judiciously and really trying to achieve real emissions reductions first," she adds, it's merely a distraction from the other types of climate action needed to prevent dangerous levels of warming.

Carbon accounting

Even if CCS can help drive down emissions in the aggregate, the net climate benefits from any given project will depend on a variety of factors, including how well it's developed and run—and what other changes it brings about throughout complex, interconnected energy systems over time.

Notably, adding carbon capture equipment to a plant doesn't trap all the climate pollution. Project developers are generally aiming for around 90%. So if you build a new project with CCS, you've increased emissions, not cut them, relative to the status quo.

In addition, the carbon capture process requires a lot of power to run, which may significantly increase emissions of greenhouse gas and other pollutants elsewhere by, for example, drawing on additional generation from natural-gas plants on the grid. Plus, the added tax incentives may make it profitable for a company to continue operating a fossil-fuel plant that it would otherwise have shut down or to run the facilities more hours of the day to generate more carbon dioxide to bury.

All the uncaptured emissions associated with those changes can reduce, if not wipe out, any carbon benefits from incorporating CCS, says Danny Cullenward, a senior fellow with the Kleinman Center for Energy Policy at the University of Pennsylvania.

But none of that matters as far as the carbon storage subsidies are concerned. Businesses could even use the savings to expand their traditional oil and gas operations, he says.

"It's not about the net climate impact—it's about the gross tons you stick under ground," Cullenward says of the tax credits.

A study last year raised a warning about how that could play out in the years to come, noting that the IRA may require the US to provide hundreds of billions to trillions of dollars in tax credits for power plants that add CCS. Under the scenarios explored, those projects could collectively deliver emissions reductions of as much as 24% or increases as high as 82%. The difference depends largely on how much the incentives alter energy production and the degree to which they extend the life of coal and natural-gas plants.

Coauthor Emily Grubert, an associate professor at Notre Dame and a former deputy assistant secretary at the Department of Energy, stressed that regulators must carefully consider these complex, cascading emissions impacts when weighing whether to approve such proposals.

"Not taking this seriously risks potentially trillions of dollars and billions of tonnes of [greenhouse-gas] emissions, not to mention the trust and goodwill of the American public, which is reasonably skeptical of these potentially critically important technologies," she wrote in an op-ed in the industry outlet *Utility Dive*.

Global goals

Other nations and regions are also accelerating efforts to capture and store carbon as part of their broader efforts to lower emissions and combat climate change. The EU, which has dedicated tens of billions of euros to accelerating the development of CCS, is working to develop the capacity to store 50 million tons of carbon dioxide per year by 2030, according to the Global CCS Institute's 2023 industry report.

Likewise, Japan hopes to sequester 240 million tons annually by 2050, while Saudi Arabia is aiming for 44 million tons by 2035. The industry trade group said there were 41 CCS projects in operation around the world at the time, with another 351 under development.

A handful of US facilities have been capturing carbon dioxide for decades for a variety of uses, including processing or producing natural gas, ammonia, and soda ash, which is used in soaps, cosmetics, baking soda, and other goods.

But Ben Grove, carbon storage manager at the Clean Air Task Force, says the increased subsidies in the IRA made CCS economical for many industry segments in the US, including: chemicals, petrochemicals, hydrogen, cement, oil, gas and ethanol refineries, and steel, at least on the low end of the estimated cost ranges.

In many cases, the available subsidies still won't fully cover the added cost of CCS in power plants and certain other industrial facilities. But the broader hope is that these federal programs will help companies scale up and optimize these processes over time, driving down the cost of CCS and making it feasible for more sectors, Grove says.

'Against all evidence'

In addition to the gas treatment and hydrogen plants, CRC says, another source for the captured carbon dioxide could eventually include its own Elk Hills Power Plant, which runs on natural gas extracted from the oil field. The company has said it intends to retrofit the facility to capture 1.5 million tons of emissions a year.

Still other sources could include renewable fuels plants, which may mean biofuel facilities, steam generators, and a proposed direct-air-capture plant that would be developed by the carbon-removal startup Avnos, according to the EPA filing. Carbon TerraVault is part of a consortium, which includes Avnos, Climeworks, Southern California Gas Company, and others, that has proposed developing a direct-air-capture hub in Kern County, where the Elk Hills field is located. Last year, the Department of Energy awarded the so-called California DAC Hub nearly $12 million to conduct engineering design studies for direct-air-capture facilities.

CCS may be a helpful tool for heavy industries that are really hard to clean up, but that's largely not what CRC has proposed, says Natalia Ospina, legal director at the Center on Race, Poverty & the Environment, an environmental-justice advocacy organization in Delano, California.

"The initial source will be the Elk Hills oil field itself and the plant that refines gas in the first place," she says. "That is just going to allow them to extend the life of the oil and gas industry in Kern County, which goes against all the evidence in front of us in terms of how we should be addressing the climate crisis."

Natalia Ospina, legal director at the Center on Race, Poverty & the Environment.

NATALIA OSPINA

Critics of the project also fear that some of these facilities will continue producing other types of pollution, like volatile organic compounds and fine particulate matter, in a region that's already heavily polluted. Some analyses show that adding a carbon capture process reduces those other pollutants in certain cases. But Ospina argues that oil and gas companies can't be trusted to operate such projects in ways that reduce pollution to the levels necessary to protect neighboring communities.

'You need it'

Still, a variety of studies, from the state level to the global, conclude that CCS may play an essential role in cutting greenhouse-gas emissions fast enough to moderate the global dangers of climate change.

California is banking heavily on capturing carbon from plants or removing it from the air through various means to meet its 2045 climate neutrality goal, aiming for 20 million metric tons by 2030 and 100 million by midcentury. The Air Resources Board, the state's main climate regulator, declared that "there is no path to carbon neutrality without carbon removal and sequestration."

Recent reports from the UN's climate panel have also stressed that carbon capture could be a "critical mitigation option" for cutting emissions from cement and chemical production. The body's modeling study scenarios that limit global warming to 1.5 °C over preindustrial levels rely on significant levels of CCS, including tens to hundreds of billions of tons of carbon dioxide captured this century from plants that use biomatter to produce heat and electricity—a process known as BECCS.

Meeting global climate targets without carbon capture would require shutting down about a quarter of the world's fossil-fuel plants before they've reached the typical 50-year life span, the International Energy Agency notes. That's an expensive proposition, and one that owners, investors, industry trade groups, and even nations will fiercely resist.

"Everyone keeps coming to the same conclusion, which is that you need it," Friedmann says.

Lorelei Oviatt, director of the Kern County Planning and Natural Resources Department, declined to express an opinion about CRC's Elk Hills project while local regulators are reviewing it. But she strongly supports the development of CCS projects in general, describing it as a way to help her region restore lost tax revenue and jobs as "the state puts the area's oil companies out of business" through tighter regulations.

County officials have proposed the development of a more than 4,000-acre carbon management park, which could include hydrogen, steel, and biomass facilities with carbon-capture components. An economic analysis last year found that the campus and related activities could create more than 22,000 jobs, and generate more than $88 million in sales and property taxes for the economically challenged county and cities, under a high-end scenario.

Oviatt adds that embracing carbon capture may also allow the region to avoid the "stranded asset" problem, in which major employers are forced to shut down expensive power plants, refineries, and extraction wells that could otherwise continue operating for years to decades.

"We're the largest producer of oil in California and seventh in the country; we have trillions and trillions of dollars in infrastructure," she says. "The idea that all of that should just be abandoned does not seem like a thoughtful way to design an economy."

Carbon dioxide leaks

But critics fear that preserving it simply means creating new dangers for the disproportionately poor, unhealthy, and marginalized communities surrounding these projects.

In a 2022 letter to the EPA, the Center for Biological Diversity raised the possibility that the sequestered carbon dioxide could leak out of wells or pipelines, contributing to climate change and harming local residents.

These concerns are not without foundation.

In February 2020, Denbury Enterprises' Delta pipeline, which stretches more than 100 miles between Mississippi and Louisiana, ruptured and released more than 30,000 barrels' worth of compressed, liquid CO_2 gas near the town of Satartia, Mississippi.

The leak forced hundreds of people to evacuate their homes and sent dozens to local hospitals, some struggling to breathe and others unconscious and foaming at the mouth, as the *Huffington Post* detailed in an investigative piece. Some vehicles stopped running as well: the carbon dioxide in air displaced oxygen, which is essential to the combustion in combustion engines.

There have also been repeated carbon dioxide releases over the last two decades at an enhanced oil recovery project at the Salt Creek oil field in Wyoming. Starting in the late 1800s, a variety of operators have drilled, abandoned, sealed, and resealed thousands of wells at the site, with varying degrees of quality, reliability, and documentation, according to the Natural Resources Defense Council. A sustained leak in 2004 emitted 12,000 cubic feet of the gas per day, on average, while a 2016 release of carbon dioxide and methane forced a school near the field to relocate its classes for the remainder of the year.

Some fear that similar issues could arise at Elk Hills, which could become the nation's first carbon sequestration project developed in a depleted oil field. Companies have drilled and operated thousands of wells over decades at the site, many of which have sat idle and unplugged for years, according to a 2020 investigation by the *Los Angeles Times* and the Center for Public Integrity.

Ospina argues that CRC and county officials are asking the residents of Kern County to act as test subjects for unproven and possibly dangerous CCS use cases, compounding the health risks facing a region that is already exposed to too many.

Whether the Elk Hills project moves forward or not, the looming carbon storage boom will soon force many other areas to wrestle with similar issues. What remains to be seen is whether companies and regulators can adequately address community fears and demonstrate that the climate benefits promised in modeling studies will be delivered in reality.

Update: This story was updated to remove a photo that was not of the Elk Hills oil field and had been improperly captioned.

by James Temple

DEEP DIVE

United States Environmental Protection Agency

Public Comments Sought on Class VI UIC Injection Well Carbon Storage Draft Permits

Carbon TerraVault LLC, Class VI UIC Injection wells

R9UIC-CA6-FY22-1.1, R9UIC-CA6-FY22-1.2,

R9UIC-CA6-FY22-1.3, R9UIC-CA6-FY22-1.4 December 2023

You are invited

EPA will hold a public workshop and a formal public hearing on the Carbon TerraVault draft permits at:

Buttonwillow Recreation and Park District Recreation Center
556 Milo Avenue
Buttonwillow, CA 93296
February 28th, 2024
Public Workshop: 3 to 5 p.m.
Public Hearing: 6 to 9 p.m.

EPA and Kern County Planning and Natural Resources staff have scheduled three additional joint workshops during the public comment period.

The details of these events are listed below:

Workshop 1 - January 17, 2024; 3:00-5:00pm PST; virtual workshop via Microsoft Live Events. Instructions for participating in this workshop will be available by January 5, 2024 on the EPA Region 9 UIC website (see web resources below).

Workshop 2 - January 30, 2024; 6:00-9:00pm PST; in-person workshop at West Side Recreation and Park District Auditorium – 500 Cascade Place Building B Taft, CA 93268.

Workshop 3 - January 31, 2024; 6:00-9:00pm PST; in-person workshop at Buttonwillow Recreation and Park District Community Center – 556 Milo Avenue Buttonwillow, CA 93206.

Web resources

https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9

The U.S. Environmental Protection Agency (EPA) is accepting public comments starting December 20, 2023, until March 20, 2024, on its intent to issue four Class VI Underground Injection Control (UIC) permits to Carbon TerraVault JV Storage Company Sub 1, LLC (CTV) to inject and store carbon dioxide underground at its four proposed injection wells in the Elk Hills oil field in Kern County, CA. The process of injecting carbon dioxide into the subsurface for long-term underground storage is called "geologic sequestration" or "carbon sequestration." Carbon sequestration is one method of reducing emissions of carbon dioxide into the atmosphere.

CTV plans to inject 1.46 million metric tons of carbon dioxide annually into the four proposed wells over a 26-year injection period. CTV plans to source carbon dioxide initially from Lone Cypress, a proposed hydrogen plant, Elk Hills pre-combustion gas treatment, and the proposed Avnos direct air capture facility. CTV would capture the carbon dioxide from the generating facilities, transport it via pipeline within the Elk Hills field to the injection wells, pressurize the gas into a liquid-like state, and inject the carbon dioxide stream deep into the ground through the wells.

CTV selected the locations of the proposed wells based on its research and using site-specific data to ensure that the carbon dioxide would be safely stored in the proposed injection formation. The proposed injection formation is the Monterey Formation, which is about 6,000 feet below ground. Above the injection formation is the Reef Ridge Shale Formation, an approximately 1,000-foot-thick rock layer that would ensure the injection fluid does not migrate outside of the injection formation. CTV would monitor the wells during the 26-year injection period, and at least 50 years after injection ceases, or until a demonstration of non-endangerment to underground sources of drinking water has been approved by EPA.

How to comment

In addition to accepting oral statements at the public hearing, EPA will accept written comments until March 20, 2024. EPA encourages electronic submittal of comments online at www.regulations.gov (docket EPA-R09-OW-2024-0623).

Comments may also be sent by email to Elise Nord at Nord.Elise@epa.gov. For assistance, or if you are unable to submit comments electronically, please email Ms. Nord or call her at (415) 972-3079.

When submitting written comments, please refer to Carbon TerraVault JV Storage Company Sub 1, LLC , Permit Nos. R9UIC-CA6-FY22-1.1, R9UIC-CA6-FY22-1.2, R9UIC-CA6-FY22-1.3, and/or R9UIC-CA6-FY22-1.4.

How did EPA make its tentative decision?

In reviewing CTV's permit application, EPA evaluated technical information and project-specific data, such as:

- Advanced computational modeling to determine the maximum extent of the carbon dioxide plume and pressure front defining the proposed project area;
- A detailed study of the geology and the rock layers through which the proposed injection wells would be drilled to confirm that the carbon dioxide will stay where it is injected;
- The location of drinking water resources near the project and how they will be protected.
- The proposed construction design for the injection wells;
- The characteristics of the carbon dioxide to be injected;
- The proposed approach and technologies CTV would use to operate and monitor the project during and after injection;
- The financial resources CTV will have available to responsibly operate, monitor, and close the project; and
- CTV's approach to ensure that the project will protect underground sources of drinking water, public health, and the environment.

What happens next in the permit process?

After the close of the public comment period, EPA will review all comments before making a final decision on whether to grant the permits. The Agency will respond to all significant comments on the draft permits when EPA makes a final permit decision.

Information Repository

The draft permit, fact sheet, and public notice are available at:

Buttonwillow Branch Library
101 North Main Street
Buttonwillow, CA 93206
(661) 764-5337

Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, CA 93301

Administrative Record

The full administrative record, including all data submitted by Carbon TerraVault in support of its permit application, is available for public review at EPA's regional office. The office is open 8:30 a.m. – 4:30 p.m., weekdays. To review the administrative record or for additional information please contact Elise Nord at 415-972-3079 or Nord.Elise@epa.gov.

On the Web

For more information about the Carbon TerraVault 26R project and draft Class VI UIC Permits: https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9

Legal Notice

To preserve your right to appeal any final permit decision, you must either participate in the public hearing or send in written comments on the draft permit decision by the end of the comment period.

The first appeal must be made to the Environmental Appeals Board; only after all agency review procedures have been exhausted may you file an action in the appropriate Circuit Court of Appeals.

Technical background and details of CTV's carbon storage project

EPA's review of CTV's permit application determined that the proposed injection would comply with the UIC regulations under the Safe Drinking Water Act. Therefore, EPA proposes to issue permits for the four proposed injection wells. Title 40 of the Code of Federal Regulations (CFR), Parts 144 and 146, requires EPA permits for carbon dioxide storage, known as Class VI UIC permits, to specify conditions for the construction, operation, monitoring, reporting, plugging, post-injection site care, and site closure of Class VI injection wells. These conditions are designed to prevent the movement of fluids into any underground source of drinking water, or USDW. Refer to 40 CFR Parts 144 and 146 for the general provisions of underground injection permits. In accordance with 40 CFR 124.8, information on the permitted activity and permit conditions for the proposed wells is provided below.

Area of Review and Corrective Action: In accordance with 40 CFR 146.84, the Area of Review, or AoR, is the region surrounding the geologic sequestration project where USDWs may be endangered by the injection activity (e.g., if there are any improperly sealed, completed, or abandoned wells that penetrate the confining zone that could provide a conduit for fluid migration). The AoR for the four proposed wells is 3.7 square miles and was delineated pursuant to 40 CFR 146.84(c)(1) using a model that predicts the movement of the carbon dioxide plume and pressure front based on available information about planned injection operations and the subsurface rock formations. Refer to Figure 1 below.

Based on CTV's search of well records, there are 157 wellbores within the AoR that require plugging because the wellbores penetrate the injection zone or confining layer and will not be used for injection or monitoring for the proposed injection project. EPA will review the plugging and abandonment plans for the 157 wells and will require CTV to properly plug and abandon the wells before authorizing injection.

As required by 40 CFR 146.84(e), CTV would re-evaluate the AoR by assessing monitoring and operational data every five years over the duration of the project to verify that the carbon dioxide plume and pressure front are moving as predicted. If there are any significant changes from the modeled predictions, CTV must revise the project-specific plans described here, and EPA will modify the permit per 40 CFR 144.39.

Underground Sources of Drinking Water: USDWs are defined by federal regulations as aquifers or portions thereof which contain less than 10,000 milligrams per liter of total dissolved solids and are being used, or could be used, as a source of drinking water. The lowest geologic unit in the Area of Review that has the potential to be a USDW is the Upper Tulare formation, with an average depth of 502 feet below ground surface. Although preliminary data submitted by CTV suggest that the Upper Tulare in the AoR is not a USDW because it is unsaturated and does not contain water, the terms and conditions of the proposed permits are written to protect this formation as a USDW. Moreover, the permits would require CTV to confirm whether the Upper Tulare formation contains a USDW during pre-injection testing, so that its status could be documented and any identified USDW would be protected.

Injection and Confining Zone: Injection for geologic sequestration is limited by the draft permits to the Monterey Formation between approximately 4,800 and 7,800 feet below ground. This zone is separated from the lowest formation that could be a USDW on average by approximately 5,000 feet of rock, including an impermeable 1,000-foot-thick confining zone of shale that would act as a barrier to fluid movement. EPA has reviewed information provided by the permittee, including maps, well logs, cores, and the results of seismic surveys and determined that the regional and local geologic features at the site would allow the Monterey Formation to receive the amounts proposed to be injected without fracturing and that the confining zone would provide a suitable trap so that the carbon dioxide would remain in place and not endanger USDWs, as required under 40 CFR 146.83.

Construction Requirements: The proposed construction of the injection wells, which includes drilling three new wells and converting one existing Class II UIC well, meets the regulatory criteria at 40 CFR 146.86. All Class VI wells must be constructed with materials and cements that can withstand exposure to carbon dioxide and carbon dioxide/water mixtures over the life of the project. Class VI wells must also be cased and cemented to prevent the movement of fluids into or between USDWs. These wells would be equipped with an automatic surface shut-off system that would shut off the well if any permitted operating parameters—such as injection pressure—diverge from permit limitations. CTV may not commence construction, including drilling, of any new well until a final permit has been issued and is effective.

Injection Fluid: The injected fluid would be at least 99.2% pure carbon dioxide. The proposed initial emission sources of carbon dioxide for the project are the Lone Cypress hydrogen plant, Avnos Direct Air Capture facility, and Elk Hills oilfield pre-combustion gas treatment. The initial expected amount of carbon dioxide to be injected from these sources is 401,500 tons per year. CTV may propose for EPA review additional sources of carbon dioxide for injection, as outlined in the draft permit, up to the maximum proposed permit limit of 1.46 million tons per year for 26 years. EPA will review whether the chemical and physical characteristics of the carbon dioxide stream from any additional proposed source meet the permit requirements. EPA will also review whether injecting carbon dioxide from the additional source would alter the project or permit requirements and result in the need for a major permit modification. The public will be notified within 30 days of EPA receiving a request for analysis of an additional source. The public will also be

notified at least 30 days before CTV injects carbon dioxide from an EPA-approved additional source.

Maximum Injection Pressure: Consistent with 40 CFR 146.88(a), to ensure that the pressure during injection does not initiate fractures in the injection or confining zones, the maximum allowable downhole injection pressure would be limited to 3,847–4,294 pounds per square inch (psi). In turn, this ensures that the injection pressure would not cause the movement of injection or formation fluids into a USDW, as prohibited by 40 CFR 146.86(a).

Monitoring and Reporting Requirements: In accordance with 40 CFR 146.90, CTV would implement an EPA-approved Testing and Monitoring Plan. The permittee would analyze the carbon dioxide stream quarterly to provide information about its chemical and physical characteristics. CTV would also be required to demonstrate well integrity before injection begins and throughout injection operations. CTV would be required to conduct and pass a two-part mechanical integrity test, in accordance with 40 CFR 146.8 and 146.89, before EPA would authorize CTV to start injecting.

After injection begins, CTV would continuously observe and record injection pressure, flow rate and volume, and the pressure on the annulus (the space between casing and tubing) to detect leaks in the casing, tubing, or packer. In addition, CTV would annually demonstrate external mechanical integrity using a temperature or noise log or another approved method to detect any fluid movement behind the casing. CTV would test the injection wells for signs of corrosion every quarter to provide early indication of any well material corrosion due to contact with carbon dioxide in the presence of water that could compromise the well. CTV would also monitor the environment near the wells to verify that the project and the injected carbon dioxide plume are behaving as predicted and that carbon dioxide is not migrating outside the injection formation. CTV would perform groundwater quality monitoring in shallow and deep wells quarterly to detect geochemical changes that may be a result of injection—such as leaching or mobilization of heavy metals and organic compounds or fluid displacement that could impact USDWs. Pressure fall-off testing would be performed at least every five years to verify that the injection zone is responding to injection as predicted. CTV would also track the movement of the carbon dioxide plume and pressure front using direct methods such as fluid monitoring of the injection zone and USDWs and pressure monitoring of the injection zone, and indirect methods such as seismicity monitoring and pulse neutron logging of well bores to verify that the carbon dioxide plume and pressure front are moving as predicted or to provide early indication if they are not. In accordance with 40 CFR 144.54 and 146.91, CTV would submit results of this monitoring to EPA semiannually or within 30 days of the completion of a mechanical integrity test or other required testing. CTV would be required to continuously monitor surface air quality including broad aerial monitoring and targeted monitoring at wells. CTV would also be required to monitor and maintain equipment at the wells that can detect leakage of carbon dioxide.

CTV would be required to develop and maintain a publicly accessible website that will include a summary section that describes the data being presented, semi-annual reports, real-time monitoring data collected for surface air monitoring and leak detection, and notification of any permit non-compliance, including the steps taken to resolve the non-compliance, and any actions taken to prevent a re-occurrence of the non-compliance.

Emergency and Remedial Response: In accordance with 40 CFR 146.94, CTV developed a site-specific Emergency and Remedial Response Plan (ERRP) that identifies key resources, including Elk Hills oil and gas production resources not associated with the CTV I Elk Hills 26R Project, the Upper Tulare formation overlying the carbon dioxide plume, and the nearest census designated area of Valley Acres, located 3.6 miles from the AoR boundary. The ERRP, an enforceable part of the permit, describes the responses that would be taken to address adverse events, and identifies the staff, equipment, and other resources available to support emergency and remedial response events. The emergency and remedial response provisions of the permit would facilitate expeditious responses and prevent or mitigate harm to public health and the environment, including USDWs.

Financial Responsibility: In accordance with 40 CFR 146.85, CTV has demonstrated, and would maintain, adequate financial responsibility to perform all needed corrective action on wells in the AoR, to plug the injection wells, to perform all required post-injection site care, to close the site, and to conduct any needed emergency and remedial response measures. The total initial cost estimates for these activities to be covered by the approved financial assurance mechanisms is $33,672,785. CTV will use a letter of credit and a third-party insurance policy to cover costs and demonstrate financial responsibility. The permits require cost estimates for the covered activities to be updated annually. These provisions ensure that resources are available to perform these USDW-protective activities without using public funds.

Plugging and Abandonment: In accordance with 40 CFR 146.92, the draft permits include an Injection Well Plugging Plan for environmentally protective well plugging at the cessation of injection operations. The wells would be plugged using approved materials that are compatible with carbon dioxide/water mixtures to ensure that the wells would not serve as a conduit for fluid movement into USDWs.

Post-Injection Site Care and Site Closure: In accordance with 40 CFR 146.93, CTV would be required to implement an EPA-approved Post-Injection Site Care and Site Closure Plan. Following the cessation of injection, CTV would be

required to continue to monitor groundwater quality and track the position of the carbon dioxide plume and pressure front in a similar manner to what is described under "Monitoring and Reporting Requirements" above. This monitoring would help confirm predictions about the behavior of the carbon dioxide plume and pressure front (e.g., that pressures are subsiding after injection ceases) and provide early indication of any potential USDW endangerment. CTV would continue this post-injection monitoring for at least 50 years and until it demonstrates USDW non-endangerment based on monitoring and other site data. At the end of the 50-year period, if site data support it, EPA may authorize CTV to close the site. Following authorization to proceed with site-closure activities, CTV would plug all monitoring wells with carbon dioxide-compatible materials to ensure they cannot serve as conduits for fluid movement and would restore the site to its original condition.

Consideration of Environmental Justice: EPA is committed to incorporating environmental justice considerations into the Agency's core mission, which is to protect human health and the environment. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs federal agencies, to the greatest extent practical and permitted by law, to identify and address, as appropriate, disproportionate and adverse human health or environmental impacts on people of color and low-income populations. See Exec. Order No. 12898, 59 Fed. Reg. 7629 (Feb. 11, 1994). Recently, Executive Order 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All, supplemented this direction and included, among other things, consideration of "effects (including risks) and hazards… related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns." See Exec. Order No. 14096, 88 Fed. Reg. 25251 (Apr. 21, 2023). It is against this backdrop that EPA has integrated environmental justice into the UIC Class VI permitting program.

As part of the decision-making process for the permit, EPA considered the above-referenced executive orders and EPA's Environmental Justice Guidance for UIC Class VI Permitting and Primacy (Aug. 17, 2023), which includes, among other things:

- Identifying communities potentially adversely and disproportionately affected by human health, environmental, climate-related, and/or other cumulative harms or risks – that is, affected communities with potential environmental justice concerns; and
- Ensuring fairness and transparency in the decision-making process – that is, allowing for meaningful involvement by communities.

EPA and CTV conducted separate environmental justice screenings to identify possible adverse impacts to communities with environmental justice concerns and opportunities for increased meaningful involvement. EPA's "EJScreen" analysis for the proposed CTV I 26R project used an 8-mile buffer beyond the AoR to incorporate census population data from the communities closest to the project, since there are no communities within the 3.7-square mile AoR. The EJScreen results from this expanded geographic analysis showed seven environmental justice indices above the 80th percentile for the United States, which highlights the potential vulnerability of nearby communities located outside the AoR and the importance of protective permit requirements and a robust outreach and public comment process. For this proposed permit, EPA is providing an extended public comment period of 90 days and multiple opportunities for public engagement through public workshops in advance of the public hearing.

The permit has several safeguards in place to prevent any adverse impacts to public health and the environment, including USDWs, from all injection-related activities throughout the lifetime of the project. For example, the permit requires CTV to run an EJScreen analysis when there is an update to the AoR, provide analysis of proposed additional carbon dioxide sources and their impact to the communities in the area they are located, notify the public of any proposed new carbon dioxide source, notify the public at least 30 days before injecting carbon dioxide from an additional source, create a public website containing monitoring data, and gather real-time monitoring data of carbon dioxide levels in the air within the AoR. Furthermore, if the gas stream of a new carbon dioxide source meets certain criteria, the permit provides that the EPA could require that its injection be subject to the "major" modification requirements of 40 CFR 124, which would trigger public notice and comment provisions.

In addition to EPA's environmental justice efforts thus far, the permit applicant has also conducted community outreach and engagement, which is documented in the CTV I Community Engagement Summary, dated October 20, 2023. EPA's EJScreen analysis and the CTV I Community Engagement Summary are included in the permit application materials and can be found on regulations.gov under docket number EPA-R09-OW-2024-0623.

Compliance with other Federal Statutes: As part of the permit process, pursuant to 40 CFR 144.4, EPA is required to consider other Federal laws, including Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA).

Endangered Species Act

The ESA and its implementing regulations require EPA to ensure that any action it authorizes does not jeopardize the continued existence of any endangered or threatened (i.e., listed) species or adversely affect their critical habitat. After

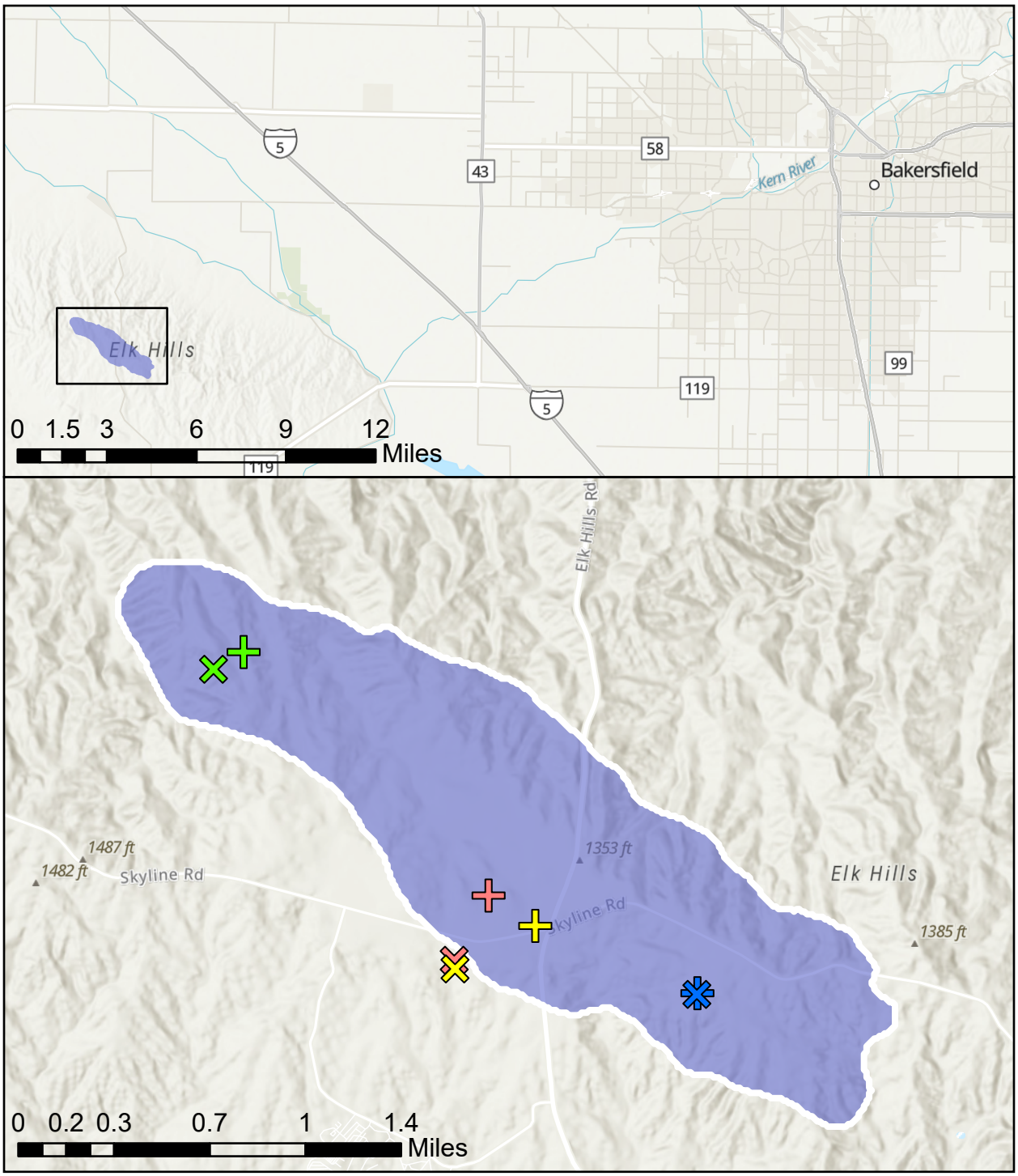
reviewing the best available science, EPA determined that CTV's proposed project may affect, but is not likely to adversely affect, four listed species that could occur in areas potentially impacted by the project. EPA is informally consulting with the U.S. Fish and Wildlife Service on this determination.

National Historic Preservation Act

The NHPA and its implementing regulations require EPA to consider the effects of its undertakings on historic properties. Because issuance of a UIC permit is a federal undertaking, EPA is consulting with the California State Historic Preservation Office (SHPO). As part of that effort, EPA provided the SHPO with a description of the project, the area of potential effect, and the steps taken to identify historic properties. EPA proposed to the SHPO a finding that no historic properties would be affected by this undertaking.

Issuance and Effective Date of Permit: In accordance with 40 CFR 124.15, the permits would become effective immediately upon issuance if no public comments are received that requested a change in the draft permits. However, if EPA receives public comments and decides to issue final permits, then the permits would become effective 45 days after the date of issuance unless the permits are appealed. In accordance with 40 CFR 144.36(a), the permits would be in effect for the duration of the project unless they are otherwise modified, revoked and reissued, or terminated as provided at 40 CFR 144.39, 144.40, and 144.41. The permits would expire in one year if CTV does not commence construction unless EPA approves a written request for an extension of this one-year period. Authorization to inject under the permits may be granted following well construction and compliance with additional requirements as outlined in the permits and regulations at 40 CFR 146.82, 146.86, 146.87, and 146.89.

Figure 1. Area of Review



PUBLIC NOTICE OF INTENT TO ISSUE A CLASS VI UNDERGROUND INJECTION CONTROL PERMIT FOR

Carbon TerraVault JV Storage Company Sub 1, LLC

Elk Hills, California

Comment period through March 20, 2024

Spanish language translation of this public notice is available at https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9.

La traducción al español del aviso público está disponible en https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9.

For assistance in other languages, please e-mail Elise Nord at Nord.Elise@epa.gov or call (415) 972-3079.

PURPOSE OF PUBLIC NOTICE

The United States Environmental Protection Agency, Region 9, Groundwater Protection Section, 75 Hawthorne Street, San Francisco, California 94105 (EPA) is providing an opportunity for the public to comment on its proposal to issue four (4) Class VI Underground Injection Control (UIC) permits for Carbon TerraVault JV Storage Company Sub 1, LLC (CTV) to construct and operate injection wells for geologic sequestration of carbon dioxide. The proposed injection wells will be located within the Elk Hills Oil Field approximately 20 miles west of Bakersfield, California. The locations of the wells are included in Table 1.

Table 1: Well Names and locations

Well Name	UIC Permit No.	Location (Lat/Long)
373-35R	R9UIC-CA6-FY22-1.1	35°16’34.5276”N 119°28’24.1836”W
345C-36R	R9UIC-CA6-FY22-1.2	35°16’30.3383”N 119°27’27.7825”W
353XC-35R	R9UIC-CA6-FY22-1.3	35°16’36.1768”N 119°28’24.4060”W
363C-27R	R9UIC-CA6-FY22-1.4	35°17’31.0601”N 119°29’21.4525”W

Class VI wells are used to inject carbon dioxide for long-term underground storage. One (1) of the proposed injection wells (UIC Permit No. R9UIC-CA6-FY22-1.1) is an existing Class II UIC well that CTV would convert to a Class VI UIC well. The other three (3) proposed wells (UIC Permit Nos. R9UIC-CA6-FY22-1.2, R9UIC-CA6-FY22-1.3, R9UIC-CA6-FY22-1.4) would be newly drilled and constructed Class VI UIC wells. The permit would authorize injection of carbon dioxide into the proposed injection wells at a depth of approximately 6,000 feet. After completing a thorough technical review of all information submitted by CTV in its permit application, as well as the operational standards, monitoring requirements, and existing geologic setting, EPA has determined that the activities authorized under the Draft Class VI UIC permits (“Draft Permits”) are protective of underground sources of drinking water as required by the Safe Drinking Water Act (SDWA).

PUBLIC COMMENTS

EPA requests public comment on the Draft UIC Permits and will accept comments in writing through the end of the comment period on March 20, 2024 (40 CFR § 124.10). During this period, EPA encourages the electronic submittal of comments online at www.regulations.gov under docket number EPA-R09-OW-2023-0623. You may also submit comments by email to Elise Nord at the email address listed above. If you are unable to submit comments electronically, or if you have any questions or require assistance submitting comments, please reach out to Ms. Nord at the phone number above.

PUBLIC WORKSHOPS

EPA and Kern County Planning and Natural Resources staff have scheduled four joint workshops during the public comment period for the Draft UIC Permits. These workshops are open to the public. The agencies will present information about EPA's UIC permitting process, the proposed UIC permits, and Kern County's draft Environmental Impact Report. All sessions will have Spanish language interpretation available.

If you are an individual with disabilities requiring a reasonable accommodation at no cost or if you need interpretation services in a language other than English, or necessitate assistance in sign language, please contact Ms. Nord by email or phone so we can make the necessary arrangements.

The public workshops will be at the following times and locations:

- January 17, 2024; 3:00-5:00pm PST; virtual workshop via Microsoft Live Events. Instructions for participating in this workshop will be available by January 5, 2024 on the EPA Region 9 UIC website at https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9
- January 30, 2024; 6:00-9:00pm PST; in-person workshop at West Side Recreation and Park District Auditorium – 500 Cascade Place Building B Taft, CA 93268.
- January 31, 2024; 6:00-9:00pm PST; in-person workshop at Buttonwillow Recreation and Park District Community Center – 556 Milo Avenue Buttonwillow, CA 93206.
- February 28, 2024; 3:00-5:00pm PST; in-person workshop at Buttonwillow Recreation and Park District Community Center – 556 Milo Avenue Buttonwillow, CA 93206. NOTE: at the end of this workshop, EPA will conduct a public hearing for the Draft Permits as described below.

PUBLIC HEARING

In addition to the four joint workshops with Kern County, EPA will hold an in-person public hearing for the Draft UIC Permits. The public hearing will be held on February 28, 2024, from 6:00pm to 9:00pm PST at the Buttonwillow Recreation and Park District Community Center, located at 556 Milo Avenue Buttonwillow, CA 93206.

At the hearing you can provide oral statements regarding the Draft UIC Permits, and those statements will become part of the administrative record. EPA will provide individuals up to 2 minutes for comments to allow sufficient time for all commenters and may provide additional time depending upon the number of interested commenters. Please note that written and oral comments are treated the same by EPA in our public process.

We encourage those who wish to provide oral comments at the public hearing to pre-register at: https://projects.erg.com/conferences/epa/register-elkshills.asp; however, pre-registration is not

required to provide comments at the hearing. Spanish interpretation services will be available at the hearing.

Commenters who want to supply written or other materials may do so via the online docket, following the public comment procedures outlined above. Any supporting materials for oral statements will be accepted via the online docket through the close of the comment period on March 20, 2024. In accordance with 40 CFR § 124.12(d), the hearing will be transcribed and made available to the public.

SUPPORTING MATERIALS

All data submitted by the applicant is available as part of the administrative record for the Draft Permits. This Notice, EPA's Fact Sheet, the Draft Permits, CTV's permit application, and other supporting documents are available for public review online at www.regulations.gov under docket number EPA-R09-OW-2023-0623.

These materials may also be accessed through the following web address - https://www.epa.gov/uic/uic-permits-epas-pacific-southwest-region-9

Hard copies of the Public Notice, Fact Sheet, and Draft Permits are also publicly available at the following locations:

Buttonwillow Branch Library
101 North Main Street
Buttonwillow, CA 93206
(661) 764-5337

Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, CA 93301
(661) 862-8600

If you have any difficulty accessing the supporting materials, please contact Ms. Nord at the telephone number or email address listed above for assistance.

FINAL PERMIT DECISION AND APPEALS PROCESS

After the close of the public comment period, EPA will respond to all significant comments, issue final permit decisions pursuant to 40 CFR § 124.15(a), and notify all commenters of the Agency's decisions. EPA will post its response to comments on www.regulations.gov under docket number EPA-R09-OW-2023-0623. The response to comments will contain a response to all significant comments on the Draft Permits, EPA's final permitting decisions, any permit conditions that are changed and the reasons for the changes, and procedures for appealing the decisions. The final decision shall be to either issue or deny the Permits. Each final decision shall become effective no sooner than thirty (30) days after the service of the notice of decision (40 CFR § 124.15). Within thirty (30) days after the final permit decisions have been issued, any person who filed comments on the Draft Permits, participated in any public hearing on this matter, or takes issue with any changes in the Draft Permits, may petition the Environmental Appeals Board to review any condition of the permit decisions. Commenters are referred to 40 CFR § 124.19 for the procedural requirements of the permit appeal process. If no comments request a change

in the Draft Permits, EPA's final decisions shall become effective immediately upon issuance unless a later date is specified in the notice of final decision (40 CFR § 124.15).

Via Email to EPA Region 9

June 17, 2024

David Albright
Manager, Groundwater Protection Section
U.S. Environmental Protection Agency, Region 9 (WTR-4-2)
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3971

Mr. Albright,

I am writing regarding the four (4) California Resources Corporation ("CRC") proposed 26R Class VI Underground Injection Control ("UIC") permits for geologic sequestration of carbon dioxide ("CO_2") at the Elk Hills Oil Field ("Elk Hills") in Kern County, California.[1]

The purpose of this letter is to inform you that at this time the Lone Cypress Energy Services hydrogen and Avnos Direct Air Capture facilities are unlikely to be initial sources of CO_2 associated with the 26R UIC permits. CRC has been was notified by Lone Cypress that it is reassessing the hydrogen project. As part of this reassessment, Lone Cypress notified Kern County on May 10, 2024 that it was withdrawing its applications for Conditional Use Permits. *See* Attachment. In addition, to-date, CRC has yet to enter into any commercial agreement with Avnos to source CO_2 from a direct air capture facility and at this point we do not expect to source CO_2 from any Avnos facility in the short-term.

Given Lone Cypress and Avnos are identified in the public noticed draft 26R UIC permits as initial CO_2 onsite emission sources, we wanted to notify you of this development. The Elk Hills field gas will continue to be the initial CO_2 onsite emission source and we do not expect that this development will impact the final issuance of the 26R UIC Permits. If Lone Cypress and/or Avnos proceed to a point where the projects may again be CO_2 emissions sources for the 26R UIC permits, CRC expects to proceed under the expected Section N framework in the draft 26R UIC permits for the "Injection of Carbon Dioxide from Additional Sources," as with any other potential future sources of CO_2 emissions. While this development is disappointing in the short-term, we are hopeful these projects may proceed in the future. Additionally, even if

[1] Permit Nos. R9UIC-CA6-FY22-1.1, R9UIC-CA6-FY22-1.2, R9UIC-CA6 FY221.3, R9UIC-CA6-FY22-1.4.

the Lone Cypress and/or Avnos project does not proceed, CRC expects that over time sources of CO_2 for the 26R UIC permits will likely include hydrogen and direct air capture facilities (among other potential future sources of CO_2).

If you have any questions related to this development, please reach out to me at travis.hurst@crc.com.

Sincerely,

T Hurst

Travis Hurst

Attachment (1): Letter from Lone Cypress to Kern County (May 10, 2024)

cc: Elise Nord, U.S. Environmental Protection Agency, Region 9
Chris Gould, California Resources Corporation
Eric Miner, California Resources Corporation

THE SLICK

Will California's Largest Oil Well Owner Get a Pass on Paying to Clean Up Its Mess?

A new state law mandates that oil companies put up money to plug wells before acquiring them. It could fail its first big test, putting taxpayers on the hook.

Published on June 18, 2024
By **Aaron Cantú**

A pumpjack operated by Aera Energy in the Belridge Oil Field in Kern County, California. All photos by Aaron Cantú.

In recent years, California has passed new laws to tackle the enormously expensive remediation of old oil wells, which pose hazards for human health and the climate. But as two of the state's largest oil well operators race toward a corporate merger, the challenge of holding companies accountable for their mess is coming into view.

Gov. Gavin Newsom signed one of the state's toughest regulations last fall: a law requiring companies that buy or acquire another operator's oil wells to put up the money to plug them once they run dry. But California Resources Corporation — which plans to acquire Aera Energy — is refusing to say whether it has complied, or will comply.

California Resources Corporation did not respond to inquiries for this story.

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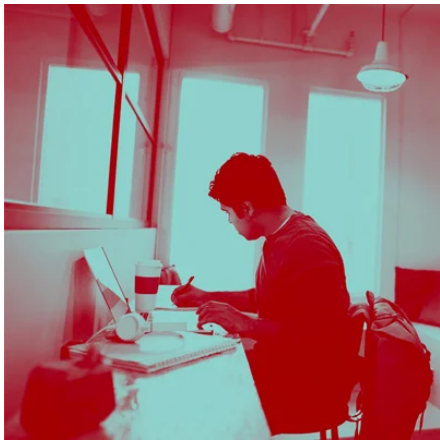

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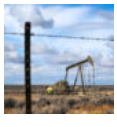

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In emails with the regulator, the company stated there would be “no change in the organizational structure” of Aera, which operates the wells California Resources Corporation wants to acquire.

The law states that the acquisition cannot be completed until the state calculates the size of the bond that the operator must secure. The law is also clear that operators such as California Resources Corporation must ask the state to begin calculating the size of the bond, which the company does not appear to have done, said Ann Alexander, director of Energy Solutions, Nature at the Natural Resources Defense Council, which advocated for the law.

Insufficient bonds could ultimately cost taxpayers billions when it comes time to plug the oil wells that will be in California Resources Corporation’s portfolio after the planned merger.

Given that the proposed merger is set for a June 26 shareholders vote — one of the main conditions for the transaction — it is “quite unlikely” California Resources Corporation has requested bond estimates from the state, Alexander said.

“There are a really large number of wells here,” Alexander said. Estimating the bond amounts for the thousands of wells is “a process that’s going to take a significant amount of time” — likely a few months.

Meanwhile, the California Geologic Energy Management Division, the state agency that oversees the 100,000 or so active and idle wells that dot California’s landscape, declined to say whether the company requested a bond amount or communicated about the bonding requirements at all.

Insufficient bonds could ultimately cost taxpayers billions when it comes time to plug the roughly 37,000 wells that will be in the company’s portfolio after the planned merger.

The bonding requirement law mandates that before any acquisition of wells, a company must put up enough money to ensure that low-producing oil wells are plugged. Plugging the wells is necessary to prevent climate-warming methane gas from escaping into the atmosphere. Fossil fuels such as methane are the main driver of the ongoing climate crisis.

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Aera Energy equipment in the Belridge Oil Field in Kern County.

In filings with the Securities and Exchange Commission, California Resources Corporation estimated that after acquiring Aera, its long-term financial obligations for plugging its old wells and decommissioning related equipment would amount to $1 billion.

But that's likely billions less than it will actually cost.

The Sierra Club last year estimated that the cost to clean up just the portion of California Resources Corporation's and Aera's wells that are no longer in production would cost $3.5 billion. If the active wells were included too, the cost would be billions more.

"It's quite frustrating to those of us who have worked very hard to try and help California dig out of the colossal mess that it is in" with unplugged wells, said Alexander.

The law arrived last year as Assembly Bill 1167, introduced by Assemblymember Wendy Carrillo (D-Los Angeles), who saw it as a way to put the financial burden of ending the lives of old oil wells on the operators, not the taxpayers.

The vast majority of the oil wells in California are low producing, meaning that they are nearing the end of their lives and will soon need to be plugged.

In a letter to the California Geologic Energy Management Division, Carrillo and other lawmakers urged regulators to enforce the law, saying it presented an opportunity to ensure companies do not foist the costs of capping idle and marginal wells onto taxpayers.

"This merger is precisely the sort of transaction that AB 1167 was designed to address," the letter states.

Carrillo's staff declined to make her available for an interview, instead directing questions to the Natural Resources Defense Council, and emailing a statement.

In a text message forwarded by a staffer, Carrillo said nobody "knows for certain at the moment what CalGEM's plans are as to enforcing AB 1167 in this merger. But the magnitude of the risk the merger creates for California and its taxpayers makes it critical in my view that CalGEM reassure the public that they intend to enforce the law."

The law states that any entity that "acquires the right to operate" a low-producing or idle well must put up a bond before completing the acquisition. The law states that the state oil and gas supervisor, not the oil operator, will calculate the amount of the bond. The bill also states that the acquisition cannot be completed until the state calculates the size of the bond that the operator must secure.

The vast majority of the oil wells in California, including those owned by California Resources Corporation and Aera, are low producing, meaning that they are nearing the end of their lives and will soon need to be plugged. A low-producing well is defined as one that produces 15 or few barrels of oil a day. Aera's active wells produce, on average, just enough to fill the tanks of 10 cars.

Asked by Capital & Main whether the agency believes AB 1167 applies in the California Resources Corporation and Aera merger, Jacob Roper, a spokesman for the California Department of Conservation, said that the agency issued regulatory guidelines to all oil companies in the state before the law went into effect.

He repeated that the law states "to the extent that wells or facilities are transferred between entities, the law puts the responsibility on operators to notify the Department of Conservation and request a cost estimate if AB 1167 applies."

Roper would not say whether AB 1167 would apply to California Resources Corporation's merger with Aera, or if California Resources Corporation had requested a bond estimate. "That's all we have to share at this time," he said.

If the merger with Aera Energy goes through, California Resources Corporation will own roughly 40% of all unplugged oil wells in California.

California Resources Corporation did not respond to inquiries for this story. But in a February email to regulators, obtained by Capital & Main, the company said, "There will be no change in the organizational structure of Aera Energy LLC or its operating subsidiaries as a result of this transaction."

After the merger, Aera would remain the operator of its wells even though it would be owned by California Resources Corporation. The latter argues that no wells are actually changing hands.

Climate activists worry that the sheer size of the merger could be a significant problem as well if the state doesn't force California Resources Corporation to put up a bond big enough to cover cleanup costs.

If the merger goes through, the company will own roughly 40% of all unplugged oil wells in California, many in the lower Central Valley. By wide margins, it would be the largest oil well owner in California.

Were the firm to cease operations without adequate bond protection, the burden could fall to taxpayers — and industry watchers say the company has a concerning track record in this regard.

Pumpjacks operated by Aera Energy in the Belridge Oil Field in Kern County.

California Resources Corporation filed for bankruptcy in 2020, allowing it to wipe $4.4 billion in debt from its books. The company was saddled with the debt after it was spun off from Occidental Petroleum, which left the state years ago without plugging its old wells.

Alexander, the Natural Resources Defense Council director, said the merger would result in putting "a colossal number of eggs in the same basket. This is creating an entity that is too big to fail," meaning if it did fail and there was not a bond big enough to pay for cleanup, the financial fallout for the public could be immense.

During a meeting with shareholders in February announcing the merger, California Resources Corporation CEO and President Francisco Leon said the merger would "more than double" the company's cash after operating expenses.

The No. 1 priority of that increased cash flow, he said, will be "to enhance shareholder returns." Yet across California's oil and gas producing industry, most of the remaining proceeds from production will be earned before 2026, after which "the liability of taxpayers will be that much greater," according to a report by the Carbon Tracker Initiative, a London-based think tank.

Even if every dollar generated by oil companies in California was squirreled away to pay for cleanup, it is unlikely the industry "will generate enough cash flow in its remaining economic life to fund its current decommissioning obligations," Carbon Tracker found.

As of December, those obligations for all oil and gas producers statewide totaled $22.9 billion.

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All photos by Aaron Cantú.

This story has been updated to include a statement from Assemblymember Wendy Carrillo.

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UP NEXT

As CRC Prepares to Buy Aera, New Law to Stem Orphan Wells Faces its First Test

The deal would place 40 percent of California's idle wells in the hands of one operator. Campaigners warn this poses an "immense" risk to the state — which new rules could help to mitigate, depending on how regulators act.

By **Joe Fassler (https://www.desmog.com/user/joe-fassler/)** on Mar 18, 2024 @ 13:25 PDT
10 min read

Oil rigs in Kern County, California, where Aera Energy owns thousands of idle and other low-performing oil wells. Credit: ***Bureau of Land Management California (https://www.flickr.com/photos/50976304@N07/36012072955), (PDM 1.0 DEED) (https://creativecommons.org/publicdomain/mark/1.0/)***

Last month, the California Resources Corporation (CRC), already the largest gas producer in the Golden State, **announced (https://www.crc.com/news/news-details/2024/California-Resources-Corporation-to-Combine-with-Aera-Energy/default.aspx)** a plan to get even bigger: It would acquire competitor Aera Energy, California's second-largest oil producer behind Chevron. Both companies already operate thousands of extraction sites in California, and their successful merger would make CRC the state's largest oil and gas producer by an overwhelming margin.

At a time when the U.S. oil and gas industry is **rapidly consolidating (https://finance.yahoo.com/news/oil-gas-industry-undergoing-biggest-043646850.html#:~:text=The%20oil%20and%20gas%20industry%20is%20undergoing%20its%20biggest%2Dever%20consolidation,-Filip%20De%20Mott&text=near%20WinkReuters-,The%20oil%20and%20gas%20industry%20is%20undergoing%20its%20biggest%2Dever,f**, in an effort to unlock new economies of scale, investors took the merger's announcement as a positive development and CRC's **stock price jumped (https://news.bloomberglaw.com/mergers-and-acquisitions/california-resources-to-buy-aera-energy-in-2-1-billion-deal)**. But what has received much less attention so far is the fact that this merger likely will put to the test a new state law that aims to hold oil and gas producers accountable for idle wells, sites that haven't been used for production for 24 consecutive months.

If successful, the merger would make CRC by far the state's largest holder of idle oil and gas wells, which can pose ongoing environmental hazards, often **continuing to leak methane (https://pubs.acs.org/doi/10.1021/acs.est.0c05279)** and other pollutants like **benzene (https://pubs.acs.org/doi/10.1021/acsomega.3c00676)** and **lead (http://www.leginfo.ca.gov/pub/15-16/bill/asm/ab_2701-2750/ab_2729_cfa_20160331_163551_asm_comm.html)**. Today, CRC and Aera are responsible for more than 15,000 of the state's roughly 40,000 idle wells, according to data from California's Geologic Energy Management Division (CalGEM). The merger would put California in uncharted territory, placing 40 percent of the state's idle wells under the control of a single entity.

"The big risk here is that the merger between Aera and CRC would create an operator that is too big to fail," said Kyle Ferrar, western program director at FracTracker Alliance, a nonprofit that analyzes data on oil and gas development hazards. If it *did* fail, he said, and if California were then forced to bear the cost of plugging all of those wells on its own, "the consequences for the state's budget would be immense."

It costs about $111,000 on average to decommission a well in California, **according (https://lao.ca.gov/Publications/Report/4508)** to CalGEM, an obligation that typically falls to the state when companies can't pay. But California recently took action to keep industry on the hook: AB 1167, which was **signed into law (https://www.gov.ca.gov/wp-content/uploads/2023/10/AB-1167-Signing.pdf)** in October, requires companies to issue a bond big enough to cover the full cost of closing down any low-producing wells they acquire, including idle wells. The new rules went into effect on Jan 1, and CRC's merger with Aera would seem to fall squarely within their scope.

"The state of California must immediately jump in before allowing this transaction to be final and require California Resources to put up the hundreds of millions of dollars in bonding needed to acquire Aera's wells so that consumers are not left holding the bag on their eventual plugging," **said (https://www.prnewswire.com/news-releases/crc-play-to-buy-aera-is-way-to-avoid-plugging-idle-wells-extending-life-of-depleted-oil-fields-via-unproven-technology-say-consumer-watchdog-and-fracktracker-alliance-302056774.html)** Liza Tucker, a consumer advocate with the nonprofit public advocacy group Consumer Watchdog, in a press release responding to news of the deal.

Jasmine Vazin, a senior campaign officer at the Sierra Club who recently co-authored a report on **the looming expense of idle well cleanup (https://www.desmog.com/2024/02/06/wspa-cipa-oil-idle-wells-ab2729-california/)** in California, said she feared the cost of shutting down tens of thousands of wells could be more than a company like CRC can sustain. The fact that CRC emerged from bankruptcy just three years ago, she said, raises questions about how prepared it is "to be taking on such a huge liability for cleanup."

A DeSmog analysis of data provided by FracTracker Alliance found that AB 1167 should trigger a bonding requirement even larger than what has been publicly discussed: Over $1 billion, a historic amount that would give California much more security while it waits for Aera to close its thousands of idle (and soon-to-be idle) wells. But the new law has only been on the books for a few months, and it hasn't been enforced before. CalGEM, the division of California's Department of Conservation responsible for reviewing the merger, has not yet signaled whether it will apply the new law to CRC's attempt to buy Aera, despite mounting questions. And some advocates are already expressing concern about how this first test of AB 1167 will play out.

Oilfields in Kern County, California, where Aera Energy owns thousands of idle wells. A merger with CRC would put an unprecedented number of low-performing wells in the hands of one operator. Credit: ***Bureau of Land Management California***

(https://www.flickr.com/photos/blmcalifornia/48080292657/in/album-72157680760359061/) (PDM 1.0 DEED) (https://creativecommons.org/publicdomain/mark/1.0/)

A Billion-Dollar Bond

For decades, the law has been clear: Oil and gas producers are required to close down their defunct wells in California. But full remediation — which includes plugging deep boreholes with concrete and fully decommissioning all above-ground equipment — is incredibly expensive, and companies have long found ways to avoid it.

Even under ideal circumstances, decommissioning costs stack up quickly. CalGEM **estimates (https://www.conservation.ca.gov/calgem/Documents/Idle%20Well%20Program%20Report%20for%202021.pdf)** that it costs $87,000 to shutter a well in what it calls the Central district, which **is made up of (https://gis.data.ca.gov/datasets/cadoc::calgem-district-boundaries/explore?location=36.285773%2C-119.198685%2C8.00)** four inland counties west of the Sierra Nevada mountains (Fresno, Kern, Kings, and Tulare), and includes the sprawling oil-producing regions near Bakersfield. The process is much more expensive elsewhere in the state. In a recent earnings call, CRC CEO Francisco Leon **said (https://finance.yahoo.com/news/california-resources-corporation-nyse-crc-141256258.html)** the company had spent $2 million to shut down six wells and related infrastructure. CalGEM estimates that the cost for closing down a single well in California's population-dense southern district — which includes Los Angeles, San Diego, and Orange counties — is close to $1 million.

Operators often buckle under the weight of this obligation. There are currently 5,000 "orphan" wells, or idle wells without a financially solvent operator, in California, **according (https://www.desmog.com/2024/02/06/wspa-cipa-oil-idle-wells-ab2729-california/)** to a Sierra Club analysis of CalGEM data. When that happens, taxpayers end up footing the bill. California **budgeted $100 million over the past two years (https://www.conservation.ca.gov/calgem/Documents/state_abandonment_expenditure_final.pdf)** for plugging wells that companies should have closed down, but didn't.

Though the state has long required operators to bond their wells as a form of financial assurance, a "blanket bond" provision has allowed companies to meet their obligation at a fraction of the cost. Industry lobbied aggressively to put these permissive rules in place, as DeSmog has previously **reported (https://www.desmog.com/2024/02/06/wspa-cipa-oil-idle-wells-ab2729-california/)**. For comparison, California currently holds only a $3 million bond for Aera — which would give the state just a few hundred dollars per well to work with if Aera ever became insolvent.

Lawmakers passed AB 1167 to address this situation, helping to prevent aging wells from transferring into the hands of entities that can't afford to close them. Under the new rules, which took effect January 1, any company that takes control of a well producing less than 15 barrels of oil or 60,000 cubic feet of natural gas per day must file a bond with the state large enough to cover the full amount of plugging, decommissioning, and site restoration. In a major shift, there is no blanket exemption; each individual well must be bonded at an amount equal to the full cost of its remediation. That requirement provides California with a strong financial guarantee — one environmental advocacy groups say is urgently needed in the case of CRC's merger with Aera.

"This is a consolidation of a really large number of wells in the hands of one operator," said Ann Alexander, director of energy solutions at the Natural Resources Defense Council. "The proposal is to put a whole lot of eggs in the CRC basket. That creates a risk."

CRC's merger with Aera stands to be the first major merger and acquisition activity since AB 1167 took effect, and Alexander, who helped to craft the language in the bill and lobbied for its passage, insisted that the new rules would be relevant. "From all appearances to us, this is a situation where 1167 is intended to and does apply," she said. Hollin Kretzmann, a legal analyst for the Center for Biological Diversity, agreed, writing by email that he was confident the merger would trigger the individual bonding requirement.

Any straightforward application of the rules would have huge implications, given the sheer number of wells that stand to change hands. CalGEM data pulled by FracTracker Alliance and provided to DeSmog for analysis showed that a huge number of Aera wells would require bonding in the event of a merger: nearly 15,000 were idle or produced less than 15 barrels per day in 2022. By applying CalGEM's standard cost estimates per district, DeSmog found it would cost over $1.3 billion to plug all those wells.

Full CalGEM data for 2023 is not yet available. But it appears that any bonding mandate triggered by CRC's merger with Aera should be well over a billion dollars, even assuming that Aera has closed hundreds of wells since 2022. In a January 25 email, Aera spokesperson Kimberly Ellis told DeSmog that it had planned to close 950 wells in 2023, though she declined to say if that goal had been achieved. Even if Aera managed to exceed its goal and close 1,000 wells last year, it would only have lowered the overall bonding requirement by about $90 million to approximately $1.2 billion.

For context, CRC reported about $400 million in free cash flow in 2023. A $1.2 billion bond — a big sum, even for an oil company — could easily tie up three years' profit. Aera's entire operation was only valued at $2.1 billion under the terms of the proposed merger.

DeSmog sent detailed questions to both California Resources Corporation and Aera Energy. Aera Energy declined to comment and California Resources Corporation did not respond by press time.

"The staggering cost to plug and abandon these wells is exactly why we pushed for AB 1167," Alexander said. "It created a means to make sure that cost doesn't land on taxpayers after a transfer. Now we just need CalGEM to enforce it."

"We have to put some kind of brakes on this slow-moving crisis, and we are now presented with a very significant opportunity to do that," said NRDC's Ann Alexander.

"No evidence the law has been complied with yet"

As California enters a new era of flagging production and more stringent regulations — what Reuters has **called (https://www.reuters.com/sustainability/climate-energy/california-big-oil-are-splitting-after-century-long-affair-2024-01-29/#:~:text=Jan%2029%20(Reuters)%20%2D%20It,its%20fight%20against%20climate%20change.)** "the end of an era" — the question of who will pay to close down spent wells has taken on new urgency. All of the state's oil wells will need to be closed eventually, which will cost between $13.2 to $21.5 billion, according to **a 2023 Carbon Tracker report (https://carbontracker.org/reports/there-will-be-blood/)**. The same report found that extracting every drop of oil left in California would only generate about $6 billion in revenues for the state's oil industry, proof that liabilities are quickly outpacing profits. That's left some concerned that the industry won't clean up its mess because it simply can't afford to.

"It would be pure fantasy to expect California's oil industry, whose in-state production peaked in the 1980s and has been declining for years, to voluntarily fulfill all of its cleanup obligations, because it won't even make enough money to pay for it," the Los Angeles Times' editorial board **wrote (https://www.latimes.com/opinion/story/2023-06-05/la-ed-oil-cleanup-costs-california-billions)** in 2023. "Without swift and dramatic changes, much of the cleanup costs will fall to taxpayers."

A billion-dollar bond for Aera's wells would be a huge boon for California as it struggles to rein in rising costs related to well cleanup. Though CalGEM has been allowed to obtain a maximum $30 million blanket bond from the state's largest operators since 2019, that amount comes nowhere close to covering the full cost of cleanup. Until recently, it had declined to seek even the full $30 million, letting **the state's largest of owners of idle wells (https://www.desmog.com/2024/02/06/wspa-cipa-oil-idle-wells-ab2729-california/)** — Chevron, Aera, and CRC — skate by with bonds of just $3 million each.

That changed on December 19, less than two months before the merger was announced, when CalGEM quietly obtained the maximum $30 million bond from CRC. It was a historic amount for an oil and gas company to put up, but it still comes nowhere close to covering the risk from CRC's thousands of idle wells — let alone from the Aera wells it plans to acquire. It's not yet clear if CalGEM's decision to raise CRC's bond was related to the pending merger.

If the merger is allowed to go through, and CRC provides California with a bond big enough to cover the full cost of closing Aera's wells, it would be a significant step toward de-risking the oil industry's liabilities in the state. And yet Alexander expressed concern that the rules so far weren't playing out as intended.

“We have no evidence that the law has been complied with yet,” she said. She explained that CalGEM will need to do an assessment to determine the bonding obligation before the merger can go through, and that CalGEM is required by law to post information about its determination online. As of this writing, that still hasn’t happened.

On February 16, Alexander and signatories from 13 other advocacy groups **wrote (https://www.documentcloud.org/documents/24480138-ito__21624)** to **newly appointed (https://epm.ucdavis.edu/people/doug-ito)** CalGEM supervisor Doug Ito — who has a background in consumer protection and public health oversight — to inquire about how the agency intends to apply the new rules.

“We are eager to track compliance, since AB 1167 was a critical priority for the environmental community last year, which we view as a bulwark against the risks inherent in transfers of low-producing wells,” they wrote.

CalGEM responded to the letter by hosting a meeting on Friday, March 15. Alexander and two staffers from the environmental lobbying nonprofit Environment California met with attendees, including Ito and CalDOC Director David Shabazian. According to Alexander, the state officials said CalGEM had no information yet to suggest that provisions passed under AB 1167 would apply to this merger, but that a conclusive determination can’t be made until the deal is finalized.

Several experts interviewed for this story felt that the language of the law — which is broadly written to include any entity who “acquires the right to operate a well or production facility, by purchase, transfer, assignment, conveyance, exchange, or other disposition” — was clear-cut, and were mystified by CalGEM’s reluctance to make a determination.

“The law regulates the transfer not between operators, but who has control and management of those operators,” said Ferrar, of FracTracker Alliance. Any merger, in other words, would give CRC the legal right to operate Aera’s wells — no matter how their day-to-day management is structured under the terms of the deal.

But when DeSmog reached Jacob Roper, assistant director of public affairs and communications for the California Department of Conservation (CalDOC), by phone on February 26, he could share no information about how AB 1167 would be enforced. In response to follow-up questions sent by email, Roper said that “the Department of Conservation is aware of the pending stock transaction between the two companies.” Roper also noted that it had issued **guidance around compliance (https://www.conservation.ca.gov/calgem/Documents/NTO%202023-10%20AB1167.pdf)** to industry in December.

Despite CalGEM’s noncommittal stance, Alexander remained hopeful that the law would be applied as intended.

“We have to put some kind of brakes on this slow-moving crisis, and we are now presented with a very significant opportunity to do that, assuming that we’re all reading correctly what has happened in this transaction,” she said, adding that the health and financial costs of inaction could be “potentially catastrophic.”

Vazin, of the Sierra Club, also expressed a mix of disappointment and optimism.

“This is par for the course for our work with CalGEM. I think the agency has a long way to go to meet the standards of its own mandates when it comes to informing the public and being more transparent about what’s going on behind closed doors,” she said. “We’re hoping, with the new supervisor in place, that CalGEM can show up differently and be an agency that does have transparency with the public. And we’re hoping we get the answers we’re looking for sooner than later.”

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Exhibit 10.1

EXECUTION VERSION

AGREEMENT AND PLAN OF MERGER

among

CALIFORNIA RESOURCES CORPORATION,

PETRA MERGER SUB I, LLC,

PETRA MERGER SUB C, LLC,

PETRA MERGER SUB O, LLC,

PETRA MERGER SUB S, LLC,

PETRA MERGER SUB O2, LLC,

PETRA MERGER SUB O3, LLC,

IKAV IMPACT S.A.R.L.,

SIMLOG INC.,

IKAV ENERGY INC.,

CPP INVESTMENT BOARD PRIVATE HOLDINGS (6), INC.,

GREEN GATE COI LLC,

IKAV IMPACT USA INC.,

CPPIB VEDDER US HOLDINGS LLC,

OPPS XB AERA E CTB, LLC,

OPPS XI AERA E CTB, LLC,

OCM OPPS XB AIF HOLDINGS (DELAWARE), L.P.,

OAKTREE HUNTINGTON INVESTMENT FUND II AIF (DELAWARE), L.P. – CLASS C,

OCM OPPS XI AIV HOLDINGS (DELAWARE), L.P., and

OCM AERA E HOLDINGS, LLC

Dated as of February 7, 2024

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Exhibit H Form of Tax Representation Letter
Exhibit I Business Plan

AGREEMENT AND PLAN OF MERGER

AGREEMENT AND PLAN OF MERGER, dated as of February 7, 2024 (this "Agreement"), among California Resources Corporation, a Delaware corporation ("Parent"), Petra Merger Sub I, LLC ("IKAV Merger Sub"), Petra Merger Sub C, LLC ("CPP Merger Sub"), Petra Merger Sub O, LLC ("COI Merger Sub"), Petra Merger Sub O2, LLC ("COI Merger Sub 2"), and Petra Merger Sub O3, LLC ("COI Merger Sub 3"), each a Delaware limited liability company and a wholly-owned direct Subsidiary of Parent (collectively, "Initial Merger Subs"), Petra Merger Sub S, LLC, a Delaware limited liability company and a wholly-owned direct Subsidiary of Parent ("Subsequent Merger Sub" and, together with Initial Merger Subs, collectively, "Merger Subs"), IKAV Impact USA Inc., a Delaware corporation ("IKAV Blocker"), CPPIB Vedder US Holdings LLC, a Delaware limited liability company ("CPP Blocker"), Opps Xb Aera E CTB, LLC, a Delaware limited liability company ("IKAV Co-Invest Blocker 1"), Opps XI Aera E CTB, LLC, a Delaware limited liability company ("IKAV Co-Invest Blocker 2" and together with IKAV Co-Invest Blocker 1, collectively, the "IKAV Co-Invest Blockers"), Green Gate COI, LLC, a Delaware limited liability company ("IKAV Co-Invest", and together with IKAV Blocker, CPP Blocker, IKAV Co-Invest Blocker 1 and IKAV Co-Invest Blocker 2, collectively, the "Companies"), and solely for purposes of the Member Provisions, IKAV Impact S.a.r.l., a Luxembourg corporation ("IKAV S.a.r.l."), Simlog Inc., a Delaware corporation ("Simlog"), and IKAV Energy Inc., a Delaware corporation (collectively, with IKAV S.a.r.l. and Simlog, "IKAV Member"), CPP Investment Board Private Holdings (6), Inc., a Canadian corporation ("CPP Member"), OCM Opps Xb AIF Holdings (Delaware), L.P., a Delaware limited partnership ("IKAV Co-Invest Blocker 1 Member A"), Oaktree Huntington Investment Fund II AIF (Delaware), L.P. – Class C, a Delaware limited partnership ("IKAV Co-Invest Blocker 1 Member B" and together with IKAV Co-Invest Blocker 1 Member A, collectively, the "IKAV Co-Invest Blocker 1 Members"), OCM XI AIV Holdings (Delaware), L.P., a Delaware limited partnership ("IKAV Co-Invest Blocker 2 Member"), and OCM Aera E Holdings, LLC, a Delaware limited liability company ("IKAV Co-Invest Member", and together with IKAV Member and CPP Member, collectively, the "Members").

WHEREAS, the board of directors of IKAV Blocker (the "IKAV Blocker Board") has, by unanimous written consent (i) determined that this Agreement and the merger of IKAV Merger Sub with and into IKAV Blocker (the "IKAV Merger") and the applicable Subsequent Merger are fair to, and in the best interests of, IKAV Blocker and IKAV Member, (ii) approved and declared advisable this Agreement, the IKAV Merger and the applicable Subsequent Merger, and (iii) resolved to recommend that IKAV Member adopt this Agreement;

WHEREAS, CPP Member, as the sole member of CPP Blocker, has approved this Agreement, the merger of CPP Merger Sub with and into CPP Blocker (the "CPP Merger") and the applicable Subsequent Merger on behalf of CPP Blocker and CPP Member;

WHEREAS, the applicable authorized Persons and governing bodies of IKAV Co-Invest (the "IKAV Co-Invest Board") and IKAV Co-Invest Blockers (the "IKAV Co-Invest Blocker Board", and, together with the IKAV Co-Invest Board and IKAV Blocker Board, the "Company Boards") have duly authorized and approved this Agreement and the transactions contemplated hereby, including (a) COI Merger Sub will merge with and into IKAV Co-Invest (the "IKAV Co-Invest Merger"), (b) COI Merger Sub 2 will merge with and into IKAV Co-Invest Blocker 1

(the "IKAV Co-Invest Blocker 1 Merger"), and (c) COI Merger Sub 3 will merge with and into IKAV Co-Invest Blocker 2 (the "IKAV Co-Invest Blocker 2 Merger" and, together with the IKAV Merger, the CPP Merger, the IKAV Co-Invest Merger and the IKAV Co-Invest Blocker 1 Merger, the "Initial Mergers");

WHEREAS, immediately following the Initial Mergers, each surviving company or corporation (as applicable) of the Initial Mergers (the "Surviving Companies") will merge with and into Subsequent Merger Sub (each, a "Subsequent Merger", and, together with the Initial Mergers, the "Mergers"), with Subsequent Merger Sub surviving the Subsequent Mergers (the "Subsequent Surviving Company");

WHEREAS, the board of directors of Parent (the "Parent Board") has, at a meeting duly called and held, by unanimous vote, (i) determined that this Agreement and the issuance of the shares of common stock of Parent, par value $0.01 per share ("Parent Common Stock"), pursuant to this Agreement (the "Parent Stock Issuance"), are fair to, and in the best interests of, Parent, (ii) approved and declared advisable this Agreement, the Mergers and the Parent Stock Issuance, and (iii) resolved to recommend that the holders of Parent Common Stock approve the Parent Stock Issuance;

WHEREAS, the board of managers of each Merger Sub (collectively, the "Merger Sub Boards") has, at a meeting duly called and held, by unanimous vote (i) determined that this Agreement and the applicable Merger are fair to, and in the best interests of, such Merger Sub and such Merger Sub's sole member, (ii) approved and declared advisable this Agreement and the applicable Merger, and (iii) resolved to recommend that Parent, as the sole member of such Merger Sub, approve this Agreement;

WHEREAS, Parent, as the sole member of each Merger Sub, has approved this Agreement concurrently with its execution;

WHEREAS, for U.S. federal and applicable state and local income Tax purposes (i) the IKAV Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (ii) each of Parent, IKAV Merger Sub, Subsequent Merger Sub, IKAV Member, and IKAV Blocker is a party to such reorganization within the meaning of Section 368(b) of the Code, (iii) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a), and (iv) IKAV Member shall be treated as transferring a "United States real property interest" on which gain is realized solely for a "United States real property interest" which, immediately following the exchange, would be subject to United States taxation upon its disposition within the meaning of Treasury Regulations Section 1.897-6T(a)(1);

WHEREAS, for U.S. federal and applicable state and local income Tax purposes (i) the CPP Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (ii) each of Parent, CPP Merger Sub, Subsequent Merger Sub, CPP Member, and CPP Blocker is a party to such reorganization within

the meaning of Section 368(b) of the Code and (iii) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a);

WHEREAS, for U.S. federal and applicable state and local income Tax purposes (i) the IKAV Co-Invest Blocker 1 Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (ii) each of Parent, the COI Merger Sub 2, the Subsequent Merger Sub, IKAV Co-Invest 1 Member, and IKAV Co-Invest Blocker 1 is a party to such reorganization within the meaning of Section 368(b) of the Code and (iii) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a);

WHEREAS, for U.S. federal and applicable state and local income Tax purposes (i) the IKAV Co-Invest Blocker 2 Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (ii) each of Parent, COI Merger Sub 3, the Subsequent Merger Sub, IKAV Co-Invest 2 Member, and IKAV Co-Invest Blocker 2 is a party to such reorganization within the meaning of Section 368(b) of the Code and (iii) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a);

WHEREAS, IKAV Member, as holders of 100% of the stock of IKAV Blocker (the "IKAV Equity Interests"), CPP Member, as holder of 100% of the membership interests of CPP Blocker (the "CPP Equity Interests"), IKAV Co-Invest Member and Green Gate ICOI LLC, as holders of 100% of the units representing membership interests of COI (the "COI Equity Interests", and, together with the IKAV Equity Interests and the CPP Equity Interests, collectively, the "Equity Interests"), have each approved and adopted this Agreement concurrently with its execution;

NOW, THEREFORE, in consideration of the foregoing and the representations, warranties, covenants and agreements contained in this Agreement, and for other valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

ARTICLE I
CERTAIN DEFINITIONS

1.1 Certain Definitions. As used in this Agreement, the capitalized terms have the meanings ascribed to such terms in Annex A or as otherwise defined elsewhere in this Agreement.

1.2 Terms Defined Elsewhere. As used in this Agreement, the following capitalized terms are defined in this Agreement as referenced in the following table:

Definition	Section
280G Member Vote	7.7(e)
Additional Parent Termination Payment	9.2(c)
Aggregate Dividend Amount	3.1(b)(i)
Agreement	Preamble
Alternative Financing	7.14(a)
Antitrust Approval	7.6(a)
Applicable Date	4.9(a)
Burdensome Condition	7.6(d)
Certificates of Merger	2.6
Closing	2.2(a)
Closing Date	2.2(a)
Closing Date Member Tax Amount	3.3(b)
Closing Date Transaction Expense Amount	3.3(b)
Commitment Letter	7.14(a)
Companies	Preamble
Company 401(k) Plans	7.7(d)
Company Boards	Recitals
Company Contracts	4.18(b)
Company Disclosure Letter	Article IV
Company Independent Petroleum Engineers	4.16(a)
Company Insurance Policies	4.20
Company Intellectual Property	4.14(a)
Company IT Assets	4.14(f)
Company Member Approvals	4.3(a)
Company Parties	11.12(b)
Company Permits	4.9(a)
Company Related Party Agreement	4.22
Company Reserve Reports	4.16(a)
Confidentiality Agreement	7.5(b)
Consideration Adjustment Election	3.3(a)
Continuing Employee	7.7(a)
CPP Blocker	Preamble
CPP Equity Interests	Recitals
CPP Member	Preamble
CPP Merger	Recitals
CPP Merger Sub	Preamble
Creditors' Rights	4.3(a)
D&O Insurance	7.8(d)
DGCL	2.1
Disclosing Party	7.6(c)
DLLCA	2.1
Effective Time	2.2(b)
Employment Laws	4.11(b)
End Date	9.1(b)(ii)
Equity Interests	Recitals
ERISA Affiliate	4.10(g)
Estimated Parent Adjustment Shares	3.3(a)
Estimated Transaction Expense Amount	3.3(a)
Final Date	10.1
Financial Statements	4.5(a)
Financial Statements Entities	4.5(a)
Green Gate Equity Interests	4.2(a)
HSR Act	4.4
IKAV Blocker	Preamble

Definition	Section
IKAV Blocker Board	Recitals
IKAV Co-Invest	Preamble
IKAV Co-Invest Blocker Board	Recitals
IKAV Co-Invest Board	Recitals
IKAV Co-Invest Equity Interests	Recitals
IKAV Co-Invest Member	Preamble
IKAV Co-Invest Merger Sub	Preamble
IKAV Co-Invest Merger Sub 2	Preamble
IKAV Co-Invest Merger Sub 3	Preamble
IKAV Equity Interests	Recitals
IKAV Member	Preamble
IKAV Merger	Recitals
IKAV Merger Sub	Preamble
Improvements	4.15(e)
Indemnified Liabilities	7.8(a)
Indemnified Persons	7.8(a)
Initial Certificates of Merger	2.2(b)
Initial End Date	9.1(b)(ii)
Initial Merger Subs	Preamble
Initial Mergers	Recitals
Interim Financial Statements	4.5(a)
Leakage Covenants	10.1
Leased Real Property	4.15(b)
Leases	4.15(b)
Member Released Claims	9.3(b)
Member Tax Adjustment Amount	3.3(c)
Members	Preamble
Merger Sub Boards	Recitals
Merger Subs	Recitals
Mergers	Recitals
Most Recent Balance Sheet	4.5(a)
Multiemployer Plan	4.10(h)
Negotiation Period	7.4(e)
New Directors	2.5
Non-Recourse Parties	11.12(a)
Order	4.11(i)
Owned Real Property	4.15(a)
Parachute Payment	7.7(e)
Parent	Preamble
Parent Board	Recitals
Parent Change of Recommendation	7.4(i), 7.4(b)
Parent Common Stock	Recitals
Parent Contracts	6.14
Parent Disclosure Letter	Article VI
Parent Intervening Event Notice	7.4(f)
Parent Intervening Event Notice Period	7.4(f)
Parent Permits	6.9
Parent Released Claims	9.3(c)
Parent SEC Documents	6.5(a)
Parent Stock Issuance	Recitals
Parent Superior Proposal Notice	7.4(e)
Partnership Subsidiaries	4.12(s)
Post-Closing Pass-Through Tax Returns	7.13(b)(i)
Pre-Closing Tax Returns	7.13(b)

Definition	Section
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Subsequent Merger Sub	Recitals
Subsequent Surviving Company	Recitals
Surviving Companies	Recitals
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Tax Contest	7.13(c)
Terminable Breach	9.1(b)(iii)
Transaction Expense Adjustment Amount	3.3(c)
Transaction Litigation	7.9
Transfer	7.18(a)
Transfer Taxes	7.13(a)
Transition Services Agreement	7.22
Union	4.18(a)(xiv)
Waived Benefits	7.7(e)
Wrong Pocket Asset	7.19

ARTICLE II
THE MERGERS

2.1 The Initial Mergers. Upon the terms and subject to the conditions of this Agreement, at the Effective Time, in accordance with the provisions of the Delaware Limited Liability Company Act (the "DLLCA") and the Delaware General Corporation Law (the "DGCL"), IKAV Merger Sub will merge with and into IKAV Blocker, CPP Merger Sub will merge with and into CPP Blocker, COI Merger Sub will merge with and into IKAV Co-Invest, COI Merger Sub 2 will merge with and into IKAV Co-Invest Blocker 1 and COI Merger Sub 3 will merge with and into IKAV Co-Invest Blocker 2. As a result of the Initial Mergers, the separate existence of each Initial Merger Sub shall cease and each Company shall continue its existence under the laws of the State of Delaware as the surviving company or corporation, as applicable. Immediately following the Initial Mergers, in accordance with the provisions of the DLLCA and the DGCL, each Company will merge with and into Subsequent Merger Sub. As a result of the Subsequent Mergers, the separate existence of each Company shall cease and Subsequent Merger Sub shall continue its existence under the laws of the State of Delaware as the surviving company (in such capacity, Subsequent Merger Sub is sometimes referred to herein as the "Subsequent Surviving Company").

2.2 Closing.

(a) The closing of the Initial Mergers (the "Closing"), shall take place at 9:00 a.m., Los Angeles time, on the date that is the third Business Day immediately following the satisfaction or (to the extent permitted by applicable Law) waiver in accordance with this Agreement of all of the conditions set forth in Article VIII (other than any such conditions which by their nature cannot be satisfied until the Closing Date, which shall be required to be so satisfied or (to the extent permitted by applicable Law) waived in accordance with this Agreement on the Closing Date) at the offices of Sullivan & Cromwell LLP in Los Angeles, California, or such other time or place as Parent and the Companies may agree in writing. For purposes of this Agreement, "Closing Date" shall mean the date on which the Closing occurs.

(b) As soon as practicable on the Closing Date after the Closing, certificates of merger with respect to the Initial Mergers prepared and executed in accordance with the relevant provisions of the DLLCA and DGCL (the "Initial Certificates of Merger") shall be filed with the Office of the Secretary of State of the State of Delaware. The Initial Mergers shall become effective upon the filing and acceptance of the Initial Certificates of Merger with the Office of the Secretary of State of the State of Delaware, or at such later time as shall be agreed upon in writing by Parent and the Companies and specified in the Initial Certificates of Merger (the "Effective Time").

(c) Notwithstanding the foregoing, if the Debt Marketing Period has not ended at the time of the satisfaction or waiver (to the extent permitted by applicable law) of the conditions set forth in Article VIII (other than any such conditions which by their nature cannot be satisfied until the Closing Date, which shall be required to be so satisfied at Closing), the Closing shall occur on the earlier of (a) a date during the Debt Marketing Period specified by Parent on no less than three Business Days' notice to the Companies and (b) the third Business Day after the end of the Debt Marketing Period (subject in each case to the satisfaction or waiver (to the extent permitted by applicable law) by the party entitled to grant such waiver of all the conditions set forth in Article VIII (other than any such conditions which by their nature cannot be satisfied until the Closing Date, which shall be required to be so satisfied at Closing), or at such other time or place as Parent and the Companies may agree in writing.

2.3 Effect of the Initial Mergers. At the Effective Time, the Initial Mergers shall have the effects set forth in this Agreement and the applicable provisions of the DLLCA or DGCL. Without limiting the generality of the foregoing, and subject thereto, at the Effective Time, all the property, rights, privileges, powers and franchises of each applicable Company and Merger Sub shall vest in the applicable Surviving Company, and all debts, liabilities, obligations, restrictions, disabilities and duties of each applicable Company and applicable Initial Merger Sub shall become the debts, liabilities, obligations, restrictions, disabilities and duties of the applicable Surviving Company.

2.4 Organizational Documents; Managers and Officers. At the Effective Time, (a) the certificate of formation or certificate of incorporation of each Surviving Company shall be amended as set forth in the applicable Initial Certificates of Merger (subject to compliance with Section 7.8); (b) the limited liability company agreement or bylaws of each Surviving Company shall be amended and restated to be in a form determined by Parent prior to the Closing Date

(subject to compliance with Section 7.8); and (c) the directors, managers and officers of each Surviving Company immediately after the Effective Time shall be those individuals designated by Parent prior to the Closing Date.

2.5 Appointment of Additional Directors. Promptly following the Effective Time, Parent shall appoint two individuals designated by the Sponsors pursuant to the terms of the Stockholder Agreements to the Parent Board (such individuals, the "New Directors"), with each such New Director to serve on the Parent Board in accordance with the applicable Stockholder Agreement.

2.6 Subsequent Mergers.

(a) As soon as practicable on the Closing Date after the Closing, a certificate of merger prepared and executed in accordance with the relevant provisions of the DLLCA and the DGCL shall be filed with the Office of the Secretary of State of the State of Delaware (the "Subsequent Certificate of Merger", and, together with the Initial Certificates of Merger, the "Certificates of Merger"). Each Subsequent Merger shall become effective upon the filing and acceptance of such certificate of merger with the Office of the Secretary of State of the State of Delaware, and at such time (the "Subsequent Effective Time"), such Subsequent Merger shall have the effects set forth in this Agreement and the applicable provisions of the DLLCA and DGCL. Without limiting the generality of the foregoing, and subject thereto, at such time, all the property, rights, privileges, powers and franchises of the Surviving Companies and Subsequent Merger Sub shall vest in the Subsequent Surviving Company, and all debts, liabilities, obligations, restrictions, disabilities and duties of each of the Surviving Companies and Subsequent Merger Sub shall become the debts, liabilities, obligations, restrictions, disabilities and duties of the Subsequent Surviving Company.

(b) At the Subsequent Effective Time, (a) the certificate of formation of the Subsequent Surviving Company shall be amended as set forth in the Subsequent Certificate of Merger (subject to compliance with Section 7.8); (b) the limited liability company agreement of the Subsequent Surviving Company shall be amended and restated to be in a form determined by Parent prior to the Closing Date (subject to compliance with Section 7.8); and (c) the managers and officers of the Subsequent Surviving Company immediately after the Subsequent Effective Time shall be those individuals designated by Parent prior to the Closing Date.

ARTICLE III
EFFECT OF THE MERGERS; EXCHANGE

3.1 Effect of the Initial Mergers. At the Effective Time, by virtue of the Initial Mergers and without any action on the part of Parent, Initial Merger Subs, the Companies, or any holder of any securities of Parent, Initial Merger Subs or the Companies:

(a) Equity Interests of Initial Merger Subs. The issued and outstanding membership interest of each Initial Merger Sub shall be converted into and become the sole membership interest or sole share of stock in the applicable Surviving Company immediately following the Effective Time.

(b) Equity Interests of the Companies.

(i) Subject to the other provisions of this Article III, the aggregate Equity Interests issued and outstanding immediately prior to the Effective Time shall be converted into the right to receive from Parent (A) that aggregate number of fully-paid and nonassessable shares of Parent Common Stock equal to the Aggregate Consideration, and (B) in respect of any dividend or other distribution declared by Parent and having a record date from and including January 1, 2024, to and including the Closing Date, (x) if paid by Parent to its stockholders prior to the Effective Time, that aggregate number of fully-paid and nonassessable shares of Parent Common Stock equal to the quotient that is obtained by dividing the portion of such dividend or other distribution to which each such share of Parent Common Stock issued in exchange for each such Equity Interests would have been entitled if issued and outstanding on January 1, 2024 (the aggregate cash amount of all such dividends or distributions, the "Aggregate Dividend Amount") by the Agreed VWAP, and (y) if unpaid at the Effective Time, the right to receive, when paid by Parent to its other stockholders, that aggregate number of fully-paid and nonassessable shares of Parent Common Stock equal to the quotient that is obtained by dividing the portion of such dividend or other distribution to which each such share of Parent Common Stock issued in exchange for each such Equity Interests would have been entitled if issued and outstanding on January 1, 2024 by the Agreed VWAP.

(ii) All such Equity Interests, when so converted, shall cease to be outstanding and shall automatically be canceled and cease to exist. Each holder of an Equity Interest that was outstanding immediately prior to the Effective Time shall cease to have any rights with respect thereto, except the right to receive such holder's Applicable Percentage of (A) the Aggregate Consideration and that number of shares of Parent Common Stock with respect to any dividends or distributions paid or payable by Parent in accordance with Section 3.1(b)(i) and (B) without limiting the foregoing, in lieu of any fractional shares of Parent Common Stock, a number of whole shares of Parent Common Stock in respect thereof as determined in accordance with Section 3.2(a), in each case to be issued in consideration therefor in exchange for the Equity Interests, in accordance with Section 3.2(a).

(c) Impact of Stock Splits, Etc. In the event of any change in the number of shares of Parent Common Stock, or securities convertible or exchangeable into or exercisable for shares of Parent Common Stock (including options to purchase Parent Common Stock), in each case issued and outstanding after the date of this Agreement and prior to the Effective Time, by reason of any stock split, reverse stock split, stock dividend, subdivision, reclassification, recapitalization, combination, exchange of shares or the like, the Aggregate Consideration shall be equitably adjusted to reflect the effect of such change and, as so adjusted, shall from and after the date of such event, be the Aggregate Consideration, subject to further adjustment in accordance with this Section 3.1(c). Nothing in this Section 3.1(c) shall be construed to permit the Parties to take any action except to the extent consistent with, and not otherwise prohibited by, the terms of this Agreement.

3.2 Exchange of Equity Interests.

(a) Delivery of Aggregate Consideration and Aggregate Dividend Amount; Fractional Shares. Upon the Effective Time, Parent will instruct Parent's transfer agent to create book-entries in respect of each share of Parent Common Stock into which the Equity Interests shall have been converted pursuant to the Mergers (including in respect of declared dividends pursuant to Section 3.1(b)(i)(B)), which shares of Parent Common Stock shall be uncertificated; provided, however, that in the event Parent determines in good faith that the amount of cash that would be included in the combined balance sheets of the Financial Statements Entities (prepared in accordance with GAAP) as of December 31, 2023 is less than (x) $36,000,000.00 or (y) the amount equal to $25,000,000 plus the aggregate amount of cash dividends or distributions made by the Companies that is Permitted Leakage up to the Excess Balance Sheet Cash Amount (such difference, the "Shortfall Amount"), then (i) in the event the Shortfall Amount is less than the Aggregate Dividend Amount, the Aggregate Dividend Amount shall by reduced by an amount equal to the Shortfall Amount and (ii) in the event the Shortfall Amount is greater than the Aggregate Dividend Amount, (A) Parent shall not be obligated to pay any Aggregate Dividend Amount pursuant to Section 3.1(b)(i) and (B) the number of shares comprising the Aggregate Consideration shall be reduced by the quotient that is obtained by dividing the Shortfall Amount *minus* the Aggregate Dividend Amount by the Agreed VWAP. If the Members shall disagree with Parent's calculation of the Shortfall Amount, then the Members shall notify Parent of such disagreement in writing, setting forth in reasonable detail the specific items included in or excluded from the Shortfall Amount that are in dispute and the nature and amount of any disagreement so identified, within 30 days after the Closing Date, and the dispute resolution provision set out in Section 3.3 (*Adjustment for Transaction Expenses*) shall apply with respect to such disagreement, *mutatis mutandis*. In respect of Section 3.2(a)(i), such book-entries shall record the applicable Member as the record owner of such shares of Parent Common Stock in direct registration. No fractional shares of Parent Common Stock shall be issued in the Initial Mergers. All fractional shares of Parent Common Stock that a holder of Equity Interests would otherwise be entitled to receive as a result of the Initial Mergers shall be aggregated and, if a fractional share results from such aggregation, such fractional share shall be rounded up to the nearest whole share of Parent Common Stock and issued to such Member in accordance with the first two sentences of this Section 3.2(a).

(b) Withholding Taxes. Notwithstanding anything in this Agreement to the contrary, Parent, Merger Subs, the Surviving Companies and the Subsequent Surviving Company shall be entitled to deduct and withhold, or cause to be deducted and withheld, from any amounts otherwise payable pursuant to this Agreement and any other Transaction Document (including the Aggregate Consideration) any amount required to be deducted and withheld with respect to the making of such payment under applicable Law and shall pay the amount deducted or withheld to the appropriate Taxing Authority in accordance with applicable Law; provided, however, that Parent, Merger Subs, the Surviving Companies and the Subsequent Surviving Company shall use reasonable best efforts to provide five Business Days' advance written notice to any payee of any intended deduction or withholding with respect to any payment to such payee (other than with respect to compensatory payments or as a result of the payee's failure to provide the withholding documents specified in Section 8.2(g)). The Parties shall cooperate in good faith to minimize any such deduction or

withholding. To the extent such amounts are so deducted or withheld and paid over to the appropriate Taxing Authority by Parent, Merger Subs, the Surviving Companies or the Subsequent Surviving Company, as the case may be, such deducted or withheld amounts shall be treated for all purposes of this Agreement as having been paid to the Person in respect of which such deduction or withholding was made.

3.3 Adjustment for Transaction Expenses and Member Taxes.

(a) Not less than five Business Days prior to the Closing Date, the Companies shall prepare and deliver to Parent a written statement setting forth in reasonable detail the Companies' good faith estimate of the amount of Transaction Expenses (the "Estimated Transaction Expense Amount") and Member Taxes with respect to each Member (the "Estimated Member Tax Amount"). If Parent notifies the Companies in writing of an objection to the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect to any Member, as applicable (which written notice shall describe in reasonable detail the specific items included in or excluded from the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect to such Member, as applicable, that are in dispute and the nature and amount of any disagreement so identified) at least two Business Days prior to the Closing Date, then Parent and the Companies shall seek in good faith to agree to revisions to the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect such Member, as applicable, to resolve such objection and the Companies shall update and redeliver a written statement setting forth their good faith estimate of the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect to each Member, as applicable, to reflect any such agreements no later than the Business Day immediately prior to the Closing Date. If Parent has provided a timely notice of an objection pursuant to this Section 3.3(a) and Parent and the Companies fail to mutually agree upon revisions to the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect to any Member, as applicable, on or prior to the Business Day immediately prior to the Closing Date, then: (i) no Party shall delay the Closing because of such failure and (ii) the Estimated Transaction Expense Amount or the Estimated Member Tax Amount with respect each Member, as applicable (with such revisions proposed by Parent as the Companies, acting in good faith, are willing to accept), shall control for purposes of determining the Estimated Transaction Expense Overage Amount or the Estimated Member Tax Overage Amount with respect to each Member, as applicable (if any). For the avoidance of doubt, the failure of the Parties to agree to such revisions shall not constitute a breach, waiver or limitation of a Party's rights and obligations under this Agreement. At the Closing, each Member shall pay (or cause to be paid) to Parent, by wire transfer of immediately available funds to the account designated by Parent, an amount equal to such Member's Applicable Percentage of the Estimated Transaction Expense Overage Amount or such Member's Estimated Member Tax Overage Amount, as applicable (if any); provided, however, that notwithstanding the foregoing, not less than two Business Days prior to the Closing Date, the Members may elect, by delivery of a written notice to Parent (the "Consideration Adjustment Election"), that the Members' reimbursement obligations in respect of the Estimated Transaction Expense Overage Amount or the Estimated Member Tax Overage Amount, as applicable (if any), shall be satisfied by withholding from delivery to each Member a number of shares of Parent Common Stock (the "Estimated Parent Adjustment Shares") equal to the quotient of (x) such Member's Applicable Percentage of the Estimated Transaction

Expense Overage Amount or such Member's Estimated Member Tax Overage Amount, as applicable, *divided by* (y) the Agreed VWAP.

(b) As soon as reasonably practicable following the Closing Date, and in any event within 90 days thereof, Parent shall prepare and deliver to the Members a written statement setting forth in reasonable detail Parent's good faith calculation of the amount of Transaction Expenses (the "Closing Date Transaction Expense Amount") and the Member Taxes with respect to each Member (the "Closing Date Member Tax Amount").

(c) Following the Members' receipt of the written statement setting forth the Closing Date Transaction Expense Amount and the Closing Date Member Tax Amount with respect to each Member from Parent, each Member shall have 30 days to review the Closing Date Transaction Expense Amount and such Member's Closing Date Member Tax Amount. During such 30-day period, Parent and the Subsequent Surviving Company shall furnish the Members and their respective Representatives with all reasonably requested access to the books and records of the Subsequent Surviving Company and its Subsidiaries to the extent reasonably related to the Closing Date Transaction Expense Amount or the relevant Closing Date Member Tax Amount, as applicable; provided that (i) the Members and their respective Representatives shall access such books and records in such a manner as not to interfere unreasonably with the business or operations of Parent, the Subsequent Surviving Company or their Subsidiaries or otherwise cause any unreasonable interference with the prompt and timely discharge by the employees of Parent, the Subsequent Surviving Company and their Subsidiaries of their normal duties, (ii) Parent shall not be required under this Section 3.3(c) to provide any Tax Returns required to be filed with respect to Parent on a consolidated, combined or unitary basis, and (iii) neither Parent nor the Subsequent Surviving Company shall be required to, or to cause any of its Subsidiaries to, grant access or furnish information, as applicable, to the Members or any of their Representatives to the extent that such information is subject to an attorney/client privilege or the attorney work product doctrine or that such access or the furnishing of such information, as applicable, is prohibited by applicable Law or an existing contract or agreement (provided, however, that Parent shall inform the Members as to the general nature of what is being withheld and Parent shall make appropriate substitute arrangements to permit reasonable disclosure that does not suffer from any of the foregoing impediments, including through the use of commercially reasonable efforts to (A) obtain the required consent or waiver of any third party required to provide such information and (B) implement appropriate and mutually agreeable measures to permit the disclosure of such information in a manner to remove the basis for the objection, including by arrangement of appropriate clean room procedures, redaction or entry into a customary joint defense agreement with respect to any information to be so provided, if the Members and Parent determine that doing so would reasonably permit the disclosure of such information without violating applicable Law or jeopardizing such privilege. If the Members shall disagree with Parent's calculation of the Closing Date Transaction Expense Amount or the Closing Date Member Tax Amount with respect to any Member, then the Members shall notify Parent of such disagreement in writing, setting forth in reasonable detail the specific items included in or excluded from the Closing Date Transaction Expense Amount or the applicable Closing Date Member Tax Amount, as applicable, that are in dispute and the nature and amount of any disagreement so identified, within 30 days after the Members' receipt of Parent's calculation of Closing Date Transaction Expense Amount or the Closing Date Member Tax Amount with

respect to each Member, as applicable. In the event that the Members do not provide a notice of disagreement within such 30-day period, the Members and Parent shall be deemed to have agreed to the calculation of the Closing Date Transaction Expense Amount and the Closing Date Member Tax Amount with respect to each Member delivered by Parent, which shall be final, binding and conclusive for purposes of calculating the Closing Date Transaction Expense Overage Amount or the Closing Date Member Tax Overage Amount with respect to each Member, as applicable (if any), hereunder. In the event any notice of disagreement is timely provided, Parent and the Members shall use reasonable best efforts for a period of 30 days to resolve any disagreements with respect to the calculation of Closing Date Transaction Expense Amount or the Closing Date Member Tax Amount with respect to any Member, as applicable. If, at the end of such 30-day period, Parent and the Members are unable to resolve such disagreements, then any such remaining disagreements shall be resolved by the Independent Accountant, and the expenses of the Independent Accountant shall be borne by the Members (in accordance with their Applicable Percentage) and Parent in inverse proportion as they may prevail on matters resolved by the Independent Accountant. If for any reason Ernst & Young LLP shall not be able to act as the Independent Accountant and Parent and the Members cannot mutually agree on another independent accounting firm of recognized national standing in the United States to serve in such capacity, then the Members shall deliver to Parent a list of three independent accounting firms of recognized national standing in the United States (other than BDO USA, LLP) with which they do not have current engagements and Parent shall select one of such three accounting firms to act as the Independent Accountant, provided Parent shall not have any existing material relationship with such accounting firm. Parent and the Members shall promptly (and in any event, within 10 days of engaging the Independent Accountant) provide their respective assertions regarding Closing Date Transaction Expense Amount or the relevant Closing Date Member Tax Amount, as applicable, in writing to the Independent Accountant and to each other. The Independent Accountant shall be instructed to render its determination with respect to such disagreements as soon as reasonably possible (which Parent and the Members agree should not be later than 45 days following the day on which the last such written submissions of the Parties with respect to the disagreement are provided to the Independent Accountant). The Independent Accountant shall act as an expert and not as an arbitrator and shall base its determination solely on (i) the written submissions of Parent and the Members and shall not conduct an independent investigation and (ii) the extent (if any) to which Closing Date Transaction Expense Amount or the relevant Closing Date Member Tax Amount, as applicable, requires adjustment (only with respect to the remaining disagreements submitted to the Independent Accountant), and in making its determination, the Independent Accountant may not assign a value to any item greater than the greatest value claimed for a matter by either Parent or the Members or less than the smallest value for such matter claimed by either Parent or the Members. The determination of the Independent Accountant shall be final, conclusive and binding on the Parties (absent manifest error).

(d) The "Transaction Expense Adjustment Amount," which may be positive or negative, shall mean the Estimated Transaction Expense Overage Amount *minus* the Closing Date Transaction Expense Overage Amount (as finally determined in accordance with Section 3.3(c)). The "Member Tax Adjustment Amount," which may be positive or negative, shall mean, with respect to any Member, the Estimated Member Tax Overage Amount *minus* the Closing Date Member Tax Overage Amount (as finally determined in accordance with Section 3.3(c)).

(e) If the Members do not timely deliver a Consideration Adjustment Election pursuant to Section 3.3(a), then within three Business Days following the final determination of the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to each Member, as applicable, in accordance with Section 3.3(c): (i) if the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to a Member is a positive number, then Parent shall issue to each applicable Member a number of shares of Parent Common Stock (which, at the time of such issuance, will be duly authorized, validly issued, fully paid and nonassessable) equal to the number that is obtained by dividing such Member's Applicable Percentage of the Transaction Expense Adjustment Amount or such Member's Member Tax Adjustment Amount, as applicable, by the Agreed VWAP (rounded up to the nearest whole share), and (ii) if the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to a Member is a negative number, then each applicable Member shall pay to Parent, by wire transfer of immediately available funds to the account designated by Parent, an amount equal to such Member's Applicable Percentage of the absolute value of the Transaction Expense Adjustment Amount or such Member's Member Tax Adjustment Amount, as applicable or, if elected by such Member in writing to Parent, then such Member shall forfeit to Parent for no consideration a number of shares of Parent Common Stock equal to the number that is obtained by dividing such Member's Applicable Percentage of the absolute value of the Transaction Expense Adjustment Amount or such Member's Member Tax Adjustment Amount, as applicable, by the Agreed VWAP.

(f) If the Members timely deliver a Consideration Adjustment Election pursuant to Section 3.3(a), then within three Business Days following the final determination of the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to each Member in accordance with Section 3.3(c): (i) if the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to a Member is a positive number, then Parent shall issue to each applicable Member a number of shares of Parent Common Stock (which, at the time of such issuance, will be duly authorized, validly issued, fully paid and nonassessable) equal to the number that is obtained by dividing such Member's Applicable Percentage of the Transaction Expense Adjustment Amount or such Member's Member Tax Adjustment Amount, as applicable, by the Agreed VWAP (rounded up to the nearest whole share) and (ii) if the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount with respect to a Member is a negative number, then each applicable Member shall forfeit to Parent for no consideration a number of shares of Parent Common Stock equal to the number that is obtained by dividing such Member's Applicable Percentage of the absolute value of the Transaction Expense Adjustment Amount or such Member's Member Tax Adjustment Amount, as applicable, by the Agreed VWAP.

(g) Any adjustments made pursuant to this Section 3.3 shall be treated by the Parties as adjustments to the Aggregate Consideration paid hereunder for Tax purposes.

(h) Notwithstanding the other provisions of this Section 3.3, Parent and the other Parties acknowledge and agree that in no event shall a Member be liable for the other Members' Applicable Percentage of the Estimated Transaction Expense Overage Amount or the Estimated Member Tax Overage Amount (if any) payable to Parent pursuant to

Section 3.3(a), or the Transaction Expense Adjustment Amount or the Member Tax Adjustment Amount (if any) payable to Parent pursuant to Section 3.3(e)(ii).

3.4 Effect of the Subsequent Mergers. At the Subsequent Effective Time, by virtue of the Subsequent Mergers and without any action on the part of Parent, Subsequent Merger Sub, the Surviving Companies, or any holder of any securities of Parent, Subsequent Merger Sub and the Surviving Companies: all equity interests of the Surviving Companies shall no longer be outstanding and shall automatically be cancelled and shall cease to exist as of the Effective Time, and the membership interests of Subsequent Merger Sub shall remain issued and outstanding as the membership interests of the Subsequent Surviving Company and be unaffected by the Subsequent Mergers.

ARTICLE IV
REPRESENTATIONS AND WARRANTIES OF THE COMPANIES

Except as set forth in the disclosure letter dated as of the date of this Agreement and delivered by the Companies to Parent and Merger Subs on or prior to the date of this Agreement (the "Company Disclosure Letter"), each Company severally (and not jointly and severally) represents and warrants to Parent and Merger Subs as follows, provided, that, notwithstanding the foregoing, the IKAV Co-Invest Blockers shall only make the representations and warranties as set forth in Sections 4.1, 4.2, 4.3, 4.4, 4.12, 4.21, 4.22, 4.26, 4.27 and 4.28:

4.1 Organization, Standing and Power. Each of such Company and its Subsidiaries is a corporation, partnership or limited liability company duly organized, as the case may be, validly existing and in good standing under the Laws of its jurisdiction of incorporation or organization, with all requisite entity power and authority to own, lease and operate its properties and to carry on its business as now being conducted. Each of such Company and its Subsidiaries is duly qualified or licensed and in good standing to do business in each jurisdiction in which the business it is conducting, or the operation, ownership or leasing of its assets or properties, makes such qualification or license necessary, other than where the failure to so qualify, license or be in good standing would not reasonably be expected to have, individually or in the aggregate, a Company Material Adverse Effect. Such Company has heretofore made available to Parent complete and correct copies of its and its Subsidiaries' Organizational Documents, each as amended prior to the execution of this Agreement and each as made available to Parent is in full force and effect, and neither such Company nor any of its Subsidiaries is in violation of any of the provisions of such Organizational Documents.

4.2 Capital Structure.

(a) The authorized equity interests of such Company consist of, in the case of IKAV Blocker, 1,000 shares of common stock; in the case of CPP Blocker, 100% membership interests; and in the case of IKAV Co-Invest, 400,000,000 units; in the case of IKAV Co-Invest Blocker 1, 100% membership interests, in the case of IKAV Co-Invest Blocker 2, 100% membership interests. The authorized equity interests of Green Gate Resources Parent, LLC consists of 785,000,000 units (the "Green Gate Equity Interests"). The foregoing equity interests in such Company and the Green Gate Equity Interests are held of record by the Persons listed on Section 4.2(a) of the Company Disclosure Letter, free and clear

of any Encumbrances (other than (i) any Encumbrances that will be terminated or satisfied at or prior to the Closing, (ii) Encumbrances on transfer imposed under applicable securities laws, and (iii) Encumbrances created by or through the actions of Parent, Merger Subs or their respective Affiliates).

(b) All outstanding Equity Interests of such Company and all outstanding Green Gate Equity Interests have been duly authorized and are validly issued, fully paid (to the extent required under the Organizational Documents of such Company or Green Gate Resources Parent, LLC and, with respect to any such Company that is a corporation, under the applicable Law of its jurisdiction of incorporation) and non-assessable (except as such nonassessability may be affected by Sections 18-607 and 18-804 of the DLLCA or the analogous provisions of applicable Law) and are not subject to preemptive rights. All outstanding Equity Interests of such Company and all outstanding Green Gate Equity Interests have been issued and granted in compliance in all material respects with (i) applicable securities Laws and other applicable Law and (ii) all requirements set forth in applicable contracts. There are no outstanding options, warrants or other rights to subscribe for, purchase or acquire from such Company or any of its Subsidiaries any equity interests of such Company or securities convertible into or exchangeable or exercisable for equity interests of such Company. Assuming the accuracy of each other Company's representation in this sentence of Section 4.2(b), all outstanding shares of capital stock or other equity interests of the Subsidiaries of the Companies are owned by the Companies, or a direct or indirect Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time, are free and clear of all Encumbrances (other than (i) any Encumbrances that will be terminated or satisfied at or prior to the Closing, and (ii) Encumbrances on transfer imposed under applicable securities laws), and have been duly authorized, validly issued, fully paid (to the extent required under the Organizational Documents of the applicable Subsidiary and, with respect to a Subsidiary that is a corporation, under the applicable Law of its jurisdiction of incorporation) and nonassessable (except as such nonassessability may be affected by Sections 18-607 and 18-804 of the DLLCA or the analogous provisions of applicable Law). Except as set forth in this Section 4.2, there are outstanding: (A) no voting securities of such Company or Green Gate Resources Parent, LLC, (B) no securities of such Company or any of its Subsidiaries convertible into or exchangeable or exercisable for shares, Equity Interests, Green Gate Equity Interests or other voting securities of such Company or its Subsidiaries and (C) no options, warrants, subscriptions, calls, rights (including preemptive and appreciation rights), commitments or agreements to which such Company or any of its Subsidiaries is a party or by which such Company is bound in any case obligating such Company or any of its Subsidiaries to issue, deliver, sell, purchase, redeem or acquire, or cause to be issued, delivered, sold, purchased, redeemed or acquired, additional Equity Interests or other voting securities of such Company or any of its Subsidiaries, or obligating such Company or any of its Subsidiaries to grant, extend or enter into any such option, warrant, subscription, call, right, commitment or agreement. Other than as set forth in the Organizational Documents of such Company and its Subsidiaries, there are no stockholder agreements, voting trusts or other agreements to which such Company or any of its Subsidiaries is a party or by which it or they are bound relating to the voting of any shares of capital stock or other equity interest of such Company or any of its Subsidiaries.

(c) Section 4.2(c) of the Company Disclosure Letter sets forth a true, correct and complete list of (1) all equity securities or other similar equity interests in any Person (including any interests in a joint venture) held by such Company or any of its Subsidiaries and (2) all obligations of such Company or any of its Subsidiaries, whether contingent or otherwise, to consummate any additional investment in any Person other than its Subsidiaries.

4.3 Authority; No Violations; Consents and Approvals.

(a) Such Company has all requisite limited liability company power and authority to execute and deliver this Agreement and, subject to the filing of the applicable Certificates of Merger with the Secretary of State of the State of Delaware in connection with the applicable Mergers, to perform its obligations hereunder. The execution and delivery of this Agreement by such Company and the consummation by such Company of the Mergers have been duly authorized by all necessary limited liability company action or corporate action, as applicable, on the part of such Company, concurrently with or prior to the execution of this Agreement. This Agreement has been duly executed and delivered by such Company and, assuming the due and valid execution of this Agreement by the Members, Parent and Merger Subs, constitutes a valid and binding obligation of such Company enforceable against such Company in accordance with its terms, subject, as to enforceability, to bankruptcy, insolvency, reorganization, moratorium and other Laws of general applicability relating to or affecting creditors' rights and to general principles of equity regardless of whether such enforceability is considered in a Proceeding in equity or at law (collectively, "Creditors' Rights"). The Company Board of such Company has duly authorized and approved this Agreement and the transactions contemplated hereby, including the applicable Merger and the applicable Subsequent Merger, and resolved to recommend that the applicable Members approve or adopt, as applicable, this Agreement (collectively, the "Company Member Approvals"). The applicable Company Member Approval is the only vote of the holders of any class or series of equity securities of such Company necessary to approve and adopt this Agreement and thereby approve the applicable Mergers. Concurrently with the execution of this Agreement, the Company Member Approval of such Company has been irrevocably obtained.

(b) The execution, delivery and performance of this Agreement does not, and the consummation of the Mergers will not (with or without notice or lapse of time, or both) (i) contravene, conflict with or result in a violation of any provision of the Organizational Documents of such Company or any of its Subsidiaries, (ii) result in a violation of, a termination (or right of termination) of or default under, the creation or acceleration of any obligation or the loss of a benefit under, or result in the creation of any Encumbrance upon any of the properties or assets of such Company or any of its Subsidiaries under, any provision of any loan or credit agreement, note, bond, mortgage, indenture, lease or other agreement, permit, franchise or license to which such Company or any of its Subsidiaries is a party or by which it or any of its Subsidiaries or its or their respective properties or assets are bound or (iii) assuming the Consents referred to in Section 4.4 are duly and timely obtained or made and the Company Member Approvals have been obtained, contravene, conflict with or result in a violation of any Law applicable to such Company or any of its Subsidiaries or any of their respective properties or assets, other than in the case of clauses (ii) and (iii), any such contraventions, conflicts, violations, defaults, acceleration, losses, or Encumbrances that would

be, individually or in the aggregate, immaterial to such Company and its Subsidiaries, taken as a whole. Other than the Organizational Documents of such Company, such Company is not party to any contract, arrangement or other commitment that does, would or would reasonably be expected to entitle any Person to appoint one or more managers to the governing body of such Company.

4.4 Consents. No Consent from any Governmental Entity is required to be obtained or made by such Company or any of its Subsidiaries in connection with the execution, delivery and performance of this Agreement by such Company or the consummation by such Company of the applicable Mergers, except for: (a) the filing of a premerger notification report by the Companies under the Hart-Scott-Rodino Antitrust Improvements Act of 1976 (the "HSR Act"), and the expiration or termination of any applicable waiting period with respect thereto; (b) the FERC Approval, (c) the filing of the applicable Certificates of Merger with the Office of the Secretary of State of the State of Delaware; (d) such filings and approvals as may be required by any applicable state securities or "blue sky" laws or Takeover Law, and (e) the Consents set forth on Section 4.4(a) of the Company Disclosure Letter.

4.5 Financial Statements.

(a) Such Company has provided Parent with complete and correct copies of the following financial statements (collectively, the "Financial Statements"): (i) the audited combined balance sheets of Aera Energy LLC and its subsidiaries and Aera Energy Services Company (collectively, the "Financial Statements Entities") as of December 31, 2022 and December 31, 2021, and the related audited combined statements of operations and other comprehensive income, members' and stockholders' equity and cash flows for the years then ended; and (ii) the unaudited combined balance sheets of the Financial Statements Entities as of November 30, 2023 (the "Most Recent Balance Sheet") and the related unaudited combined statements of operations and other comprehensive income and cash flows for the eleven-month period then ended (the Financial Statements referred to in this clause (ii), collectively, the "Interim Financial Statements").

(b) The Financial Statements (including the related notes thereto) fairly present in all material respects the combined financial condition, results of operations, changes in members' equity and cash flows of the Financial Statements Entities as of the dates or for the periods set forth therein and were prepared in accordance with GAAP consistently applied during the periods involved (subject, in the case of the Interim Financial Statements, to the absence of footnote disclosures and normal year-end audit adjustments that are not expected to be material in amount or effect), except as may be noted therein or indicated in the notes thereto.

(c) The Financial Statements Entities maintain a system of internal accounting controls that are designed to provide reasonable assurances that transactions are recorded as necessary to permit preparation of financial statements in accordance with GAAP.

(d) The Financial Statements Entities have disclosed, based on their most recent evaluations of their internal accounting controls prior to date hereof, to the Financial Statements Entities' auditors (i) any significant deficiencies and material weaknesses in the design or operation of internal controls that would be reasonably expected to adversely affect

the Financial Statements Entities' ability to record, process, summarize and report financial information for inclusion in the applicable combined financial statements and (ii) any known occurrence of fraud, whether or not material, that involves any current or former employees who have (or had) a significant role in the Financial Statements Entities' internal controls over financial reporting. Since the Applicable Date, to the knowledge of such Company, no material complaints from any source regarding accounting, internal accounting controls or auditing matters have been received by the Financial Statements Entities. Such Company has made available to Parent a summary of all material complaints or material concerns relating to other matters made since the Applicable Date through the Financial Statements Entities' whistleblower hotline or equivalent system for receipt of employee concerns regarding possible violations of Law.

(e) Such Company has no operations and has no liabilities or assets, other than its ownership interests in Green Gate Resources Parent, LLC, which ownership interest is direct or indirect as of the date hereof and shall be direct immediately prior to the Effective Time. Green Gate Resources Parent, LLC has no operations and has no liabilities or assets, other than its ownership interest in Green Gate Resources Holdings, LLC. Green Gate Resources Holdings, LLC has no operations and has no liabilities or assets, other than its ownership interests in Green Gate Resources E LLC and Green Gate Resources S LLC. Green Gate Resources E LLC has no operations and has no liabilities or assets, other than its ownership interest in Green Gate Intermediate LLC. Green Gate Resources S LLC has no operations and has no liabilities or assets, other than its ownership interest in Green Gate Intermediate LLC. Green Gate Intermediate LLC has no operations and has no liabilities or assets, other than its ownership interest in Aera Energy LLC and Aera Energy Services Company.

4.6 Absence of Certain Changes or Events.

(a) From December 31, 2022 through the date of this Agreement, there has not been a Company Material Adverse Effect or any event, change, effect or development that, individually or in the aggregate, would reasonably be expected to have a Company Material Adverse Effect.

(b) From the date of the Most Recent Balance Sheet through the date of this Agreement:

(i) such Company and its Subsidiaries have conducted their business in the Ordinary Course in all material respects;

(ii) there has not been any material damage, destruction or other casualty loss with respect to any material asset or property owned, leased or otherwise used by such Company or any of its Subsidiaries, including the Oil and Gas Properties of such Company and its Subsidiaries, whether or not covered by insurance; and

(iii) neither such Company nor any of its Subsidiaries has taken, or agreed, committed, arranged, authorized or entered into any understanding to take, any action that, if taken after the date of this Agreement and prior to the Closing Date, would

(without Parent's prior written consent) have constituted a breach of any of the covenants set forth in Section 7.1(b).

4.7 No Undisclosed Material Liabilities. There are no liabilities of such Company or any of its Subsidiaries of any kind whatsoever, whether accrued, contingent, absolute, determined, determinable or otherwise, other than: (a) liabilities adequately provided for on the Most Recent Balance Sheet or the Financial Statements (including the notes thereto, as applicable); (b) liabilities incurred in the Ordinary Course subsequent to the date of the Most Recent Balance Sheet; (c) executory obligations under any contract, which are not related to any breach or default of a contract by such Company or any of its Subsidiaries; (d) liabilities incurred in connection with the Mergers; and (e) liabilities that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

4.8 Information Supplied. None of the information supplied or to be supplied by such Company for inclusion or incorporation by reference in the Proxy Statement will, at the date it is first mailed to stockholders of Parent and at the time of the Parent Stockholders Meeting, contain any untrue statement of a material fact or omit to state any material fact required to be stated therein or necessary in order to make the statements therein, in the light of the circumstances under which they are made, not misleading.

4.9 Company Permits; Compliance with Applicable Law.

(a) Such Company and its Subsidiaries hold and at all times since December 31, 2021 (the "Applicable Date") have held all material permits, licenses, certifications, registrations, consents, authorizations, variances, exemptions, orders, franchises and approvals of all Governmental Entities (collectively, the "Company Permits") necessary for the lawful conduct of their respective businesses as they were or are now being conducted, as applicable, and have paid all fees and assessments due and payable in connection therewith. Except as would be, individually or in the aggregate, immaterial to such Company and its Subsidiaries, taken as a whole, all such Company Permits are in full force and effect and no suspension or cancellation of any of such Company Permits is pending or, to the knowledge of such Company, threatened, and such Company and its Subsidiaries are in compliance with the terms of such Company Permits. Such Company and its Subsidiaries has fulfilled and performed its obligations with respect to such Company Permits, conducts its business in a manner that does not violate any of such Company Permits, and no event has occurred that allows, or after notice or lapse of time would allow, revocation or termination thereof or would result in any impairment of the rights of the holder of any of such Company Permits, except for such revocations, terminations and impairments that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(b) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries taken as a whole, the businesses of such Company and its Subsidiaries are, and since the Applicable Date have been, in compliance with all applicable Law. To the knowledge of such Company, no investigation or review by any Governmental Entity with respect to such Company or any of its Subsidiaries is

pending or threatened, other than those the outcome of which would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

4.10 Compensation; Benefits.

(a) Section 4.10(a) of the Company Disclosure Letter sets forth a true, correct and complete list of all of the material Company Plans.

(b) With respect to each material Company Plan, true, correct and complete copies of the following have (as applicable) been made available to Parent: (i) the plan document, including any amendments thereto (or, in the case of any material Company Plan not in writing, a description of the material terms thereof) and related trust documents, insurance contracts or other funding vehicles, if any, (ii) the most recently prepared actuarial report, (iii) the most recent Internal Revenue Service determination or opinion letter, (iv) the most recent report filed on Form 5500 and summary plan description (together with any summaries of all material modifications thereto) with respect to each material Company Plan required to file a Form 5500, and (v) all non-routine material correspondence to or from any Governmental Entity received in the last two years.

(c) Each Company Plan has been established, operated and maintained in compliance in all material respects with its terms and all applicable Laws, including ERISA and the Code.

(d) There are no actions, suits or claims pending (other than routine claims for benefits) or, to the knowledge of such Company, threatened against, or with respect to, any of the Company Plans, and there are no Proceedings by a Governmental Entity with respect to any of the Company Plans, except in each case of the forgoing for such pending actions, suits, claims or Proceedings that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(e) There are no unfunded benefit obligations that have not been properly accrued for in the Financial Statements, and since the Applicable Date all contributions required to be made by such Company and its Subsidiaries to the Company Plans pursuant to their terms in respect of current or prior plan years have been timely made or accrued for in the Financial Statements in accordance with GAAP.

(f) Each Company Plan that is intended to be qualified under Section 401(a) of the Code has been determined by the Internal Revenue Service to be qualified under Section 401(a) of the Code and, to the knowledge of such Company, nothing has occurred that could adversely affect the qualification or tax exemption of any such Company Plan. With respect to any Company Plan, neither such Company nor any of its Subsidiaries have engaged in a transaction in connection with which such Company or any of its Subsidiaries reasonably could be subject to either a civil penalty assessed pursuant to Section 409 or 502(i) of ERISA or a tax imposed pursuant to Section 4975 or 4976 of the Code in an amount that could be material.

(g) Neither such Company nor any of its Subsidiaries has during the last six years or is expected to incur any material liability under subtitles C or D of Title IV of ERISA with respect to any ongoing, frozen or terminated "single-employer plan", within the meaning of Section 4001(a)(15) of ERISA, currently or formerly maintained by any of them or any ERISA Affiliate. With respect to any Company Plan subject to the minimum funding requirements of Section 412 of the Code or Title IV of ERISA, (i) no such plan is, or is expected to be, in "at-risk" status (within the meaning of Section 303(i)(4)(A) of ERISA or Section 430(i)(4)(A) of the Code), (ii) as of the last day of the most recent plan year ended prior to the date hereof, the actuarially determined present value of all "benefit liabilities" within the meaning of Section 4001(a)(16) of ERISA did not exceed the then current value of assets of such Company Plan, (iii) no unsatisfied liability (other than for premiums to the Pension Benefit Guaranty Corporation) under Title IV of ERISA has been, or is expected to be, incurred by such Company or any of its Subsidiaries, (iv) the Pension Benefit Guaranty Corporation has not instituted proceedings to terminate any such Company Plan and (v) no "reportable event" within the meaning of Section 4043 of ERISA (excluding any such event for which the 30 day notice requirement has been waived under the regulations to Section 4043 of ERISA) has occurred, nor has any event described in Sections 4062, 4063 or 4041 of ERISA occurred. For purposes of this Agreement, "ERISA Affiliate" means all employers (whether or not incorporated) that would be treated together with such Company or any of its Subsidiaries as a "single employer" within the meaning of Section 414 of the Code.

(h) Neither such Company nor any ERISA Affiliate has maintained, established, participated in or contributed to, or is or has been obligated to contribute to, or has otherwise incurred any obligation or liability (including any contingent liability) under, any "multiemployer plans" within the meaning of Section 3(37) of ERISA (each, a "Multiemployer Plan") in the last six years. No Company Plan is a "multiple employer welfare arrangement" (as defined in Section 3(40) of ERISA).

(i) Except as required by applicable Law, no Company Plan provides retiree or post-employment medical, disability, life insurance or other welfare benefits to any Person, and neither such Company nor any of its Subsidiaries has any obligation to provide such benefits, except where the cost thereof is borne entirely by the former employee (or his or her eligible dependents or benefits) or as required by Section 4980B(f) of the Code or any similar Laws. To the extent that such Company or any of its Subsidiaries sponsors such plans, such Company or such Subsidiary has reserved the right to amend, terminate or modify at any time each Company Plan that provides retiree or post-employment disability, life insurance or other welfare benefits to any Person.

(j) Neither the execution and delivery of this Agreement nor the consummation of the Mergers could, either alone or in combination with another event, (i) entitle any employee of such Company or its Subsidiaries to severance pay or any increase in severance pay, (ii) accelerate the time of payment or vesting, or increase the amount of compensation due to any such employee of such Company or its Subsidiaries, (iii) directly or indirectly cause such Company or its Subsidiaries to transfer or set aside any material amount of assets to fund any material benefits under any Company Plan, (iv) otherwise give rise to any material liability under any Company Plan or (v) limit or restrict the right to materially amend, terminate or transfer the assets of any Company Plan on or following the Effective Time.

(k) Neither the execution and delivery of this Agreement nor the consummation of the Mergers could, either alone or in combination with another event, result in any "excess parachute payment" within the meaning of Section 280G of the Code.

(l) Neither such Company nor any of its Subsidiaries has any obligation to provide, and no Company Plan or other agreement provides any individual with the right to, a gross up, indemnification, reimbursement or other payment for any excise or additional Taxes, interest or penalties incurred pursuant to Section 409A or Section 4999 of the Code or due to the failure of any payment to be deductible under Section 280G of the Code.

(m) No Company Plan is maintained outside the jurisdiction of the United States or covers any current or former employee of such Company or its Subsidiaries who reside or work outside of the United States.

4.11 Labor Matters.

(a) Prior to the date hereof, such Company has made available a census of each employee of such Company or any of its Subsidiaries that is true and complete in all material respects and contains the following information: (i) the name or employee identification number, (ii) job title, (iii) date of hire, (iv) principal work location, (v) whether the employee is active or on leave (and if on leave, the anticipated date of return), (vi) exempt or non-exempt classification status under the Fair Labor Standards Act, (vii) annualized salary, (viii) target annual cash bonus opportunity and (ix) long-term bonus eligibility.

(b) (i) Section 4.11(b)(i) of the Company Disclosure Letter sets forth all collective bargaining agreements and other agreements with any labor union, works council, or other similar bargaining unit representative to which any of such Company or its Subsidiaries is party or otherwise bound, complete and correct copies of which, each as amended prior to the execution of this Agreement, have been made available to Parent, (ii) there is no pending union representation petition before the National Labor Relations Board or similar Governmental Entity involving employees of such Company or any of its Subsidiaries, and (iii) to the knowledge of such Company, there is no pending activity by any labor organization (or representative thereof) or employee group (or representative thereof) to organize any such employees.

(c) There is no unfair labor practice charge, arbitration, complaint, grievance or Proceeding by, before or involving any Governmental Entity against such Company or any of its Subsidiaries pending, or, to the knowledge of such Company, threatened.

(d) There is no strike, concerted slowdown, work stoppage, lockout pending or material dispute, or, to the knowledge of such Company, threatened, against or involving such Company or any of its Subsidiaries.

(e) Such Company and its Subsidiaries are, and since the Applicable Date have been, in compliance in all material respects with all applicable Laws respecting labor, employment, employment practices terms and conditions of employment, wages and hours, and occupational safety and health ("Employment Laws").

(f) There are no Proceedings pending or, to the knowledge of such Company, threatened against such Company or any of its Subsidiaries, by or on behalf of any applicant for employment, any current or former employee or any class of the foregoing, relating to any Employment Laws, or alleging breach of any express or implied contract of employment, wrongful termination of employment, or alleging any other discriminatory, wrongful or tortious conduct in connection with the employment relationship. Since the Applicable Date, neither such Company nor any of its Subsidiaries has received any written notice of the intent of the Equal Employment Opportunity Commission, the National Labor Relations Board, the Department of Labor or any other Governmental Entity responsible for the enforcement of Employment Laws to conduct an investigation with respect to such Company or any of its Subsidiaries.

(g) Since the Applicable Date: (i) to the knowledge of such Company, no allegations of sexual harassment have been made against any current or former director or employee of such Company or its Subsidiaries at the level of Director or above; and (ii) neither such Company nor any of its Affiliates have been in involved in any Proceedings, or entered into any settlement agreements, related to such allegations.

(h) Neither such Company nor any of its Affiliates have utilized or waived the employment tax deferral or employee retention credit relief provided under Sections 2301, 2302 or 3606 of the Coronavirus Aid, Relief, and Economic Security Act, as applicable, or the payroll tax obligation deferral under IRS Notice 2020-65 or any related guidance, executive order or memorandum.

(i) Since the Applicable Date, no individual who has performed services for such Company or any of its Subsidiaries have been improperly excluded from participation in any Company Plan. Except as would be, individually or in the aggregate, immaterial to such Company and its Subsidiaries, taken as a whole, neither such Company nor any of its Subsidiaries has any liability, whether actual or contingent, with respect to any misclassification of any person as an independent contractor rather than as an employee, with respect to any misclassification of any employee as exempt versus non-exempt, or with respect to any employee leased from another employer and there is no pending or, to the knowledge of such Company, threatened claim by any Person who is performing or has performed services for such Company or any of its Subsidiaries that such Person is or was misclassified for any purpose under applicable Law. There is no pending or, to the knowledge of such Company, threatened claim by any current employee or former employee that such employee has not been given the meal or rest periods to which he or she is or was entitled under applicable Law, nor does such Company or any of its Subsidiaries have any liability with respect to the failure to give meal/rest periods to any eligible current or former employee except such liabilities as would be, individually or in the aggregate, immaterial to such Company and its Subsidiaries, taken as a whole.

4.12 Taxes.

(a) All income and other material Tax Returns required to be filed (i) by or with respect to such Company or any of its Subsidiaries or (ii) with respect to any of the assets of such Company or any of its Subsidiaries have been duly and timely filed with the

appropriate Taxing Authority when due (taking into account extensions of time for filing), and all such filed Tax Returns are true, complete and accurate in all material respects. All income and other material Taxes that are due and payable (whether or not shown on any Tax Returns and whether or not as a result of any required estimated tax payments) by such Company or any of its Subsidiaries or with respect to any of the assets of such Company or any of its Subsidiaries (other than Taxes being contested in good faith by appropriate Proceedings and for which adequate reserves have been established in accordance with GAAP in the Financial Statements) have been paid in full. All material withholding Tax requirements imposed on or with respect to such Company or any of its Subsidiaries have been satisfied in full, and such Company or any of its Subsidiaries have complied in all respects with all information reporting (and related withholding) and record retention requirements. Such Company and its Subsidiaries has properly reserved or accrued, in accordance with GAAP, all material amounts of Taxes not yet due and payable and all required estimated Tax payments sufficient to avoid any material underpayment penalties or interest have been made by or on behalf of such Company and its Subsidiaries. Such Company has not incurred material liability for Taxes outside the Ordinary Course, and there is no matter or circumstance which is reasonably expected to result in additional Tax liabilities of such Company outside of the Ordinary Course.

(b) After giving effect to the Restructuring, such Company has no direct or indirect Subsidiaries, other than Green Gate Resources Parent, LLC and its Subsidiaries.

(c) There is not in force any consent, waiver or agreement for any extension of time for the assessment or payment of any income or other material Tax by such Company or any of its Subsidiaries and there has been no written request by any Taxing Authority to execute such a consent, waiver or agreement.

(d) There is no outstanding claim, assessment or deficiency against such Company or any of its Subsidiaries, or with respect to any of the assets of such Company or any of its Subsidiaries, in respect of any income or other material Taxes that has been asserted or, to the knowledge of such Company, threatened by any Governmental Entity. There are no disputes, audits, examinations, investigations or Proceedings pending or, to the knowledge of each Company, threatened regarding any Taxes of such Company or any of its Subsidiaries or the assets of such Company and its Subsidiaries.

(e) Neither such Company nor any of its Subsidiaries is a party to any Tax allocation, sharing or indemnity contract or arrangement (not including, for the avoidance of doubt (i) an agreement or arrangement solely between or among any of the Companies and/or any of their Subsidiaries, or (ii) any customary Tax sharing or indemnification provisions contained in any commercial agreement entered into in the Ordinary Course and not primarily relating to Tax (e.g., leases, credit agreements or other commercial agreements)). Neither such Company nor any of its Subsidiaries has (x) been a member of an affiliated group filing a consolidated U.S. federal income Tax Return (other than a group the common parent of which is or was any Company or any of its Subsidiaries) or (y) any liability for Taxes of any Person (other than any Company or any of its Subsidiaries) under Treasury Regulations § 1.1502-6 (or any similar provision of state, local or foreign Law) or as a transferee or successor, by contract (other than contracts described in the preceding clause (ii)) or otherwise.

(f) Neither such Company nor any of its Subsidiaries has participated, or is currently participating, in a "listed transaction," as defined in Treasury Regulations § 1.6011-4(b)(2) (or any similar provision of state, local or foreign Law).

(g) Neither such Company nor any of its Subsidiaries has constituted a "distributing corporation" or a "controlled corporation" in a distribution of stock intended to qualify for tax-free treatment under Section 355 of the Code (or any similar provision of state, local or foreign Law) (i) in the two years prior to the date of this Agreement or (ii) as part of a "plan" or "series of related transactions" (within the meaning of Section 355(e) of the Code) in conjunction with the Mergers.

(h) No claim has been made by any Taxing Authority in a jurisdiction where such Company or any of its Subsidiaries does not currently file a Tax Return that it, or any of the assets of such Company or any of its Subsidiaries, is or may be (i) required to filed any Tax Return or (ii) subject to any Tax, in each case in such jurisdiction, nor, to the knowledge of such Company, has any such assertion been threatened or proposed by such Taxing Authority.

(i) Such Company and each of its Subsidiaries is resident for Tax purposes in the country where it is incorporated or formed. Neither such Company nor any of its Subsidiaries is engaged in or has ever been engaged in a trade or business through a "permanent establishment" within the meaning of an applicable income Tax treaty or otherwise has an office or fixed place of business in any country other than the United States.

(j) Neither such Company nor any of its Subsidiaries has requested, has received or is subject to any written ruling of a Taxing Authority that will be binding on it for any taxable period ending after the Closing Date or has entered into any "closing agreement" as described in Section 7121 of the Code (or any similar provision of state, local or foreign Law).

(k) Such Company has made available all Tax Returns filed by or with respect to it and its Subsidiaries for all open taxable years.

(l) There are no Encumbrances for Taxes on any of the assets of such Company or any of its Subsidiaries, except for Permitted Encumbrances.

(m) Neither such Company nor any of its Subsidiaries will be required to include any material item of income in, or to exclude any material item of deduction from, taxable income in any taxable period (or portion thereof) ending after the Closing Date as a result of any closing agreement, installment sale or open transaction on or prior to the Closing Date, any accounting method change or agreement with any Taxing Authority, any prepaid amount received outside the Ordinary Course on or prior to the Closing Date, any intercompany transaction or excess loss account described in Section 1502 of the Code (or any corresponding provision of Law with respect to Taxes), or any election pursuant to Section 108(i) or Section 965(h) of the Code (or any similar provision of state, local or foreign Law) made with respect to any taxable period ending on or prior to the Closing Date.

(n) Neither such Company nor any of its Subsidiaries is a "United States shareholder" (within the meaning of Section 951(b) of the Code) of any foreign corporation

which may be required to include in income any amounts under Section 951(a) of the Code (or any similar provision of state, local or foreign Law).

(o) Neither such Company nor any of its Subsidiaries has availed itself of any government grants, Tax holidays, loans, or other Tax benefits or relief related to COVID-19, including a loan under the Paycheck Protection Program or relief pursuant to Section 2301 or Section 2302 of the CARES Act or any similar applicable federal, state or local Law.

(p) Such Company and its Subsidiaries has (x) collected and remitted, or will remit on a timely basis, in each case, all material sales, use, value-added and similar Taxes required by applicable Law to be collected with respect to sales made or services provided to its customers, (y) for all material sales or services that are exempt from sales, use, value-added and similar Taxes and that were made without charging or remitting such Taxes, received and retained any appropriate tax exemption certificates and other documentation qualifying such sale or services as exempt and (z) materially complied with all applicable transfer pricing laws and regulations including any applicable record keeping obligations.

(q) There are no private letter rulings, closing agreements, gain recognition agreements or similar agreements or rulings that have been entered into or issued by any Governmental Entity in respect of any Tax matters with respect to such Company or any of its Subsidiaries or with respect to any of the assets of such Company or any of its Subsidiaries.

(r) Such Company, in respect of IKAV Co-Invest, is, and has been at all times since its formation, classified and properly treated as a partnership for U.S. federal income Tax purposes, or, in respect of each other Company, is, and has been at all times since its formation, classified as and properly treated as a C corporation for U.S. federal income Tax purposes.

(s) Each Subsidiary of such Company that is treated as a partnership for U.S. federal income Tax purposes (such subsidiaries, "Partnership Subsidiaries") has made a valid election under Section 754 of the Code, which election will be effective for the taxable period that includes the Closing Date.

(t) Neither such Company nor any of the Partnership Subsidiaries is or has ever been treated as a "publicly traded partnership" within the meaning of Section 7704 of the Code. As of the date of this Agreement, such Company has made available to Parent all information that has been reasonably requested by Parent for Parent to determine that neither such Company nor any of the Partnership Subsidiaries is or has ever been treated as a "publicly traded partnership" within the meaning of Section 7704 of the Code.

(u) Neither such Company nor any of its Subsidiaries is a party to any contractual arrangement or joint venture or other arrangement (other than the applicable operating agreements of any Partnership Subsidiaries) that is characterized as a partnership for Tax purposes.

(v) No Subsidiary of such Company (other than Aera Energy Services Company and Terrain Technology Inc.) is treated as an association taxable as a corporation for U.S. federal income tax purposes. The current entity classifications of such Company and each

of its Subsidiaries for U.S. federal income Tax purposes are set forth in Section 4.12(v) of the Company Disclosure Letter.

(w) No election has been made with respect to any Partnership Subsidiaries to apply Subchapter C of Chapter 63 of the Code to any taxable year beginning before January 1, 2018, and no similar election has been made with respect to any Partnership Subsidiaries under any similar provisions of state or local Law.

(x) Such Company is not a "domestically controlled qualified investment entity" within the meaning of Section 897(h)(4) of the Code.

(y) Neither such Company nor any of its Subsidiaries has taken or agreed to take, or have any plan or intention of taking, any action not contemplated by this Agreement and/or any other Transaction Documents that could reasonably be expected to prevent, impair or impede the Intended Tax Treatment. To the knowledge of such Company, there is no fact or circumstance that could reasonably be expected to prevent, impair or impede the Intended Tax Treatment.

(z) Such Company (other than IKAV Co-Invest) is a "United States real property holding corporation" within the meaning of Section 897(c)(2) of the Code and the Treasury Regulations promulgated thereunder. The Equity Interests of such Company constitute "United States real property interests" within the meaning of Section 897(c)(1) of the Code and the Treasury Regulations promulgated thereunder.

4.13 Litigation. Except for such matters as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, there is no (a) Proceeding pending, or, to the knowledge of such Company, threatened against such Company or any of its Subsidiaries or any of their Oil and Gas Properties or (b) judgment, decree, injunction, ruling, order, writ, stipulation, determination or award of any Governmental Entity or arbitrator (each, an "Order") outstanding against such Company or any of its Subsidiaries. Neither such Company nor any of its Subsidiaries is a party to or subject to the provisions of any Order that restricts the manner in which such Company and its Subsidiaries conduct their businesses in any material respect.

4.14 Intellectual Property.

(a) Section 4.14(a) of the Company Disclosure Letter contains a list of all Intellectual Property owned or purported to be owned by such Company or any of its Subsidiaries ("Company Intellectual Property") that is registered with, issued by or the subject of a pending application before any Governmental Entity (collectively, the "Registered Company IP"), including for each such item of Registered Company IP (i) the jurisdiction where each item of such Registered Company IP is registered or filed, (ii) the applicable patent, registration or application number and (iii) the current record owner. Each item of Registered Company IP is subsisting and, to the knowledge of such Company, other than Registered Company IP constituting applications, valid and enforceable.

(b) Such Company and its Subsidiaries exclusively own all right, title and interest to all material Company Intellectual Property, free and clear of all Encumbrances

except for Permitted Encumbrances. Such Company and its Subsidiaries own or have the right to use all Intellectual Property material to and used in or necessary for the operation of the businesses of such Company and its Subsidiaries as presently conducted except where the failure to own or have such right would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(c) To the knowledge of such Company, the operation of the businesses of such Company and its Subsidiaries as presently conducted, does not infringe, misappropriate or otherwise violate any Intellectual Property of any other Person, except as would not reasonably be expected, individually or in the aggregate, to result in material liability, individually or in the aggregate, to such Company and its Subsidiaries, taken as a whole. There are no pending or, to the knowledge of such Company, threatened claims in writing against such Company or any of its Subsidiaries (i) alleging infringement, misappropriation, or other violation by such Company or any of its Subsidiaries of any Intellectual Property of any other Person, except as would not reasonably be expected, individually or in the aggregate, to result in material liability, individually or in the aggregate, to such Company and its Subsidiaries, taken as a whole, or (ii) challenging the ownership, validity or enforceability of any Registered Company IP that is material to such Company and its Subsidiaries, taken as a whole.

(d) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, to the knowledge of such Company, no Person is infringing, misappropriating or otherwise violating, any Company Intellectual Property.

(e) Such Company and its Subsidiaries have taken reasonable measures consistent with prudent industry practices to protect the confidentiality of Trade Secrets included in the Company Intellectual Property or otherwise used in the businesses of such Company and its Subsidiaries as presently conducted, except where failure to do so is not and would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole. No such Trade Secrets have been used, disclosed to or, to the knowledge of such Company, accessed by, any Person, other than pursuant to valid and enforceable confidentiality and non-disclosure obligations that, to the knowledge of such Company, has not been breached, except where such use, disclosure or access is not and would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(f) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, the IT Assets owned, used, or held for use by such Company or any of its Subsidiaries (collectively, "Company IT Assets"): (i) are sufficient for the current needs of the businesses of such Company and its Subsidiaries; (ii) have not malfunctioned or failed since the Applicable Date; and (iii) to the knowledge of such Company, are free from any Malicious Code.

(g) Such Company and its Subsidiaries have taken commercially reasonable measures to ensure the confidentiality, privacy and security of Personal Information collected or held for use by such Company and its Subsidiaries that are consistent in all material respects with all Privacy Laws. Except as would not reasonably be expected, individually or in the

aggregate, to be material to such Company and its Subsidiaries, taken as a whole, to the knowledge of such Company, there has been no unauthorized access to, or unauthorized disclosure or use of, as applicable, any Company IT Assets or Personal Information collected or held for use by such Company or its Subsidiaries. Such Company and its Subsidiaries: (i) are in compliance in all material respects with all Privacy Laws; (ii) have not, since the Applicable Date, notified, or been legally required to notify, any Person of any unauthorized access to, or unauthorized disclosure or use of, any Personal Information collected or held for use by such Company or its Subsidiaries; and (iii) except as would not reasonably be expected, individually or in the aggregate, to result in material liability, or otherwise be material, to such Company and its Subsidiaries, taken as a whole, have not received any written notice, communication or complaint from any Person alleging a breach of (or claiming compensation under) any Privacy Laws.

4.15 Real Property.

(a) Section 4.15(a) of the Company Disclosure Letter includes, among other things (but without delineation as between the Owned Real Property and the Oil and Gas Property), a list of all material real property owned in fee by such Company or its Subsidiaries (such material real property, exclusive of any Oil and Gas Property and the Real Property Assets (as defined in Exhibit D), the "Owned Real Property"). Except in any such case as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, (i) such Company or its Subsidiaries, as applicable, has good and marketable title to all real property (other than any Oil and Gas Property) in which such Company or its Subsidiaries hold a fee interest (the "Owned Real Property"), free and clear of all Encumbrances except for Permitted Encumbrances, (ii) neither such Company nor any of its Subsidiaries has granted any outstanding options or rights of first refusal to purchase the Owned Real Property, or any portion of the Owned Real Property or interest therein and (iii) except pursuant to the Permitted Encumbrances, neither such Company nor any of its Subsidiaries, as applicable, has leased or otherwise granted to any Person the right to use or occupy any Owned Real Property or any portion thereof.

(b) Section 4.15(b) of the Company Disclosure Letter sets forth a list of all material real property (other than any Oil and Gas Property) leased or subleased to such Company or any of its Subsidiaries (collectively, the "Leased Real Property", and, together with the Owned Real Property, the "Real Property") and a list of all leases and subleases entered into by such Company or its Subsidiaries with respect to the Leased Real Property (the "Leases"). Except in any such case as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, (i) such Company or its applicable Subsidiary has a valid leasehold or subleasehold interest in all Leased Real Property, free and clear of all Encumbrances except for Permitted Encumbrances, (ii) there exists no default or event of default on the part of any of such Company or its Subsidiaries (as applicable) under the Leases, and (iii) except pursuant to the Permitted Encumbrances, neither such Company nor any of its Subsidiaries, as applicable, has leased or otherwise granted to any Person the right to use or occupy any Leased Real Property or any portion thereof.

(c) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, (i) such Company and its Subsidiaries hold all of their respective easements and rights-of-way (other than any Oil and Gas Property) (collectively, "Rights-of-Way") that such Company and its Subsidiaries use in the conduct of their respective businesses, (ii) there exists no default or event of default on the part of such Company or its Subsidiaries (as applicable) under any Rights-of-Way, and (iii) no event has occurred that allows, or after notice or lapse of time would allow, revocation or termination of any Right-of-Way by the applicable counterparty thereto. Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, all pipelines operated by such Company and its Subsidiaries are subject to Rights-of-Way or are located on the Real Property. There are no gaps (including any gap arising as a result of any breach by the such Company any of its Subsidiaries of the terms of any Rights-of-Way) in the Rights-of-Way other than gaps that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(d) As of the date of this Agreement, (i) neither such Company nor any of its Subsidiaries is in breach or default of any restrictive covenant affecting the Real Property, and to which the interests of such Company or its Subsidiaries in such Real Property are subject and subordinate, and, (ii) there has not occurred any event that with the lapse of time or the giving of notice, or both, would constitute such a default under any such restrictive covenant affecting the Real Property, in each case of clauses (i) and (ii), except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(e) As of the date of this Agreement, except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, (i) all improvements owned by such Company or its Subsidiaries and located on the Real Property (the "Improvements") are in good condition and repair, except for ordinary wear and tear and (ii) are sufficient for the operation of the business of such Company or its Subsidiaries as currently used.

(f) No damage or destruction has occurred with respect to any of the Real Property that would reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, not covered by an insurance policy.

(g) There are no pending or, to the knowledge of such Company, threatened condemnation, expropriation or eminent domain proceedings with respect to any Real Property, in each case, except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole.

(h) Notwithstanding the foregoing or any other provision of this Agreement to the contrary, in no event shall the representations and warranties of this Section 4.15 pertain in any way to the Real Property Assets (as defined in Exhibit D) or any property pertaining thereto, and the terms "Owned Real Property", "Leased Real Property", "Real Property", "Rights-of-Way" and "Improvements" (each as used in this Agreement) shall not include the Real Property Assets or any property pertaining thereto.

4.16 Oil and Gas Matters.

(a) Section 4.16(a) of the Company Disclosure Letter includes, among other things (but without delineation as between the Owned Real Property and the Oil and Gas Property), a list of all Oil and Gas Properties owned by such Company or its Subsidiaries in all material respects. Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, and except for property (i) reflected in the reserve reports prepared by Netherland, Sewell & Associates, Inc. (the "Company Independent Petroleum Engineers") relating to the Companies' interests referred to therein as of December 31, 2022 (the "Company Reserve Reports") as having been sold or otherwise disposed of, or (ii) sold or otherwise disposed of in the Ordinary Course since the Company Reserve Reports (in each case, other than sales or dispositions after the date hereof in accordance with Section 7.1(b)(vi)), such Company and its Subsidiaries have good and defensible title to all Oil and Gas Properties forming the basis for the reserves reflected in the Company Reserve Reports and in each case as attributable to interests owned by such Company and its Subsidiaries, free and clear of any Encumbrances, except for Permitted Encumbrances. For purposes of the foregoing sentence, "good and defensible title" means that such Company's or one or more of its Subsidiaries', as applicable, title (as of the date hereof and as of the Closing) to each of the Oil and Gas Properties held or owned by them (or purported to be held or owned by them) (1) entitles such Company (or one or more of its Subsidiaries, as applicable) to receive (after satisfaction of all Production Burdens applicable thereto), not less than the net revenue interest share shown in the Company Reserve Reports of all Hydrocarbons produced from such Oil and Gas Properties throughout the life of such Oil and Gas Properties, other than decreases in connection with operations in which the Company or its Subsidiaries may be a non-consenting co-owner, decreases resulting from reversion of interests to co-owners with respect to operations in which such co-owners elected not to consent, decreases resulting from the establishment of pools or units, and decreases required to allow other working interest owners to make up past underproduction or pipelines to make up past under deliveries; in each case, to the extent occurring after the date of the Company Reserve Report, (2) obligates such Company (or one or more of their Subsidiaries, as applicable) to bear a percentage of the costs and expenses for the maintenance and development of, and operations relating to, such Oil and Gas Properties, of not greater than the working interest shown on the Company Reserve Reports for such Oil and Gas Properties (other than any positive differences in such percentage) and the applicable working interest shown on the Company Reserve Reports for such Oil and Gas Properties that are accompanied by a proportionate (or greater) net revenue interest in such Oil and Gas Properties and (3) is free and clear of all Encumbrances (other than Permitted Encumbrances). Notwithstanding anything herein to the contrary, the Company and its Subsidiaries will not treat title to any Oil and Gas Property affected or burdened by a sliding scale Production Burden as less than defensible title so long as such Production Burden is accurately disclosed on the Company Reserve Report.

(b) The factual, non-interpretive data supplied by such Company or its Subsidiaries to the Company Independent Petroleum Engineers relating to such Company's or its Subsidiaries' interests referred to in the Company Reserve Reports, by or on behalf of such Company and its Subsidiaries that was material to such firm's estimates of proved oil and gas reserves attributable to the Oil and Gas Properties of such Company and its Subsidiaries in

connection with the preparation of the Company Reserve Reports was, as of the time provided, accurate in all material respects. Except for any such matters that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, the oil and gas reserve estimates of such Company or its Subsidiaries set forth in the Company Reserve Reports are derived from reports that have been prepared by the Company Independent Petroleum Engineers, and such reserve estimates fairly reflect, in all respects, the oil and gas reserves of such Company and its Subsidiaries at the dates indicated therein. Except for changes generally affecting the oil and gas exploration, development and production industry (including changes in commodity prices) and normal depletion by production, there has been no change in respect of the matters addressed in the Company Reserve Reports that would reasonably be expected to be material to such Company and its Subsidiaries, taken as a whole.

(c) Except for such acts or failures to act as would not be reasonably expected to be material to such Company and its Subsidiaries, taken as a whole, the Oil and Gas Properties (and properties unitized therewith) of such Company and its Subsidiaries have been maintained, operated and developed in a good and workmanlike manner and in conformity with the provisions of all leases, subleases or other contracts comprising a part of the Oil and Gas Leases and other contracts and agreements forming a part of such Oil and Gas Properties of such Company and its Subsidiaries. Specifically in connection with the foregoing, except for those as would not be reasonably expected to be material to such Company and its Subsidiaries, taken as a whole, (a) no Oil and Gas Property of such Company and its Subsidiaries is subject to having allowable production reduced below the full and regular allowable (including the maximum permissible tolerance) because of any overproduction (whether or not the same was permissible at the time) and (b) none of the wells comprising a part of the Oil and Gas Properties (or properties unitized therewith) of such Company and its Subsidiaries is deviated from the vertical more than the maximum permitted by Law, and such wells are, in fact, bottomed under and are producing from, and the well bores are wholly within, the Oil and Gas Properties (or in the case of wells located on properties unitized therewith, such unitized properties) of such Company and its Subsidiaries. All pipelines, wells, gas processing plants, platforms and other material improvements, fixtures and equipment owned in whole or in part by such Company and its Subsidiaries that are necessary to conduct normal operations are being maintained in a state adequate to conduct normal operations, and with respect to such of the foregoing which are operated by such Company and its Subsidiaries, in a manner consistent with the past practices of such Company and its Subsidiaries (other than those the failure of which to maintain in accordance with this Section would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole). Such Company and its Subsidiaries do not own, and have not acquired or made any other expenditure (whether such expenditure is capital, operating or otherwise) in or related to, any Oil and Gas Properties located outside of the geographical boundaries of the United States or in the offshore federal waters of the United States.

(d) There are no take-or-pay or other prepayments which would require such Company to deliver Hydrocarbons produced from their Oil and Gas Properties at some future time without then or thereafter receiving full payment therefor. Except as would be,

individually or in the aggregate, immaterial to such Company and its Subsidiaries, taken as a whole, there are no gas imbalances applicable to the Oil and Gas Properties.

(e) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, (i) all rentals, shut-ins and similar payments owed to any Person or individual under (or otherwise with respect to) any Oil and Gas Leases have been properly and timely paid, (ii) all royalties, minimum royalties, overriding royalties and other Production Burdens with respect to any Oil and Gas Properties owned or held by such Company and its Subsidiaries have been timely and properly paid and (iii) neither such Company nor any of its Subsidiaries (and, to the knowledge of such Company, no third party operator) has violated any provision of, or taken or failed to take any act that, with or without notice, lapse of time, or both, would constitute a default under the provisions of any Oil and Gas Lease (or entitle the lessor thereunder to cancel or terminate such Oil and Gas Lease) included in the Oil and Gas Properties owned or held by such Company or any of its Subsidiaries.

(f) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, all proceeds from the sale of Hydrocarbons produced from the Oil and Gas Properties of such Company and its Subsidiaries are being received by them in a timely manner and are not being held in suspense (by any of such Company, any of its Subsidiaries, any third party operator thereof or any other Person) for any reason other than awaiting preparation and approval of division order title opinions for recently drilled Wells.

(g) Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, all of the Wells and all water, carbon dioxide, injection or other wells located on the Oil and Gas Properties of such Company and its Subsidiaries or otherwise associated with an Oil and Gas Property of such Company or any of its Subsidiaries have been drilled, completed and operated within the limits permitted by the applicable contracts entered into by such Company or any of its Subsidiaries related to such wells and applicable Law, and all drilling and completion (and plugging and abandonment) of such wells and all related development, production and other operations have been conducted in compliance with all applicable Law.

(h) None of the material Oil and Gas Properties of such Company or any of its Subsidiaries is subject to any (i) preferential purchase, or (ii) except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, consent or similar right, in each case of (i) and (ii) above, that would become operative as a result of the Mergers.

4.17 Environmental Matters.

(a) Except for those matters that would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole:

(i) such Company and its Subsidiaries and their respective operations and assets have at all times since the Applicable Date been in compliance with Environmental Laws;

(ii) such Company and its Subsidiaries are not subject to any pending or, to the knowledge of such Company, threatened Proceedings under Environmental Laws;

(iii) (A) there have been no Releases of Hazardous Materials by such Company or any of its Subsidiaries at or from any property currently or, to the knowledge of such Company, formerly owned, operated or otherwise used by such Company or any of its Subsidiaries, or, to the knowledge of such Company, by any predecessors of such Company or any of its Subsidiaries, which Releases could reasonably be expected to result in liability to the Companies under Environmental Law, and, (B) as of the date of this Agreement, neither such Company nor any of its Subsidiaries has received any written notice asserting a liability or obligation under any Environmental Laws with respect to the investigation, remediation, removal, or monitoring of any Release of Hazardous Materials at or from any property currently or formerly owned, leased, or otherwise used by such Company, or at or from any offsite location where Hazardous Materials from such Company's or its Subsidiaries' operations have been sent for treatment, disposal, storage or handling, which in each case remains unresolved; and

(b) as of the date of this Agreement, there have been no environmental investigations, studies, audits, or other analyses conducted by or on behalf of, or that are in the possession of, such Company or its Subsidiaries addressing potentially material environmental matters with respect to any property owned, operated or otherwise used by any of them that have not been delivered or otherwise made available to Parent prior to the date hereof.

4.18 Material Contracts.

(a) Section 4.18(a) of the Company Disclosure Letter sets forth a true and complete list, as of the date of this Agreement, of:

(i) each contract that provides for the acquisition, disposition, license, use, distribution or outsourcing of assets (including Intellectual Property), services, rights or properties (other than Oil and Gas Properties) with respect to which each Company reasonably expects that such Company and its Subsidiaries will make payments in excess of $5,000,000 during the year ended December 31, 2024 or during any subsequent calendar year;

(ii) each contract relating to Indebtedness or the deferred purchase price of property by such Company or any of its Subsidiaries (whether incurred, assumed, guaranteed or secured by any asset), in excess of $2,000,000, other than agreements solely between or among a Company and Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time;

(iii) each contract for the lease of personal property or real property (other than Oil and Gas Properties) involving payments in excess of $1,000,000 in the

current calendar year or over the life of the contract that are not terminable without penalty or other liability to such Company and its Subsidiaries (other than any ongoing obligation pursuant to such contract that is not caused by any such termination) within 90 days, other than contracts related to drilling rigs;

(iv) each contract that (A) purports to limit in any material respect either the type of business in which such Company or any of its Subsidiaries may engage or the manner or the locations in which any of them may so engage in any business (including any contract containing any area of mutual interest, joint bidding area, joint acquisition area, or non-compete or similar type of provision), (B) requires the disposition of any material assets or line of business of such Company or any of its Subsidiaries following the occurrence of events stated on the face of such contract or (C) prohibits or limits in each case, in any material respect, the rights of such Company or any of its Subsidiaries to make, sell or distribute any products or services, or use, transfer or distribute, or enforce any of their rights with respect to, any of their material assets;

(v) each contract involving the pending acquisition or sale of (or option to purchase or sell) any material amount of the assets or properties of such Company and its Subsidiaries, taken as a whole, other than contracts involving the acquisition or sale of (or option to purchase or sell) Hydrocarbons in the Ordinary Course;

(vi) each contract pursuant to which such Company or any of its Subsidiaries acquired another operating business and which contract contains "earn out" or other similar contingent payment obligations or indemnity obligations of such Company or its Subsidiary to a third party, in each case, that remain in effect as of the date hereof and are reasonably expected to result in future payments by such Company or its Subsidiaries in excess of $10,000,000;

(vii) each contract containing any standstill or similar agreement pursuant to which a Person has agreed not to acquire assets or securities of another Person;

(viii) each contract obligating such Company or any of its Subsidiaries to purchase or otherwise obtain any product or service exclusively from a single third party or granting any third party the exclusive right to develop, market, sell or distribute such Company's or any of its Subsidiaries' product or services in each case, that is not terminable without penalty or liability within 90 days;

(ix) each material partnership, joint venture or limited liability company agreement, other than any customary joint operating agreements, unit agreements or participation agreements affecting the Oil and Gas Properties of such Company or any of its Subsidiaries;

(x) each joint development agreement, exploration agreement, participation, farm-out, farm-in or program agreement or similar contract requiring such

Company or any of its Subsidiaries to make expenditures from and after December 31, 2023 that would reasonably be expected to be in excess of $8,000,000 in the aggregate, other than customary joint operating agreements and continuous development obligations under Oil and Gas Leases;

(xi) each contract (A) that provides for the purchase or sale by such Company or any of its Subsidiaries of Hydrocarbons (1) in excess of 1,000 barrels of oil equivalent of Hydrocarbons per day over a period of one month (calculated on a yearly average basis) or (2) for a term greater than two years or (B) which such Company or its Subsidiaries reasonably expects that it will make aggregate payments in excess of $5,000,000 in any of the next three succeeding fiscal years or over the life of the contract that, in the case of (A) or (B), (x) has a remaining term of greater than 60 days and does not allow such Company or such Subsidiary to terminate it without penalty to such Company or such Subsidiary within 90 days and (y) provides for a "take-or-pay" clause or any similar prepayment obligation and acreage dedication, minimum volume commitments or capacity reservation fees to a gathering, transportation or other arrangement downstream of the wellhead, that cover, guaranty or commit volumes in each case, in excess of $1,000,000 per year;

(xii) each contract for the transportation of Hydrocarbons;

(xiii) each resource adequacy attribute purchase and sale agreement, resource adequacy contract or similar contract;

(xiv) each collective bargaining agreement to which such Company or its Subsidiaries is a party or is subject, with any labor union or similar representative body (collectively, a "Union");

(xv) each agreement under which such Company or any of its Subsidiaries has advanced or loaned any amount of money to any of its officers, managers, directors, employees or consultants, in each case with a principal amount outstanding in excess of $100,000;

(xvi) each Company Related Party Agreement;

(xvii) each agreement that contains any "most favored nation" or most favored customer provision, call or put option, preferential right or rights of first or last offer, negotiation or refusal with a fair market value of equal to or greater than $10,000,000 or that would be triggered by the transactions contemplated by this Agreement; or

(xviii) each contract creating or granting an Encumbrance on any material asset of any Company or any of its Subsidiaries, other than Permitted Encumbrances.

(b) Collectively, the contracts set forth in Section 4.18(a) are herein referred to as the "Company Contracts." A complete and correct copy of each of the Company Contracts has been made available to Parent. Each Company Contract is legal, valid, binding and enforceable in accordance with its terms on each Company and its Subsidiaries that is a

party thereto and, to the knowledge of such Company, each other party thereto, and is in full force and effect, subject, as to enforceability, to Creditors' Rights. Except for breaches or defaults that would be, individually or in the aggregate, immaterial to the Companies and their Subsidiaries, taken as a whole, neither such Company nor any of its Subsidiaries is in breach or default under any Company Contract nor, to the knowledge of such Company, is any other party to any such Company Contract in breach or default thereunder, and no event has occurred that with the lapse of time or the giving of notice or both would constitute a default thereunder by such Company or any of its Subsidiaries, or, to the knowledge of such Company, any other party thereto. There are no material disputes pending or, to the knowledge of such Company, threatened with respect to any Company Contract and neither such Company nor any of its Subsidiaries has received any written notice of the intention of any other party to any Company Contract to terminate for default, convenience or otherwise any Company Contract, nor to the knowledge of such Company, is any such party threatening to do so.

4.19 Hedging Transactions.

(a) All Hedging Transactions entered into by such Company or any of its Subsidiaries or for the account of any of its customers as of the date of this Agreement were entered into in accordance with applicable Laws, and in accordance with the investment, securities, commodities, risk management and other policies, practices and procedures employed by such Company and its Subsidiaries, and were entered into with counterparties believed at the time to be able to understand (either alone or in consultation with their advisers) and to bear the risks of such Hedging Transactions.

(b) Such Company and its Subsidiaries have duly performed in all respects all of their respective obligations under the Hedging Transactions to the extent that such obligations to perform have accrued, and, to the knowledge of such Company, there are no breaches, violations, collateral deficiencies, requests for collateral or demands for payment (except for Ordinary Course margin deposit requests), or defaults or allegations or assertions of such by any party thereunder.

(c) Section 4.19(c) of the Company Disclosure Letter (i) lists, as of the close of business on January 31, 2024, all Hedging Transactions to which such Company or any of its Subsidiaries is a party and pursuant to which such party has outstanding rights or obligations, and (ii) accurately summarize, in all respects, the outstanding positions under any Hedging Transaction of the Companies and their Subsidiaries, including Hydrocarbon and financial positions under any Hedging Transaction of such Company attributable in a respect to the production and marketing of such Company and its Subsidiaries, as of the date of this Agreement.

4.20 Insurance. Each of the indemnity bonds and material insurance policies held by such Company or any of its Subsidiaries as of the date of this Agreement (collectively, the "Company Insurance Policies") is in full force and effect on the date of this Agreement. To the knowledge of such Company, the Company Insurance Policies provide coverage in breadth of coverage and amount at least equivalent to that carried by Persons engage in similar businesses and subject to the same or similar indemnity bonding obligations, perils or hazards. Except as would not reasonably be expected, individually or in the aggregate, to be material to such

Company and its Subsidiaries, taken as a whole, all premiums payable under the Company Insurance Policies prior to the date of this Agreement have been duly paid to date, and neither such Company nor any of its Subsidiaries has taken any action or failed to take any action that (including with respect to the Mergers), with notice or lapse of time or both, would constitute a breach or default, or permit a termination of any of the Company Insurance Policies. Except as would not reasonably be expected, individually or in the aggregate, to be material to such Company and its Subsidiaries, taken as a whole, as of the date of this Agreement, no written notice of cancellation or termination has been received with respect to any Company Insurance Policy. As of the date hereof neither such Company nor any of its Subsidiaries has any claims pending with insurers that are reasonably expected to result in an insurance recovery of more than $1,000,000 in the aggregate.

4.21 Brokers. Except, in respect of the Companies, for the fees and expenses payable to Person identified on Section 4.21 of the Company Disclosure Letter, no broker, investment banker, or other Person is entitled to any broker's, finder's or other similar fee or commission in connection with the Mergers based upon arrangements made by or on behalf of such Company, its Subsidiaries or the applicable Member. Such Company has made available to Parent a complete and correct copy of the contract set forth on Section 4.21 of the Company Disclosure Letter.

4.22 Related Party Transactions. Section 4.22 of the Company Disclosure Letter sets forth, as of the date of this Agreement, a complete and correct list of any agreement, arrangement or understanding (i) between such Company or any of its Subsidiaries, on the one hand, and any of any Company's Affiliates (other than Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time), on the other hand, or (ii) that would be required to be disclosed by such Company under Item 404 of Regulation S-K under the Securities Act (assuming such Company or such Subsidiary were required to comply with such Item), other than any compensation or other employment arrangements entered into between such Company or any of its Subsidiaries, on the one hand, and any officer thereof, on the other hand, in the Ordinary Course (each of the foregoing, a "Company Related Party Agreement"); provided that the Second Lien Credit Facility and documents entered into in connection therewith shall not be deemed a "Company Related Party Agreement".

4.23 Regulatory Matters.

(a) Such Company is (i) not an "investment company" or a company "controlled" by an "investment company" within the meaning of the U.S. Investment Company Act of 1940 or (ii) a "holding company" under PUHCA solely with respect to one or more EWGs, QFs, or foreign utility companies, and is exempt from, or has waiver of, federal access to books and records, accounting and recordkeeping requirements as set forth in FERC's regulations at 18 C.F.R. §§ 366.3 and 366.4.

(b) Midway-Sunset Cogeneration Company (i) is an EWG and (ii) is subject to FERC jurisdiction as a "public utility" as defined in Section 201 of the FPA and has MBR Authority. Midway-Sunset Cogeneration Company (i) has timely made all filings required to maintain its EWG status and MBR Authority and (ii) has not received written notice from

FERC alleging any violation of the FPA or seeking revocation of Midway-Sunset Cogeneration Company's MBR Authority.

(c) Section 4.23(c) of the Company Disclosure Letter sets forth, as of the date of the Agreement, a complete and correct list of each of the QFs in which each Company directly or indirectly holds an ownership interest, each of which is exempt from regulation under FPA Sections 203, 205 and 206.

(d) All natural gas pipeline systems and related facilities constituting such Company's and its Subsidiaries' properties are (i) "gathering facilities" that are exempt from regulation by the FERC under the Natural Gas Act of 1938 and (ii) not subject to rate regulation or comprehensive nondiscriminatory access regulation under the Laws of any state or other local jurisdiction.

4.24 Takeover Laws. The approval of the governing body of such Company of this Agreement and the Mergers represents all the action necessary to render inapplicable to this Agreement, and the Mergers applicable to such Company, any Takeover Law or any anti-takeover provision in such Company's Organizational Documents that is applicable to such Company, the applicable Equity Interests or the applicable Mergers.

4.25 Anti-Corruption Laws; Economic Sanctions/Trade Laws.

(a) Since the Applicable Date, none of such Company, its Subsidiaries or, to the knowledge of such Company, any of their respective directors, officers, employees or any other person acting on behalf of such Company or any of its Subsidiaries, in connection with the business of such Company (i) violated any applicable Anti-Corruption Law; (ii) engaged in any activity, practice or conduct which would constitute an offence under any applicable Anti-Corruption Law, or (iii) offered, paid, promised or agreed to pay, or authorized the payment of, either directly or indirectly through third parties, anything of value to any Government Official or other person with the intent to corruptly (1) influence any act or decision of a Government Official in his or her official capacity, (2) induce a Government Official to do or omit to do any act in violation of his or her lawful duties, (3) secure any improper advantage for such Company or its Subsidiaries, (4) induce a Government Official improperly to influence or affect any act or decision of any Governmental Entity or (5) assist such Company or any of its Subsidiaries in improperly obtaining or retaining business or other improper business advantage.

(b) Such Company and its Subsidiaries (i) are, and at all times since the Applicable Date, have been, in material compliance with all applicable Economic Sanctions/Trade Laws and all applicable Money Laundering Laws and (ii) are not engaged in, and have not since the Applicable Date, engaged in any transaction or dealing in any Sanctioned Country or with or involving any Sanctions Target. Neither such Company nor any of its Subsidiaries, nor, to the knowledge of such Company, any of their directors, officers, employees or any other person acting on behalf of such Company and its Subsidiaries, nor any of such Company's or its Subsidiaries' customers or any other person with which such Company or its Subsidiaries interacts, is a Sanctions Target or otherwise a person or entity with whom transactions are prohibited under any applicable Economic Sanctions/Trade Laws.

(c) Since the Applicable Date, (i) neither such Company nor any of its Subsidiaries has conducted or initiated any internal investigation, review or audit, or made a voluntary, directed, or mandatory disclosure to any Governmental Entity with respect to any applicable Anti-Corruption Law, Economic Sanctions/Trade Law, or Money Laundering Law, (ii) neither such Company nor any of its Subsidiaries, nor, to the knowledge of such Company, any of their directors, officers, employees or any other person acting on behalf of such Company and its Subsidiaries received any written notice, request or citation regarding any Anti-Corruption Law, Economic Sanctions/Trade Law or Money Laundering Law or been subject to any investigation, inquiry, information request, or proceeding by any Governmental Entity under Anti-Corruption Law, Economic Sanctions/Trade Law; and (iii) such Company and its Subsidiaries have implemented and maintained internal controls, policies and procedures reasonably designed to detect, prevent and deter violations of applicable Anti-Corruption Laws, Economic Sanctions/Trade Laws and Money Laundering Laws.

4.26 Accredited Investors. Each of the Members is an "accredited investor" within the meaning of Regulation D promulgated by the SEC under the Securities Act.

4.27 Obligations to the Members. As of the date of this Agreement, there are no obligations or liabilities payable by such Company or any of its Subsidiaries (whether or not due) to any of the Members or any of their respective Affiliates, other than pursuant to this Agreement and Ordinary Course transactions on an arm's length basis with portfolio companies affiliated with any of the Members.

4.28 No Additional Representations.

(a) Except for the representations and warranties made in this Article IV and Article V, no Company nor any other Person makes any express or implied representation or warranty with respect to such Company or its Subsidiaries or their respective businesses, operations, assets, liabilities or conditions (financial or otherwise) in connection with this Agreement, the Mergers or the Parent Stock Issuance, and such Company hereby disclaims any such other representations or warranties. In particular, without limiting the foregoing disclaimer, no Company nor any other Person makes or has made any representation or warranty to Parent, Merger Sub, or any of their respective Affiliates or Representatives with respect to (i) any financial projection, forecast, estimate, budget or prospect information relating to such Company or any of its Subsidiaries or their respective businesses; or (ii) except for the representations and warranties made by such Company in this Article IV and the Members in Article V, any oral or written information presented to Parent or Merger Sub or any of their respective Affiliates or Representatives in the course of their due diligence investigation of such Company, the negotiation of this Agreement or in the course of the Mergers or the Parent Stock Issuance. Notwithstanding the foregoing, nothing in this Section 4.28 shall limit Parent's or Merger Subs' remedies with respect to claims of fraud arising from or relating to the express representations and warranties made by each Company in this Article IV or the Members in Article V.

(b) Notwithstanding anything contained in this Agreement to the contrary, each Company acknowledges and agrees that none of Parent, Merger Sub or any other Person has made or is making any representations or warranties relating to Parent or its Subsidiaries

(including Merger Sub) whatsoever, express or implied, beyond those expressly given by Parent and Merger Subs in Article VI, including any implied representation or warranty as to the accuracy or completeness of any information regarding Parent furnished or made available to any Company or any of its Representatives and that the Companies have not relied on any such other representation or warranty not set forth in this Agreement. Without limiting the generality of the foregoing, each Company acknowledges that no representations or warranties are made with respect to any projections, forecasts, estimates, budgets or prospect information that may have been made available to any Company or any of its Representatives (including in certain "data rooms," "virtual data rooms," management presentations or in any other form in expectation of, or in connection with, the Mergers or the Parent Stock Issuance).

ARTICLE V
REPRESENTATIONS AND WARRANTIES OF THE MEMBERS

Each Member severally (and not jointly and severally) represents and warrants to Parent and Merger Subs as follows as to itself and not with respect to the other Members:

5.1 Organization; Authorization. Such Member is a corporation, partnership or limited liability company duly organized, as the case may be, validly existing and in good standing under the Laws of its jurisdiction of incorporation or organization. Such Member has all requisite entity power and authority to execute and deliver this Agreement and the other Transaction Documents to which it is a party and, subject to the filing of the Certificates of Merger with the Secretary of State of the State of Delaware in connection with the Mergers, to perform its obligations under this Agreement and the other Transaction Documents to which it is a party. The execution and delivery of this Agreement and the other Transaction Documents by such Member and such Member's performance of its obligations under this Agreement and the other Transaction Documents have been duly authorized by all necessary limited liability company or other organizational action on the part of such Member, and no other limited liability company or other organizational action on the part of such Member is necessary to authorize the execution and delivery of this Agreement and the other Transaction Documents or for such Member to perform its obligations under this Agreement and the other Transaction Documents. No approval by any holder of such Member's equity is necessary to approve this Agreement except for those approvals that have been obtained as of or prior to the date of this Agreement. This Agreement and the other Transaction Documents have been duly executed and delivered by or on behalf of such Member and, assuming the due authorization, execution and delivery of (i) this Agreement by Parent, Merger Subs, the Companies and the other Members, and (ii) the other Transaction Documents by Parent and the other Members, this Agreement and the other Transaction Documents constitute legal, valid and binding obligations of such Member, enforceable against such Member in accordance with their respective terms, subject as to enforceability to Creditors' Rights. Concurrently with the execution of this Agreement, the Company Member Approvals have been irrevocably obtained.

5.2 No Violations. The execution, delivery and performance of this Agreement and the other Transaction Documents to which it is a party by such Member does not, and the consummation of the transactions contemplated hereby and thereby will not (with or without notice or lapse of time, or both) (i) contravene, conflict with or result in a violation of any provision of the Organizational Documents of such Member, (ii) with or without notice, lapse of

time or both, result in a violation of, a termination (or right of termination) of or default under, the creation or acceleration of any obligation or the loss of a benefit under, or result in the creation of any Encumbrance upon any of the properties or assets of such Member under, any provision of any loan or credit agreement, note, bond, mortgage, indenture, lease or other agreement, permit, franchise or license to which such Member is a party or by which it or its properties or assets are bound, or (iii) contravene, conflict with or result in a violation of any Law applicable to such Member or any of its properties or assets, in each case, other than, in such contraventions, conflicts, violations, defaults, acceleration, losses, or Encumbrances that would not reasonably be expected, individually or in the aggregate, to prevent or materially delay the consummation of the Mergers.

5.3 Litigation. There are no Proceedings pending or, to the knowledge of such Member, threatened in writing against such Member that seek to enjoin, or are reasonably likely to have the effect of preventing, making illegal or otherwise interfering with, the performance of such Member's obligations under this Agreement, except as would not, individually or in the aggregate, be reasonably expected to prevent or materially delay the ability of such Member to perform such Member's obligations under this Agreement or the consummation of the Mergers.

5.4 Ownership of Equity Interests; Voting Power. Section 4.2(a) of the Company Disclosure Letter correctly sets forth across from such Member's name the number of Equity Interests held of record and beneficially by such Member. Such Member is the sole record holder of all of its Equity Interests and has full voting power and power of disposition with respect to all such Equity Interests free and clear of any Encumbrances (other than (i) any Encumbrance that will be terminated or satisfied at or prior to the Closing, (ii) any Encumbrance on transfer imposed under applicable securities laws, and (iii) any Encumbrance created by or through the actions of Parent, Merger Sub or their respective Affiliates). Except as set forth in the Organizational Documents of the Companies, no Person has any contractual or other right or obligation to purchase or otherwise acquire any Equity Interests.

5.5 Accredited Investor. Such Member is an "accredited investor" as defined in Rule 501(a) of Regulation D under the Securities Act.

5.6 Tax.

(a) To the knowledge of IKAV Member, IKAV Member will receive Parent Common Stock in respect of its Equity Interests pursuant to the IKAV Merger representing more than five percent of the total fair market value of all Parent Common Stock issued and outstanding on the Closing Date (within the meaning of Treasury Regulations Section 1.897-1(c)(2)(iii)(A)). All of the Parent Common Stock thereby received by IKAV Member will constitute in the hands of IKAV Member "United States real property interests" within the meaning of Section 897(c)(1) of the Code and the Treasury Regulations promulgated thereunder.

(b) To the knowledge of CPP Member, CPP Member will receive Parent Common Stock in respect of its Equity Interests pursuant to the CPP Merger representing more than five percent of the total fair market value of all Parent Common Stock issued and outstanding on the Closing Date (within the meaning of Treasury Regulations Section 1.897-

1(c)(2)(iii)(A)). All of the Parent Common Stock thereby received by CPP Member will constitute in the hands of CPP Member "United States real property interests" within the meaning of Section 897(c)(1) of the Code and the Treasury Regulations promulgated thereunder.

(c) CPP Member is a "qualified controlled entity" within the meaning of Treasury Regulation Section 1.897(l)-1(e)(9), a "qualified holder" within the meaning of Treasury Regulation Section 1.897(l)-1(d), and a "withholding qualified holder" within the meaning of Treasury Regulation Section 1.1445-1(g)(11).

5.7 No Additional Representations.

(a) Except for the representations and warranties made in Article IV and this Article V, neither such Member nor any other Person makes any express or implied representation or warranty with respect to such Member, the Companies or their Subsidiaries or their respective businesses, operations, assets, liabilities or conditions (financial or otherwise) in connection with this Agreement, the Mergers or the Parent Stock Issuance, and such Member hereby disclaims any such other representations or warranties. In particular, without limiting the foregoing disclaimer, neither such Member nor any other Person makes or has made any representation or warranty to Parent, Merger Subs, or any of their respective Affiliates or Representatives with respect to (i) any financial projection, forecast, estimate, budget or prospect information relating to any Company or any of its Subsidiaries or their respective businesses; or (ii) except for the representations and warranties made by the Companies in Article IV and the Members in this Article V, any oral or written information presented to Parent or Merger Subs or any of their respective Affiliates or Representatives in the course of their due diligence investigation of any Company, the negotiation of this Agreement or in the course of the Mergers or the Parent Stock Issuance. Notwithstanding the foregoing, nothing in this Section 5.7 shall limit Parent's or Merger Subs' remedies with respect to claims of fraud arising from or relating to the express representations and warranties made by the Companies in Article IV or the Members in this Article V.

(b) Notwithstanding anything contained in this Agreement to the contrary, such Member acknowledges and agrees that none of Parent, Merger Subs or any other Person has made or is making any representations or warranties relating to Parent or its Subsidiaries (including any Merger Sub) whatsoever, express or implied, beyond those expressly given by Parent and Merger Subs in Article VI, including any implied representation or warranty as to the accuracy or completeness of any information regarding Parent furnished or made available to such Member or any of its Representatives and that such Member has not relied on any such other representation or warranty not set forth in this Agreement. Without limiting the generality of the foregoing, such Member acknowledges that no representations or warranties are made with respect to any projections, forecasts, estimates, budgets or prospect information that may have been made available to such Member or any of its Representatives (including in certain "data rooms," "virtual data rooms," management presentations or in any other form in expectation of, or in connection with, the Mergers or the Parent Stock Issuance).

ARTICLE VI
REPRESENTATIONS AND WARRANTIES OF PARENT AND MERGER SUBS

Except as set forth in the disclosure letter dated as of the date of this Agreement and delivered by Parent and Merger Subs to each Company on or prior to the date of this Agreement (the "Parent Disclosure Letter") and except as disclosed in the Parent SEC Documents) (including all exhibits and schedules thereto and documents incorporated by reference therein) filed with or furnished to the SEC and available on EDGAR since December 31, 2021 prior to the date of this Agreement (excluding any disclosures set forth or referenced in any risk factor section or in any other section, in each case, to the extent they are forward-looking statements or cautionary, predictive, non-specific or forward-looking in nature), Parent and Merger Subs jointly and severally represent and warrant to each Company and each Member as follows:

6.1 Organization, Standing and Power. Each of Parent and its Subsidiaries is a corporation, partnership or limited liability company duly organized, as the case may be, validly existing and in good standing under the Laws of its jurisdiction of incorporation or organization, with all requisite entity power and authority to own, lease and operate its properties and to carry on its business as now being conducted, other than, in the case of Parent's Subsidiaries, where the failure to be so organized or to have such power, authority or standing would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect. Each of Parent and its Subsidiaries is duly qualified or licensed and in good standing to do business in each jurisdiction in which the business it is conducting, or the operation, ownership or leasing of its assets or properties, makes such qualification or license necessary, other than where the failure to so qualify, license or be in good standing would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect. Parent and each Merger Sub each has heretofore made available to each Company complete and correct copies of its Organizational Documents, each as amended prior to the execution of this Agreement, and each as made available to Parent is in full force and effect, and neither Parent nor any of its Subsidiaries is in violation of any of the provisions of such Organizational Documents.

6.2 Capital Structure.

(a) As of the date of this Agreement, the authorized capital stock of Parent consists of (i) 200,000,000 shares of Parent Common Stock and (ii) 20,000,000 shares of preferred stock, par value $0.01 per share ("Parent Preferred Stock", and, together with the Parent Common Stock, the "Parent Capital Stock"). At the close of business on February 5, 2024: (A) 69,274,418 shares of Parent Common Stock were issued and outstanding and no shares of Parent Preferred Stock were issued and outstanding; (B) there were outstanding warrants to purchase 4,180,908 shares of Parent Common Stock; (C) there were 1,185,437 shares of Parent Common Stock reserved for issuance pursuant to Parent's Employee Stock Purchase Plan (as amended from time to time, the "Parent ESPP"); (D) there were 760,798 shares of Parent Common Stock subject to outstanding restricted stock units granted pursuant to Parent's 2021 Long-Term Incentive Plan, as amended from time to time, and prior plans (the "Parent LTIP", and, together with the Parent ESPP, the "Parent Stock Plans"); and (E) there were 800,151 shares of Parent Common Stock (assuming the target level of performance) subject to outstanding performance stock units granted pursuant to the Parent LTIP.

(b) All outstanding shares of Parent Common Stock and outstanding equity interests of each Subsidiary of Parent have been, in each case, duly authorized and are validly issued, fully paid and non-assessable and are not subject to preemptive rights. The Parent Common Stock to be issued pursuant to this Agreement, when issued, will be validly issued, fully paid and nonassessable and not subject to preemptive rights. All outstanding shares of Parent Common Stock have been issued and granted in compliance in all material respects with (i) applicable securities Laws and other applicable Law and (ii) all requirements set forth in applicable contracts (including the Parent Stock Plans). The Parent Common Stock to be issued pursuant to this Agreement, when issued, will be issued in compliance in all material respects with (A) assuming the accuracy of each Company's representation in Section 4.26, applicable securities Laws and other applicable Law and (B) all requirements set forth in applicable contracts. As of the close of business on February 5, 2024, except as set forth in this Section 6.2, there are no outstanding options, warrants or other rights to subscribe for, purchase or acquire from Parent or any of its Subsidiaries any capital stock of Parent or securities convertible into or exchangeable or exercisable for capital stock of Parent (and the exercise, conversion, purchase, exchange or other similar price thereof). All outstanding shares of capital stock or other equity interests of the Subsidiaries of Parent are owned by Parent, or a direct or indirect Subsidiary of Parent, are free and clear of all Encumbrances and have been duly authorized, validly issued, fully paid and nonassessable. Except as set forth in this Section 6.2, and except for changes since February 5, 2024 resulting from the exercise of warrants outstanding at such date (and the issuance of shares thereunder), issuance pursuant to Parent's Employee Stock Purchase Plan, restricted stock units granted pursuant to Parent's 2021 Long-Term Incentive Plan, as amended from time to time, and prior plans, and performance stock units granted pursuant to the Parent LTIP or other awards granted in accordance with this Agreement, there are outstanding: (1) no shares of Parent Capital Stock or other voting securities of Parent; (2) no securities of Parent or any Subsidiary of Parent convertible into or exchangeable or exercisable for shares of capital stock or other voting securities of Parent; and (3) no options, warrants, subscriptions, calls, rights (including preemptive and appreciation rights), commitments or agreements to which Parent or any Subsidiary of Parent is a party or by which it is bound in any case obligating Parent or any Subsidiary of Parent to issue, deliver, sell, purchase, redeem or acquire, or cause to be issued, delivered, sold, purchased, redeemed or acquired, additional shares of capital stock or other voting securities of Parent, or obligating Parent or any Subsidiary of Parent to grant, extend or enter into any such option, warrant, subscription, call, right, commitment or agreement. Neither Parent nor any of its Subsidiaries is party to any contract or arrangement with any Person obligating Parent or any of its Subsidiaries to register shares of Parent Capital Stock or other securities under the Securities Act. There are not any stockholder agreements, voting trusts or other agreements to which Parent or any of its Subsidiaries is a party or by which it is bound relating to the voting of any shares of capital stock or other equity interest of Parent or any of its Subsidiaries. No Subsidiary of Parent owns any shares of Parent Common Stock or any other shares of Parent Capital Stock. As of the date of this Agreement, the authorized membership interests of (i) IKAV Merger Sub consists of 100 membership interests; (ii) CPP Merger Sub consists of 100 membership interests; and (iii) COI Merger Sub consists of 100 membership interests, all of which shares are duly authorized, validly issued and owned by Parent. Each Merger Sub was formed on February 1, 2024 and since the date of such formation, no Merger Sub has engaged in any activity other than in connection with its

organization and the preparation, negotiation and execution of this Agreement. No Merger Sub has any operations, assets or liabilities other than in connection with the foregoing and as provided under this Agreement.

6.3 Authority; No Violations; Consents and Approvals.

(a) Each of Parent and each Merger Sub has all requisite corporate or limited liability company power and authority to execute and deliver this Agreement and the other Transaction Documents to which it is a party and, subject to the filing of the Certificates of Merger with the Secretary of State of the State of Delaware in connection with the Mergers, to perform its obligations hereunder and thereunder, including the Mergers and, subject only to receipt of the Parent Stockholder Approval, the Parent Stock Issuance. The execution and delivery of this Agreement and the other Transaction Documents by Parent and each Merger Sub, as applicable, and the performance by each of Parent and each Merger Sub of its obligations under this Agreement and the other Transaction Documents have been duly authorized by all necessary corporate or limited liability company action on the part of each of Parent (subject to obtaining Parent Stockholder Approval) and each Merger Sub (other than the approval of this Agreement by Parent as sole member of each Merger Sub, which occurred concurrently with the execution and delivery of this Agreement). This Agreement and the other Transaction Documents have been duly executed and delivered by each of Parent and each Merger Sub, as applicable, and, assuming the due and valid execution of (i) this Agreement by the Companies and the Members, and (ii) the other Transaction Documents by the Members, constitute valid and binding obligations of each of Parent and each Merger Sub enforceable against Parent and each Merger Sub in accordance with their terms, subject as to enforceability to Creditors' Rights. The Parent Board, at a meeting duly called and held, has by unanimous vote(i) determined that this Agreement, the Mergers and the Parent Stock Issuance, are fair to, and in the best interests of, Parent, (ii) approved and declared advisable this Agreement, the Mergers and the Parent Stock Issuance, and (iii) resolved to recommend that the holders of Parent Common Stock approve the Parent Stock Issuance (such recommendation described in clause (iii), the "Parent Board Recommendation"). Each Merger Sub Board has by unanimous vote (A) determined that this Agreement and the Mergers are fair to, and in the best interests of, the applicable Merger Sub and the sole member of such Merger Sub, (B) approved and declared advisable this Agreement and the applicable Merger, and (C) resolved to recommend that Parent, as the sole member of such Merger Sub, approve this Agreement. Parent, as the sole member of each Merger Sub, has approved this Agreement and the Mergers concurrently with its execution of this Agreement. The Parent Stockholder Approval is the only vote of the holders of any class or series of Parent's capital stock necessary to approve the Parent Stock Issuance.

(b) The execution, delivery and performance of this Agreement and the other Transaction Documents does not, and the consummation of the transactions contemplated hereby and thereby will not (with or without notice or lapse of time, or both) (i) contravene, conflict with or result in a violation of any provision of the Organizational Documents of Parent or any Merger Sub, (ii) result in a violation of, a termination (or right of termination) of or default under, the creation or acceleration of any obligation or the loss of a benefit under, or result in the creation of any Encumbrance upon any of the properties or assets of Parent or any of its Subsidiaries under, any provision of any loan or credit agreement, note, bond, mortgage,

indenture, lease or other agreement, permit, franchise or license to which Parent or any of its Subsidiaries is a party or by which Parent or any Merger Sub or any of their respective Subsidiaries or their respective properties or assets are bound or (iii) assuming the Consents referred to in Section 6.4 are duly and timely obtained or made and the Parent Stockholder Approval has been obtained, contravene, conflict with or result in a violation of any Law applicable to Parent or any of its Subsidiaries or any of their respective properties or assets, other than any such contraventions, conflicts, violations, defaults, acceleration, losses or Encumbrances that would not reasonably be expected, individually or in the aggregate, to be material to the business of Parent and its Subsidiaries, taken as a whole.

6.4 Consents. No Consent from any Governmental Entity is required to be obtained or made by Parent or any of its Subsidiaries in connection with the execution, delivery and performance by Parent and Merger Subs of this Agreement and the other Transaction Documents or the consummation by Parent and Merger Subs of the transactions contemplated hereby or thereby, except for: (a) the filing of a premerger notification report by Parent under the HSR Act, and the expiration or termination of any applicable waiting period with respect thereto; (b) the FERC Approval; (c) the filing with the SEC of (i) a Proxy Statement in preliminary and definitive form (the "Proxy Statement") relating to the Parent Stockholders Meeting and (ii) such reports under Section 13(a) of the Exchange Act, and such other compliance with the Exchange Act and the rules and regulations thereunder, as may be required in connection with this Agreement and the other Transaction Documents, the Mergers and the Parent Stock Issuance; (d) the filing of the Certificates of Merger with the Office of the Secretary of State of the State of Delaware; (e) filings with the NYSE; and (f) such filings and approvals as may be required by any applicable state securities or "blue sky" Laws or Takeover Law.

6.5 SEC Documents; Financial Statements; Internal Controls; NYSE Matters.

(a) Since the Applicable Date, Parent has filed or furnished with the SEC, on a timely basis, all forms, reports, certifications, schedules, statements and documents required to be filed or furnished under the Securities Act or the Exchange Act, respectively, (such forms, reports, certifications, schedules, statements and documents, collectively, the "Parent SEC Documents"). As of their respective dates, each of the Parent SEC Documents, as amended, complied, or if not yet filed or furnished, will comply as to form in all material respects with the applicable requirements of the Securities Act, the Exchange Act and the Sarbanes-Oxley Act, as the case may be, and the rules and regulations of the SEC thereunder applicable to such Parent SEC Documents, and none of the Parent SEC Documents contained, when filed or, if amended prior to the date of this Agreement, as of the date of such amendment with respect to those disclosures that are amended, or if filed with or furnished to the SEC subsequent to the date of this Agreement, will contain any untrue statement of a material fact or omitted to state a material fact required to be stated therein or necessary to make the statements therein, in the light of the circumstances under which they were made, not misleading.

(b) The financial statements of Parent included in the Parent SEC Documents, including all notes and schedules thereto, complied, or, in the case of Parent SEC Documents filed after the date of this Agreement, will comply, in all material respects, when filed or if amended prior to the date of this Agreement, as of the date of such amendment, with

applicable accounting requirements and with the rules and regulations of the SEC with respect thereto, were, or, in the case of Parent SEC Documents filed after the date of this Agreement, will be, prepared in accordance with GAAP applied on a consistent basis during the periods involved (except as may be indicated in the notes thereto or, in the case of the unaudited statements, as permitted by Rule 10-01 of Regulation S-X of the SEC) and fairly present in all material respects in accordance with applicable requirements of GAAP (subject, in the case of the unaudited statements, to normal year-end audit adjustments) the financial position of Parent and its consolidated Subsidiaries as of their respective dates and the results of operations and the cash flows of Parent and its consolidated Subsidiaries for the periods presented therein.

(c) Parent has established and maintains a system of internal control over financial reporting and disclosure controls and procedures (as such terms are defined in Rule 13a-15 or Rule 15d-15, as applicable, under the Exchange Act); such disclosure controls and procedures are designed to ensure that material information relating to Parent, including its consolidated Subsidiaries, required to be disclosed by Parent in the reports that it files or submits under the Exchange Act is accumulated and communicated to Parent's principal executive officer and its principal financial officer to allow timely decisions regarding required disclosure; and such disclosure controls and procedures are effective to ensure that information required to be disclosed by Parent in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in SEC rules and forms, and further designed and maintained to provide reasonable assurance regarding the reliability of Parent's financial reporting and the preparation of Parent financial statements for external purposes in accordance with GAAP. Parent has disclosed, based on its most recent evaluation of its internal accounting controls prior to the date hereof, to Parent's auditors (i) any significant deficiencies and material weaknesses in the design or operation of internal controls that would be reasonably expected to adversely affect Parent's ability to record, process, summarize and report financial information in the reports it files or submits under the Exchange Act, (ii) any known occurrence of fraud, whether or not material, that involves any current or former employees who have (or had) a significant role in Parent's internal controls over financial reporting. There is not, and since January 1, 2020 there has not been, any "extensions of credit" (within the meaning of Section 402 of the Sarbanes-Oxley Act) or prohibited loans to any executive officer of Parent (as defined in Rule 3b-7 under the Exchange Act) or director of Parent or any of its Subsidiaries. The principal executive officer and the principal financial officer of Parent has made all certifications required by the Sarbanes-Oxley Act, the Exchange Act and any related rules and regulations promulgated by the SEC with respect to Parent SEC Documents, and, to the knowledge of Parent, the statements contained in such certifications were complete and correct as of the dates they were made.

(d) Since January 1, 2022, (i) neither Parent nor any of its Subsidiaries nor, to the knowledge of Parent, any director, officer, employee, auditor, accountant or representative of Parent or any of its Subsidiaries has received or otherwise had or obtained knowledge of any material complaint, allegation, assertion or claim, whether written or oral, regarding the accounting or auditing practices, procedures, methodologies or methods of Parent or any of its Subsidiaries or their respective internal accounting controls, and (ii) no attorney representing Parent or any of its Subsidiaries, whether or not employed by Parent or any of its Subsidiaries, has reported evidence of a material violation of securities Laws, breach of fiduciary duty or similar violation by Parent or any of its Subsidiaries or any of their respective

officers, directors, employees or agents to the board of directors of Parent or any committee thereof or to any director or officer of Parent or any of its Subsidiaries.

(e) As of the date hereof, there are no outstanding or unresolved comments in the comment letters received from the SEC staff with respect to the Parent SEC Documents. As of the date hereof, to the knowledge of Parent, none of the Parent SEC Documents is subject to ongoing review or outstanding SEC comment or investigation.

(f) Parent is in compliance in all material respects with (i) the provisions of the Sarbanes-Oxley Act and (ii) the rules and regulations of the NYSE, in each case, that are applicable to Parent.

(g) No Subsidiary of Parent is required to file any form, report, schedule, statement or other document with the SEC.

(h) The Parent Common Stock is registered under Section 12(b) of the Exchange Act and listed on the NYSE, and Parent has not received any notice of deregistration or delisting from the SEC or the NYSE, as applicable. No judgment, order, ruling, decree, injunction, or award of any securities commission or similar securities regulatory authority or any other Governmental Entity, or of the NYSE, preventing or suspending trading in any securities of Parent has been issued, and no proceedings for such purpose are, to Parent's knowledge, pending, contemplated or threatened. Parent has taken no action that is designed to terminate the registration of the Parent Common Stock under the Exchange Act.

6.6 Absence of Certain Changes or Events. From December 31, 2022 through the date of this Agreement, there has not been any Parent Material Adverse Effect or any event, change, effect or development that, individually or in the aggregate, would reasonably be expected to have a Parent Material Adverse Effect.

6.7 Information Supplied. None of the information supplied or to be supplied by Parent for inclusion or incorporation by reference in the Proxy Statement will, at the date it is first mailed to stockholders of Parent and at the time of the Parent Stockholders Meeting, contain any untrue statement of a material fact or omit to state any material fact required to be stated therein or necessary in order to make the statements therein, in the light of the circumstances under which they are made, not misleading. Subject to the accuracy of the first sentence of Section 4.8, the Proxy Statement will comply as to form in all material respects with the provisions of the Exchange Act, and the rules and regulations thereunder; provided, however, that no representation is made by Parent with respect to statements made therein based on information supplied by the Companies for inclusion or incorporation by reference therein.

6.8 No Undisclosed Material Liabilities. There are no material liabilities of Parent or any of its Subsidiaries of any kind whatsoever, whether accrued, contingent, absolute, determined, determinable or otherwise, other than: (a) liabilities adequately provided for on the balance sheet of Parent dated as of September 30, 2023 (including the notes thereto) contained in Parent's Quarterly Report on Form 10-Q for the quarter ended September 30, 2023; (b) liabilities incurred in the Ordinary Course subsequent to September 30, 2023; (c) executory obligations under any contract, which are not related to any breach or default of a contract by Parent or any

of its Subsidiaries; (d) liabilities incurred in connection with the Mergers and the Parent Stock Issuance; and (e) liabilities that would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect.

6.9 Parent Permits; Compliance with Applicable Law.

(a) Parent and its Subsidiaries hold and at all times since the Applicable Date have held all material permits, licenses, certifications, registrations, consents, authorizations, variances, exemptions, orders, franchises, and approvals of all Governmental Entities necessary to own, lease and operate their respective properties and assets and for the lawful conduct of their respective businesses as they were or are now being conducted, as applicable (collectively, the "Parent Permits"), and have paid all fees and assessments due and payable in connection therewith. All Parent Permits are in full force and effect and no suspension or cancellation of any of the Parent Permits is pending or, to the knowledge of Parent, threatened, and Parent and its Subsidiaries are in compliance with the terms of the Parent Permits, except where the failure to be in full force and effect or failure to so comply would not reasonably be expected, individually or in the aggregate, to be material to the business of Parent and its Subsidiaries, taken as a whole.

(b) The businesses of Parent and its Subsidiaries are not currently being conducted, and at no time since the Applicable Date have been conducted, in violation of any applicable Law, except for violations that would not reasonably be expected, individually or in the aggregate, to be material to the business of Parent and its Subsidiaries, taken as a whole. To the knowledge of Parent no investigation or review by any Governmental Entity with respect to Parent or any of its Subsidiaries is pending or threatened, other than those the outcome of which would not reasonably be expected, individually or in the aggregate, to be material to the business of Parent and its Subsidiaries, taken as a whole.

6.10 Taxes.

(a) Except as would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect: all Tax Returns required to be filed (i) by or with respect to Parent or any of its Subsidiaries have been duly and timely filed with the appropriate Taxing Authority when due (taking into account extensions of time for filing), and all such filed Tax Returns are true, complete and accurate in all respects. All Taxes that are due and payable (whether or not shown on any Tax Returns) by Parent or any of its Subsidiaries (other than Taxes being contested in good faith by appropriate Proceedings and for which adequate reserves have been established in accordance with GAAP in the Financial Statements) have been paid in full. All withholding Tax requirements imposed on or with respect to Parent and its Subsidiaries have been satisfied in full, and Parent and its Subsidiaries have complied in all respects with all information reporting (and related withholding) and record retention requirements.

(b) Except as would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect: there is no outstanding claim, assessment or deficiency against Parent or any of its Subsidiaries in respect of any Taxes that has been asserted or, to the knowledge of Parent, threatened by any Governmental Entity. There are no

disputes, audits, examinations, investigations or Proceedings pending or, to the knowledge of Parent, threatened regarding any Taxes of Parent or any of its Subsidiaries.

(c) IKAV Merger Sub, CPP Merger Sub, COI Merger Sub 2 and COI Merger Sub 3 are classified as corporations for U.S. federal income Tax purposes. COI Merger Sub and Subsequent Merger Sub are treated as disregarded entities of Parent for U.S. federal income Tax purposes.

(d) Neither Parent nor any Merger Sub has taken or agreed to take, or has any plan or intention of taking, any action not contemplated by this Agreement and/or any other Transaction Documents that could reasonably be expected to prevent, impair or impede the Intended Tax Treatment. To the knowledge of Parent, there is no fact or circumstance that could reasonably be expected to prevent, impair or impede the Intended Tax Treatment.

(e) None of Parent nor any Merger Sub is a "domestically controlled qualified investment entity" within the meaning of Section 897(h)(4) of the Code.

(f) Parent is a "United States real property holding corporation" within the meaning of Section 897(c)(2) of the Code and the Treasury Regulations promulgated thereunder. Each of IKAV Member and CPP Member will separately receive Parent Common Stock in respect of their respective Equity Interests pursuant to the Mergers representing more than five percent of the total fair market value of all Parent Common Stock issued and outstanding on the Closing Date (within the meaning of Treasury Regulations Section 1.897-1(c)(2)(iii)(A)). All of the Parent Common Stock received by IKAV Member and CPP Member in respect of their Equity Interests will constitute in the hands of such Members "United States real property interests" within the meaning of Section 897(c)(1) of the Code and the Treasury Regulations promulgated thereunder.

6.11 Litigation. Except for such matters as would not reasonably be expected, individually or in the aggregate, to be material to the business of Parent and its Subsidiaries, taken as a whole, there is no (a) Proceeding pending, or to the knowledge of Parent, threatened against Parent or any of its Subsidiaries or any of its Subsidiaries or any of their Oil and Gas Properties, or (b) judgment, decree, injunction, ruling, order, writ, stipulation, determination or award of any Governmental Entity or arbitrator outstanding against Parent or any of its Subsidiaries. Neither Parent nor any of its Subsidiaries is a party to or subject to the provisions of any Order that restricts the manner in which Parent and its Subsidiaries conduct their businesses in any material respect.

6.12 Environmental Matters.

(a) Except for those matters that would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect:

(i) Parent and its Subsidiaries and their respective operations and assets have at all times since the Applicable Date been in compliance with Environmental Laws;

(ii) Parent and its Subsidiaries are not subject to any pending or, to Parent's knowledge, threatened Proceedings under Environmental Laws; and

(iii) (A) there have been no Releases of Hazardous Materials by Parent or any of its Subsidiaries at or from any property currently or, to the knowledge of Parent, formerly owned, operated or otherwise used by Parent or any of its Subsidiaries, or, to the knowledge of Parent, by any predecessors of Parent or any Subsidiary of Parent, which Releases have resulted or could reasonably be expected to result in liability to Parent under Environmental Law, and, (B) as of the date of this Agreement, neither Parent nor any of its Subsidiaries has received any written notice asserting a liability or obligation under any Environmental Laws with respect to the investigation, remediation, removal, or monitoring of any Release of Hazardous Materials at or from any property currently or formerly owned, operated, or otherwise used by Parent, or at or from any offsite location where Hazardous Materials from Parent's or its Subsidiaries' operations have been sent for treatment, disposal, storage or handling, which in each case remains unresolved.

(b) As of the date of this Agreement, there have been no environmental investigations, studies, audits, or other analyses conducted since the Applicable Date that are in the possession of Parent or its Subsidiaries addressing potentially material environmental matters with respect to any property owned, operated or otherwise used by Parent or its Subsidiaries that have not been delivered or otherwise made available to the Companies prior to the date hereof.

6.13 Material Contracts. Except as would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect, each "material contract" (as such term is defined in Item 601(b)(10) of Regulation S-K under the Exchange Act), (the "Parent Contracts"), is a legal, valid, binding and enforceable in accordance with its terms on Parent and each of its Subsidiaries that is a party thereto and, to the knowledge of Parent, each other party thereto, and is in full force and effect, subject, as to enforceability, to Creditors' Rights. Except as would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect, none of Parent or any of its Subsidiaries is in breach or default under any Parent Contract nor, to the knowledge of Parent, is any other party to any such Parent Contract in breach or default thereunder, and no event has occurred that with the lapse of time or the giving of notice or both would constitute a default thereunder by Parent or its Subsidiaries, or, to the knowledge of Parent, any other party thereto. Except as would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect, there are no disputes pending or, to the knowledge of Parent, threatened with respect to any Parent Contract and neither Parent nor any of its Subsidiaries has received any written notice of the intention of any other party to any Parent Contract to terminate for default, convenience or otherwise any Parent Contract, nor to the knowledge of Parent, is any such party threatening to do so.

6.14 Opinion of Financial Advisor. The Parent Board has received the oral opinion of Jefferies LLC, to be subsequently confirmed in writing, to the effect that, as of the date of such opinion, and based upon and subject to the various assumptions made, procedures followed, matters considered, and qualifications and limitations on the scope of the review set forth in such opinion, the Aggregate Consideration to be paid by Parent pursuant to this Agreement is fair from a financial point of view to Parent, a signed copy of which written opinion will be made

available to the Companies for informational purposes only on a non-reliance basis promptly following the date of this Agreement.

6.15 Brokers. Except for the fees and expenses payable to Citigroup Global Markets Inc. and Jefferies LLC, no broker, investment banker, or other Person is entitled to any broker's, finder's or other similar fee or commission in connection with the Mergers and the Parent Stock Issuance based upon arrangements made by or on behalf of Parent or its Subsidiaries.

6.16 Regulatory Matters.

(a) Parent is (i) not an "investment company" or a company "controlled" by an "investment company" within the meaning of the U.S. Investment Company Act of 1940 or (ii) a "holding company" under PUHCA solely with respect to one or more EWGs, QFs and foreign utility companies and is exempt from, or has waiver of, federal access to books and records, accounting and recordkeeping requirements as set forth in FERC's regulations at 18 C.F.R. §§ 366.3 and 366.4.

(b) Elk Hills Power, LLC (i) is a QF and (ii) is subject to FERC jurisdiction as a "public utility" as defined in Section 201 of the FPA and has MBR Authority. Elk Hills Power, LLC (i) has timely made all filings required to maintain its QF status and MBR Authority and (ii) has not received written notice from FERC alleging any violation of the FPA or seeking revocation of Elk Hills Power, LLC's MBR Authority.

(c) Section 6.16(c) of the Parent Disclosure Letter sets forth, as of the date of the Agreement, a complete and correct list of each of the QFs in which Parent directly or indirectly holds an ownership interest, each of which is exempt from regulation under FPA Sections 203, 205 and 206.

(d) All natural gas pipeline systems and related facilities constituting Parent's and its Subsidiaries' properties are (i) "gathering facilities" that are exempt from regulation by the FERC under the Natural Gas Act of 1938 and (ii) not subject to rate regulation or comprehensive nondiscriminatory access regulation under the Laws of any state or other local jurisdiction.

6.17 Sufficient Funds.

(a) Assuming compliance in all material respects by each Company with its material obligations hereunder set forth in Section 7.14 and assuming satisfaction of the conditions in Article VIII (other than the conditions set forth in Sections 8.1 and 8.3 and those conditions that by their nature can only be satisfied at the Closing, but subject to the satisfaction thereof), Parent and Merger Subs will have available to them at the Effective Time all funds and commitments necessary to refinance in full all amounts outstanding under the Company Credit Agreements and to pay the fees and expenses relating to the Mergers and the Financing (defined below) (such amount, the "Required Amount"). Parent has delivered to the Companies true and complete copies of the fully executed Commitment Letter and Debt Fee Letter (with only fee amounts and other economic terms, and the rates and amounts included in the "flex" provisions, redacted, none of which redacted provisions would adversely affect the conditionality, enforceability, termination or amount of the Financing). Pursuant to the

Commitment Letter, and subject to the terms and conditions thereof, the Financing Sources party thereto have committed to provide Parent with the amounts set forth in the Commitment Letter for the purposes set forth therein. As of the date of this Agreement, the Commitment Letter is in full force and effect and has not been withdrawn, rescinded or terminated, or otherwise amended or modified in any respect (other than as set forth in the Debt Fee Letters with respect to flex rights and/or to add additional lenders, arrangers, bookrunners, syndication agents and similar entities who had not executed the Commitment Letter as of the date of this Agreement), and the Commitment Letter, in the form so delivered, constitutes the legal, valid and binding obligation of, and is enforceable against, Parent and, to the knowledge of Parent, each of the other parties thereto, subject, in each case, to the qualification that such enforceability may be limited by bankruptcy, insolvency, reorganization or other laws of general application relating to or affecting rights of creditors and subject, as to enforceability, to general principles of equity. Except as set forth in the Commitment Letter and except for any related engagement letters related to the Financing described in the Commitment Letter, as of the date of this Agreement, there are no contracts, agreements, "side letters" or other arrangements to which Parent or any of its affiliates is a party relating to the Commitment Letter or the Financing.

(b) As of the date of this Agreement, no event has occurred which, with or without notice, lapse of time or both, constitutes, or would reasonably be expected to constitute, a default or breach by Parent or, to the knowledge of Parent, any other party thereto, of any term of the Commitment Letter. As of the date of this Agreement, no Financing Source party to the Commitment Letter has notified Parent of its termination or repudiation (or intent to terminate or repudiate) any of the commitments under such Commitment Letter or its intent not to provide the Financing. Assuming compliance in all material respects by each Company with its material obligations hereunder set forth in Section 7.14 and assuming satisfaction of the conditions in Article VIII (other than the conditions set forth in Sections 8.1 and 8.3 and those conditions that by their nature can only be satisfied at the Closing, but subject to the satisfaction or waiver thereof), Parent has no reason to believe that it or any other party thereto will be unable to satisfy on a timely basis any term of the Commitment Letter that could affect the availability of the Financing on the Closing Date. Parent has no reason to believe that it or any other party thereto will be unable to satisfy on a timely basis any term of the Commitment Letter that could affect the availability of the Financing on the Closing Date. Parent has no reason to believe that any of the Financing Conditions will fail to be satisfied on the Closing Date or that the full amounts committed pursuant to the Commitment Letter will not be available to be funded on the Closing Date to the extent required, when taken together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, to pay the Required Amounts.

(c) Parent understands and acknowledges that its obligations under this Agreement are not in any way contingent on or otherwise subject to or conditional upon Parent's ability to obtain any financing, whether pursuant to the Commitment Letter or otherwise.

(d) Parent has fully paid (or caused to be paid) any and all commitment fees or other fees required by the Commitment Letter to be paid on or before the date of this Agreement. Assuming (i) the funding of the full amount of the Financing in accordance with

and subject to the satisfaction of the conditions in the Commitment Letter, (ii) compliance in all material respects by each Company with its material obligations hereunder and (iii) satisfaction of the conditions in Article VIII (other than the conditions set forth in Sections 8.1 and 8.3 and those conditions that by their nature can only be satisfied at the Closing, but subject to the satisfaction thereof), the aggregate proceeds from the Financing (after netting out applicable fees, expenses, original issue discount and similar premiums and chargers and after giving effect of the maximum amount of flex (including original issue discount flex) provided under the Commitment Letter), together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, constitute all of the financing necessary to finance the Required Amount. There are no conditions precedent related to the funding of the full amount of the Financing, other than the Financing Conditions.

6.18 Anti-Corruption Laws; Economic Sanctions/Trade Laws.

(a) Since the Applicable Date, neither Parent nor any Merger Sub nor, to the knowledge of Parent, any of their respective directors, officers, employees or any other person acting on behalf of Parent or any Merger Sub in connection with the business of Parent or any Merger Sub (i) violated any applicable Anti-Corruption Law; (ii) engaged in any activity, practice or conduct which would constitute an offence under any applicable Anti-Corruption Law; (iii) offered, paid, promised or agreed to pay, or authorized the payment of, either directly or indirectly through third parties, anything of value to any Government Official or other person with the intent to corruptly (1) influence any act or decision of a Government Official in his or her official capacity, (2) induce a Government Official to do or omit to do any act in violation of his or her lawful duties, (3) secure any improper advantage for Parent or any Merger Sub, (4) induce a Government Official improperly to influence or affect any act or decision of any Governmental Entity or (5) assist Parent or any Merger Sub in improperly obtaining or retaining business or other improper business advantage.

(b) Parent and Merger Subs (i) are, and at all times since the Applicable Date, have been, in material compliance with all applicable Economic Sanctions/Trade Laws and all applicable Money Laundering Laws and (ii) are not engaged in, and have not since the Applicable Date engaged in any transaction or dealing in any Sanctioned Country or with or involving any Sanctions Target other than such business that was authorized, licensed or exempt from applicable Economic Sanctions/Trade Laws. Neither Parent nor any Merger Sub, nor, to the knowledge of Parent, any of their directors, officers, employees or any other person acting on behalf of Parent or any Merger Sub, nor any of Parent or any Merger Sub's customers or any other person with which the Companies or their Subsidiaries interact, is a Sanctions Target or otherwise a person or entity with whom transactions are prohibited under any applicable Economic Sanctions/Trade Laws.

(c) Since the Applicable Date, (i) neither Parent nor any Merger Sub has conducted or initiated any internal investigation, review or audit, or made a voluntary, directed, or mandatory disclosure to any Governmental Entity with respect to any applicable Anti-Corruption Law, Economic Sanctions/Trade Law, or Money Laundering Law, (ii) neither Parent nor any Merger Sub, nor, to the knowledge of Parent, any of their directors, officers, employees or any other person acting on behalf of Parent or any Merger Sub received any

written notice, request or citation regarding any Anti-Corruption Law, Economic Sanctions/Trade Law or Money Laundering Law or been subject to any investigation, inquiry, information request, or proceeding by any Governmental Entity under Anti-Corruption Law, Economic Sanctions/Trade Law; and (iii) Parent and Merger Subs have implemented and maintained internal controls, policies and procedures reasonably designed to detect, prevent and deter violations of applicable Anti-Corruption Laws, Economic Sanctions/Trade Laws and Money Laundering Laws.

6.19 Form S-3. As of the date hereof, Parent (a) is eligible to register the resale of the Parent Common Stock to be issued to the Members under Form S-3 promulgated under the Securities Act and (b) qualifies as a "well-known seasoned issuer" (as defined in Rule 405 of the Securities Act).

6.20 No Additional Representations.

(a) Except for the representations and warranties made in this Article VI, neither Parent nor any other Person makes any express or implied representation or warranty with respect to Parent or its Subsidiaries or their respective businesses, operations, assets, liabilities or conditions (financial or otherwise) in connection with this Agreement, the Mergers or the Parent Stock Issuance, and Parent hereby disclaims any such other representations or warranties. In particular, without limiting the foregoing disclaimer, neither Parent nor any other Person makes or has made any representation or warranty to the Companies or the Members or any of their respective Affiliates or Representatives with respect to (i) any financial projection, forecast, estimate, budget or prospect information relating to Parent or any of its Subsidiaries or their respective businesses; or (ii) except for the representations and warranties made by Parent in this Article VI, any oral or written information presented to the Companies or the Members or any of their respective Affiliates or Representatives in the course of their due diligence investigation of Parent, the negotiation of this Agreement or in the course of the Mergers and the Parent Stock Issuance. Notwithstanding the foregoing, nothing in this Section 6.20 shall limit the Members' or Companies' remedies with respect to claims of fraud arising from or relating to the express written representations and warranties made by Parent and Merger Subs in this Article VI.

(b) Notwithstanding anything contained in this Agreement to the contrary, Parent acknowledges and agrees that none of the Members, the Companies or any other Person has made or is making any representations or warranties relating to the Companies or their Subsidiaries whatsoever, express or implied, beyond those expressly given by the Companies in Article IV and the Members in Article V, including any implied representation or warranty as to the accuracy or completeness of any information regarding any Company or any Member furnished or made available to Parent or any of its Representatives and that neither Parent nor any Merger Sub has relied on any such other representation or warranty not set forth in this Agreement. Without limiting the generality of the foregoing, Parent acknowledges that no representations or warranties are made with respect to any projections, forecasts, estimates, budgets or prospect information that may have been made available to Parent or any of its Representatives (including in certain "data rooms," "virtual data rooms," management presentations or in any other form in expectation of, or in connection with, the Mergers and the Parent Stock Issuance).

ARTICLE VII
COVENANTS AND AGREEMENTS

7.1 Conduct of Company Business Pending the Mergers.

(a) Except (i) as set forth on Section 7.1(a) of the Company Disclosure Letter, (ii) as expressly permitted or required by this Agreement (including pursuant to the Restructuring), (iii) as may be required by applicable Law, or (iv) otherwise consented to by Parent in writing (which consent shall not be unreasonably withheld, delayed or conditioned), each Company covenants and agrees that, until the earlier of the Effective Time and the termination of this Agreement pursuant to Article IX, it shall, and shall cause each of its Subsidiaries to, (x) continue to enter into Hedging Transactions in the Ordinary Course, provided, however, that prior to entering into any Hedging Transaction described on Section 7.1(a) of the Company Disclosure Letter, the Companies shall have first consulted with Parent regarding the terms of such Hedging Transaction, and (y) use commercially reasonable efforts to conduct its businesses in the Ordinary Course, including by using commercially reasonable efforts to preserve substantially intact its present business organization, goodwill and assets, to keep available the services of its current officers and employees and preserve its existing relationships with Governmental Entities and its material customers, suppliers, licensors, licensees, distributors, lessors and others having business dealings that are material to the Companies and their Subsidiaries, taken as a whole.

(b) Except (i) as set forth on Section 7.1(b) of the Company Disclosure Letter, (ii) as expressly permitted or required by this Agreement (including pursuant to the Restructuring), (iii) as otherwise required or expressly permitted by, or otherwise contemplated in, the Business Plan, (iv) as may be required by applicable Law, or (v) otherwise consented to by Parent in writing (which consent shall not be unreasonably withheld, delayed or conditioned), until the earlier of the Effective Time and the termination of this Agreement pursuant to Article IX each Company shall not, and shall not permit its Subsidiaries to:

(i) other than Permitted Leakage, (A) declare, set aside or pay any dividends on, or make any other distribution in respect of any outstanding equity interests in, any Company or any of its Subsidiaries, except for dividends and distributions by a direct or indirect Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time to a Company or another direct or indirect Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time; (B) purchase, redeem or otherwise acquire, or offer to purchase, redeem or otherwise acquire, any capital stock of, or other equity interests in, any Company or any Subsidiary of any Company, except as required by the terms of any capital stock or equity interest of a Subsidiary existing as of the date hereof and made available to Parent; or (C) cause or permit to occur: (I) a Related Person receiving any consulting, advisory, management, service, directors or monitoring fee, bonus, or any other cash payment of any kind from any Company or any of its Subsidiaries, or becoming entitled to receive any of the foregoing, or directing or causing any Company or any of its Subsidiaries to make or pay, or commit to make or pay, any of the foregoing to any Person on its behalf in satisfaction of any liability, commitment or obligation on the part of any Related Person (in each case, other than Ordinary Course director fees and

Ordinary Course compensation (including incentive or bonus payments) or benefits made or provided to employees, officers or other service providers of any Company or any of its Subsidiaries or any Related Person pursuant to Company Plans in effect on January 1, 2024 to the extent otherwise permissible under this Section 7.1(b)); (II) a Related Person receiving a loan or security or similar right (including without limitation, options and similar rights), being transferred cash or any other asset or payment, becoming owed any indebtedness or other similar liability, commitment or obligation, or receiving payments in respect of any of the foregoing from any Company or any of its Subsidiaries, or becoming entitled to receive any of the foregoing, or directing or causing any Company or any of its Subsidiaries to make or pay, or commit to make or pay, any of the foregoing to any Person on its behalf in satisfaction of any liability, commitment or obligation on the part of any Related Person; (III) a Related Person having any claim by any Company or any of its Subsidiaries (whether such claim had been pending or anticipated) against a Related Person forgiven, discounted, released or canceled, or directing or causing any Company or any of its Subsidiaries to forgive, discount, cancel or release any such claims in respect of any agreement, arrangement or understanding with or otherwise against a Person in satisfaction of any liability, commitment or obligation on the part of any Related Person; (IV) any Company or any of its Subsidiaries having assumed, created, guaranteed, indemnified or incurred any liabilities, including any Encumbrance to the extent in favor or for the benefit of any Related Person (including any amounts incurred in connection with the Restructuring); (V) any Company or any of its Subsidiaries having paid any fees, costs or expenses to or on behalf of any Related Person which were incurred as a result of the matters set out in clauses (I) through (IV); (VI) amounts having become payable or liabilities having been assumed or created or assets having been transferred by any Company or any of its Subsidiaries pursuant to any contract made or entered into by any Company or any of its Subsidiaries the performance of which would fall under any of clauses (I) through (V); and (VII) any Tax being paid, payable or incurred by any Company or any of its Subsidiaries as a consequence of any matters referred to in clauses (I) through (VI);

(ii) split, combine or reclassify any capital stock of, or other equity interests in, or issue or authorize or propose the issuance of any other securities in respect of, in lieu of or in substitution for equity interests in any Company or any of its Subsidiaries;

(iii) offer, issue, deliver, grant or sell, or authorize or propose to offer, issue, deliver, grant or sell, any capital stock of, or other equity interests in, any Company or any of its Subsidiaries or any securities convertible into, or any rights, warrants or options to acquire, any such capital stock or equity interests, other than: (A) issuances by a Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time of such Subsidiary's capital stock or other equity interests to any Company or any other Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time or and (B) shares of capital stock issued as a dividend made in accordance with Section 7.1(b)(i);

(iv) (A) amend or propose to amend any Company's Organizational Documents or (B) amend or propose to amend the Organizational Documents of any of

any Company's Subsidiaries (other than, in the case of the Subsidiaries of any Company, for ministerial changes);

(v) (A) merge, consolidate, combine or amalgamate with any Person other than between Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time or (B) acquire or agree to acquire (including by merging or consolidating with, purchasing any equity interest in or a substantial portion of the assets of, licensing, or by any other manner), any business or any corporation, partnership, association or other business organization or division thereof, in each case other than acquisitions for which the consideration is less than $5,000,000 individually or $15,000,000 in the aggregate;

(vi) sell, lease, transfer, farmout, license, Encumber (other than Permitted Encumbrances), discontinue or otherwise dispose of, or agree to sell, lease, transfer, farmout, license, Encumber (other than Permitted Encumbrances), discontinue or otherwise dispose of, any portion of its assets or properties (including Company Intellectual Property), other than (A) sales, leases, transfers, farmouts or dispositions for which the consideration is less than $10,000,000 individually or $20,000,000 in the aggregate, (B) the sale or transfer of Hydrocarbons in the Ordinary Course, (C) asset or property swaps the fair market value of which are less than $10,000,000 individually or $20,000,000 in the aggregate, (D) abandonment or statutory expirations of immaterial Registered Company IP in the Ordinary Course, (E) grants of non-exclusive licenses to Company Intellectual Property in the Ordinary Course, (F) sales, leases, transfers, farmouts or dispositions among the Companies and their Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time, or (G) sales or dispositions of obsolete or worthless equipment in the Ordinary Course;

(vii) authorize, recommend, propose, enter into, adopt a plan or announce an intention to adopt a plan of complete or partial liquidation or dissolution, merger, consolidation, restructuring, recapitalization or other reorganization of any Company or any of its Subsidiaries, other than such transactions among Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time;

(viii) change in any material respect their material accounting principles, practices or methods, except as required by GAAP or applicable Law;

(ix) make, change or revoke any material election relating to Taxes, change an annual Tax accounting period, adopt or change any material Tax accounting method, file any material amended Tax Return (other than as required pursuant to a "determination" within the meaning of Section 1313(a) of the Code (or any analogous provision of state, local or foreign Law)), enter into any closing agreement with respect to material Taxes, settle or compromise any material Tax claim, audit, assessment or dispute, surrender any right to claim a material refund, agree to an extension or waiver of the statute of limitations with respect to the assessment or determination of any material Tax, or change Tax residence or create any office or fixed place of business or become subject to direct Tax (excluding any Tax that arises solely because sales are made to

customers in the applicable jurisdiction) in a country other than the country in which any Company or its relevant Subsidiaries is organized; provided that nothing in this Section 7.1(b)(ix) or Section 7.1(b)(viii) shall restrict the Members from taking any action in connection with their own Taxes unless such action could reasonably be expected to adversely affect Parent, any Company or any of its Subsidiaries with respect to any Post-Closing Tax Period;

(x) (A) grant any increases in the compensation or benefits payable or to become payable to any Company Service Provider, except (1) with respect to Company Service Providers with an annual base salary or wage rate (as applicable) of $250,000 or less, any merit-based or promotion-based increases that are made in the Ordinary Course that do not exceed 4% in the aggregate, (2) as required by the terms of a Company Plan existing as of the date hereof or (3) for the payment of annual bonuses for completed periods based on actual performance in the Ordinary Course; (B) take any action to accelerate the vesting or lapsing of restrictions or payment, or fund or in any other way secure the payment, of compensation or benefits; (C) grant any new equity-based or non-equity awards, amend or modify the terms of any outstanding equity-based or non-equity awards; (D) pay any incentive or performance-based compensation or benefits (except for payments in respect of completed periods based on actual performance in the Ordinary Course); (E) forgive any loans or issue any loans (other than routine travel advances issued in the Ordinary Course or loans in the Ordinary Course under and in accordance with the terms of any Company Plan that is a defined contribution plan) to any Company Service Provider; (F) enter into or establish any material Company Plan which was not in existence prior to the date of this Agreement, or amend or terminate any material Company Plan in existence on the date of this Agreement, other than (1) health and welfare program renewals, adoptions, amendments, and updates in the Ordinary Course, (2) as may be required by applicable Law or (3) *de minimis* administrative amendments that do not have the effect of enhancing any benefits thereunder or otherwise resulting in increased costs to any Company or any of their Subsidiaries; (G) hire or promote any employee or engage any other service provider (who is a natural person) who is (or would be) an employee or other service provider (who is a natural person) who has (or would have) an annual base salary or wage rate (as applicable) in excess of $250,000; (H) terminate the employment of any employee or other service provider (who is a natural person) who has an annual base salary or wage rate (as applicable) in excess of $250,000, in each case, other than for cause or as a result of such person's death or disability; or (I) enter into, adopt, commence participation in, amend or terminate any collective bargaining agreement or other labor agreement;

(xi) (A) retire, repay, defease, repurchase, discharge, satisfy or redeem all or any portion of the outstanding aggregate principal amount of any Company's or its Subsidiaries' Indebtedness that has a repayment cost, "make whole" amount, prepayment penalty or similar obligation (other than Indebtedness incurred by any Company or Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time and owed to any Company or Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time), other than any such amounts under the Company Credit Agreements; (B) incur, create or assume any Indebtedness or guarantee any such Indebtedness of another Person; or (C)

create any Encumbrances on any property or assets of any Company or any of its Subsidiaries in connection with any Indebtedness thereof, other than Permitted Encumbrances; provided, however, that the foregoing clauses (B) and (C) shall not restrict (1) the incurrence of Indebtedness under existing credit facilities in the Ordinary Course, and in no event exceeding $20,000,000 of borrowings in the aggregate, (2) the incurrence of Indebtedness by any Company that is owed to any Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time or by any Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time that is owed to a Company or a Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time, (3) the incurrence of Indebtedness incurred or assumed in connection with any acquisition permitted by Section 7.1(b)(v), (4) additional Indebtedness in an amount not to exceed $1,000,000, (5) the incurrence of Indebtedness under the RBL as may be required in the event of an emergency to protect life, property or the environment; provided that such borrowings incurred do not result in an aggregate amount outstanding under the RBL in excess of $40,000,000, or (6) the creation of any Encumbrances securing any Indebtedness permitted by the foregoing clauses (1), (2), (3), (4) or (5);

(xii) (A) enter into any contract that would be a Company Contract if it were in effect on the date of this Agreement, (B) modify, amend, terminate or assign, or waive or assign any rights under, any Company Contract (including the renewal of an existing Company Contract on substantially the same terms in the Ordinary Course) or (C) enter into any Hedging Transaction, other than in each case of the foregoing subclauses (A), (B) and (C) in the Ordinary Course;

(xiii) cancel, modify or waive any debts or claims held by any Company or any of its Subsidiaries or waive any rights held by any Company or any of its Subsidiaries having in each case a value in excess of $1,000,000 individually or $2,000,000 in the aggregate;

(xiv) waive, release, assign, settle or compromise or offer or propose to waive, release, assign, settle or compromise, any Proceeding (excluding any audit, claim or other proceeding in respect of Taxes) other than the settlement of such proceedings involving only the payment of monetary damages by any Company or any of its Subsidiaries of any amount not exceeding $8,000,000 in the aggregate and that would not result in any restriction on future activity or conduct or a finding or admission of a violation of Law; provided, in each case, that any Company shall be permitted to settle any Transaction Litigation in accordance with Section 7.9;

(xv) make or commit to make any capital expenditures in any fiscal quarter that are, in the aggregate, greater than 110% of 25% of the capital expenditures expressly provided for in the Business Plan for such fiscal year, except for capital expenditures to repair damage resulting from insured casualty events or capital expenditures required on an emergency basis or for the safety of individuals, assets or the environment;

(xvi) terminate any Company Permit or Right-of-Way, permit any Company Permit or Right-of-Way to lapse (other than in the Ordinary Course) or fail to apply on a timely basis for any renewal of any renewable Company Permit or Right-of-Way, except to the extent such termination, lapse or failure to apply for renewal would not reasonably be expected, individually or in the aggregate, to be material to the Companies and their Subsidiaries, taken as a whole; or

(xvii) agree to take any action that is prohibited by this Section 7.1(b).

7.2 Conduct of Parent Business Pending the Mergers.

(a) Except (i) as set forth on Section 7.2(a) of the Parent Disclosure Letter, (ii) as expressly permitted or required by this Agreement, (iii) as may be required by applicable Law, or (iv) as otherwise consented to by the Companies in writing (which consent shall not be unreasonably withheld, delayed or conditioned), Parent covenants and agrees that, until the earlier of the Effective Time and the termination of this Agreement pursuant to Article IX, it shall, and shall cause each of its Subsidiaries to, use commercially reasonable efforts to conduct its businesses in the Ordinary Course, including by using commercially reasonable efforts to preserve substantially intact its present business organization, goodwill and assets, to keep available the services of its current officers and employees and preserve its existing relationships with Governmental Entities and its material customers, suppliers, licensors, licensees, distributors, lessors and others having material business dealings with it.

(b) Except (i) as set forth on Section 7.2(b) of the Parent Disclosure Letter, (ii) as expressly permitted or required by this Agreement, (iii) as may be required by applicable Law, or (iv) otherwise consented to by the Companies in writing (which consent shall not be unreasonably withheld, delayed or conditioned), until the earlier of the Effective Time and the termination of this Agreement pursuant to Article IX Parent shall not, and shall not permit its Subsidiaries to:

(i) (A) declare, set aside or pay any dividends on, or make any other distribution in respect of any capital stock of, or other outstanding equity interests in, Parent or its Subsidiaries, except for (x) regular cash dividends (or corresponding dividend equivalents in respect of equity awards) payable by Parent in the Ordinary Course (and, for the avoidance of doubt, excluding any special dividends), with such increases as the Parent Board may determine from time to time, and (y) dividends and distributions by a direct or indirect wholly-owned Subsidiary of Parent to Parent or another direct or indirect wholly-owned Subsidiary of Parent; or (B) purchase, redeem or otherwise acquire, or offer to purchase, redeem or otherwise acquire, any capital stock of, or other equity interests in, Parent or any Subsidiary of Parent, except as (x) required by the terms of any capital stock or equity interest of a Subsidiary existing as of the date hereof, or as contemplated by any share repurchase program publicly disclosed prior to the date of this Agreement or (y) as contemplated by any Parent Plan existing as of the date hereof or any successor to such plan adopted or established in the Ordinary Course following the date of this Agreement;

(ii) split, combine or reclassify any capital stock of, or other equity interests in, or issue or authorize or propose the issuance of any other securities, warrants, rights or options in respect of, in lieu of or in substitution for equity interests in Parent or any of its Subsidiaries other than (A) the issuance of Parent Common Stock upon the vesting or lapse of any restrictions on any awards granted under Parent Plans and outstanding on the date hereof or issued in compliance with clause (B) below; and (B) issuances of awards granted in the Ordinary Course under the Parent Plans or any successor to such plan adopted or established in the Ordinary Course following the date of this Agreement;

(iii) amend or propose to amend Parent's Organizational Documents (other than in immaterial respects) or adopt any material change in the Organizational Documents of any of Parent's Subsidiaries that would prevent, delay or impair the ability of the Parties to consummate the Mergers or the ability of Parent to effect the Parent Stock Issuance;

(iv) merge, consolidate, combine or amalgamate with any Person other than between wholly-owned Subsidiaries of Parent;

(v) acquire or agree to acquire (including by merger or consolidating with, purchasing any equity interest in or a substantial portion of the assets of, licensing or by any other manner), any business or any corporation, partnership, association or other business organization or division thereof, in each case other than (1) Permitted Acquisitions, or (2) acquisitions of inventory, equipment or other similar assets in the Ordinary Course;

(vi) incur, create or assume any Indebtedness or guarantee any such Indebtedness of another Person, other than (x) as contemplated by this Agreement or (y) Indebtedness permitted under the existing credit agreements of Parent, as modified by the Commitment Letters; or

(vii) agree to take any action that is prohibited by this Section 7.2(b).

7.3 Preparation of Proxy Statement.

(a) The Parties understand and agree that the shares of Parent Common Stock to be issued and transferred as contemplated in this Agreement comprising the Aggregate Consideration to Members have not been registered under the securities Laws of the United States, including the Securities Act, or any other jurisdiction and will be issued and transferred pursuant to a "private placement" exempt from registration under the Securities Act by virtue of Regulation D promulgated thereunder. The shares of Parent Common Stock comprising the Aggregate Consideration will initially be characterized as "restricted securities" under the Securities Act and may only be transferred pursuant to a registration statement or an applicable exemption under the Securities Act. Any book entries recording the record ownership of shares of Parent Common Stock may bear customary legends indicating the applicability of restrictions on transferability of such Parent Common Stock pursuant to the Securities Act.

(b) Parent (with the assistance and cooperation of the Companies as reasonably requested by Parent) shall prepare, and Parent shall file with the SEC, as promptly as practicable after the date of this Agreement (but, in any event, no later than the later of (i) 60 days following the date of this Agreement and (ii) five days after the date the Companies have provided to Parent such information regarding the Companies and their Affiliates as may be reasonably required by Parent under applicable Law to file the Proxy Statement in preliminary form), the Proxy Statement in preliminary form. Parent shall promptly notify the Companies of the receipt of all comments of the SEC with respect to the Proxy Statement and of any request by the SEC for any amendment or supplement thereto or for additional information and shall promptly provide to the Companies copies of all written correspondence between any Company or any of its Representatives, on the one hand, and the SEC, on the other hand, with respect to the Proxy Statement. Parent shall use reasonable best efforts to cause the Proxy Statement and all other documents that it is responsible for filing with the SEC in connection with the Mergers or the Parent Stock Issuance to comply with the rules and regulations promulgated by the SEC. Subject to Section 7.3(d), Parent shall use its reasonable best efforts, with the assistance of the Companies, as applicable, to promptly provide responses to the SEC with respect to all comments received on the Proxy Statement by the SEC, and Parent shall cause the definitive Proxy Statement to be mailed as promptly as possible (but, in any event, not later than five Business Days) after the date the SEC staff advises that it has no further comments thereon or that Parent may commence mailing the Proxy Statement (but, in any event, not later than five Business Days after such date).

(c) Each Member shall permit and hereby authorizes Parent to publish and disclose in all documents and schedules filed with the SEC, including the Proxy Statement, or other disclosure document filed with the SEC that Parent or the Companies reasonably determine to be necessary to comply with applicable Law, the Member's identity and ownership of the Equity Interests and the nature of the Member's commitments and obligations under this Agreement, the Stockholder Agreements and the Registration Rights Agreement.

(d) Notwithstanding anything to the contrary in this Section 7.3, prior to filing or mailing the Proxy Statement (or any amendment or supplement thereto) or responding to any comments of the SEC with respect thereto, Parent will (i) provide the Companies with a reasonable opportunity to review and comment on such document or response, and (ii) consider in good faith any such comments reasonably and promptly proposed by the Companies.

7.4 No Solicitation; Parent Stockholders Meeting; Approvals.

(a) Except as otherwise provided in this Section 7.4, from the date of this Agreement until the Effective Time or, if earlier, the termination of this Agreement in accordance with its terms, Parent will not, nor shall it authorize or permit any of its Subsidiaries to, and will use its reasonable best efforts to cause its and their respective Representatives not to, (a) initiate, solicit or knowingly encourage the making of any Acquisition Proposal or (b) other than informing third parties of the provisions contained in this Section 7.4, engage in negotiations or substantive discussions with, or furnish any material nonpublic information to, any third party that may relate to an Acquisition Proposal. Parent agrees that it and its Subsidiaries shall, and that they shall cause their respective

Representatives to, (i) immediately cease and cause to be terminated any existing activities, discussions or negotiations with any person (other than the Companies) conducted prior to the date of this Agreement with respect to any Acquisition Proposal and (ii) request each third party (if any) that has executed a confidentiality agreement that relates to an Acquisition Proposal (other than the Companies) during the six months prior to the date of this Agreement to return or destroy all confidential information regarding Parent or its Subsidiaries heretofore furnished to such third party by Parent or on its behalf.

(b) Subject to Sections 7.4(c) through 7.4(g), prior to the Closing Date, neither the Parent Board nor any committee thereof shall, directly or indirectly, (i) withdraw, withhold, modify or qualify, or publicly propose to withdraw, withhold, modify or qualify, in a manner adverse to the Companies, the Parent Board Recommendation, (ii) approve, adopt or recommend, or publicly propose to approve, adopt or recommend, any Acquisition Proposal, (iii) in the event of the commencement of a tender offer or exchange offer for any outstanding shares of Parent's capital stock, fail to recommend against acceptance of such tender offer or exchange offer by the holders of Parent Common Stock (including, subject to Section 7.4(c), by taking no position or a neutral position with respect to any such offer) within ten Business Days of the commencement thereof, (iv) recommend that the Parent stockholders not approve the Parent Stock Issuance, (v) fail to publicly reaffirm the Parent Board Recommendation within five Business Days of the Companies' written request to do so following the public announcement or disclosure of an Acquisition Proposal (or promptly after announcement or disclosure of an Acquisition Proposal if announced or disclosed on or after the fifth Business Day before the date of the Parent Stockholders Meeting) (any action described in clauses (i)-(v) above being referred to as an "Parent Change of Recommendation"), (vi) either fail to enforce, or grant any waiver or release under, any standstill or similar agreement with respect to any class of equity securities of Parent or any of its Subsidiaries unless the Parent Board determines in good faith, after consultation with outside legal counsel, that the failure to take such action would be inconsistent with its fiduciary duties under applicable Laws, (vii) approve any transaction under, or any Person becoming an "interested stockholder" under applicable Law or (viii) enter into any agreement in principle, letter of intent, term sheet, merger agreement, acquisition agreement, option agreement or other similar instrument relating to an Acquisition Proposal.

(c) Nothing contained in this Agreement shall prevent Parent or the Parent Board from complying with its disclosure obligations under Rule 14d-9 and 14e-2 promulgated under the Exchange Act, or issuing a "stop, look and listen" statement pending disclosure of its position (none of which, in and of itself, shall be deemed to constitute a Parent Change of Recommendation).

(d) Notwithstanding the limitations set forth in Section 7.4(a) and Section 7.4(b), until the earlier of the receipt of the Parent Stockholder Approval and any termination of this Agreement pursuant to Article IX, if after the date of this Agreement Parent receives a written *bona fide* Acquisition Proposal, that did not result from a breach of this Section 7.4, and that the Parent Board has determined in good faith, after consultation with its outside legal counsel and financial advisors (i) constitutes a Parent Superior Proposal or (ii) could reasonably be expected to result in a Parent Superior Proposal, then Parent, its Subsidiaries and its and their respective Representatives may, subject to Section 7.4(g), in response to such

Acquisition Proposal take the following actions, to the extent that the Parent Board has determined in good faith, after consultation with its outside legal counsel, that failure to take such actions would be inconsistent with the Parent Board's fiduciary duties under applicable Law: (A) furnish nonpublic information to the third party making such Acquisition Proposal, if, and only if, prior to furnishing such information, Parent receives from the third party an executed confidentiality agreement containing a customary "standstill provision" if and to the extent such provision is determined by the Parent Board in good faith to be in the best interests of Parent's stockholders and provisions no less restrictive to such third party with respect to the use or disclosure of nonpublic information than the Confidentiality Agreement and expressly allow Parent to comply with its obligations under this Section 7.4 and (B) engage in discussions or negotiations with the third party with respect to such Acquisition Proposal.

(e) Notwithstanding anything in this Agreement to the contrary but subject to compliance with this Section 7.4, nothing contained in this Agreement shall prevent Parent or the Parent Board from, at any time prior to, but not after, the receipt of the Parent Stockholder Approval, in response to the receipt of a written Acquisition Proposal after the date of this Agreement that did not result from a breach of this Section 7.4, effecting a Parent Change of Recommendation, if and only if, prior to taking such action, (i) the Parent Board determines in good faith, after consultation with its outside legal counsel and financial advisors, that such Acquisition Proposal constitutes a Parent Superior Proposal and (ii)(A) the Companies shall have received written notice (the "Parent Superior Proposal Notice") of Parent's or of the Parent Board, as applicable, intention to take such action at least four Business Days prior to the taking of such action by Parent or the Parent Board, as applicable, which notice shall include the information with respect to such Acquisition Proposal that is specified in Section 7.4(g) (to the extent not previously provided), (B) until 5:00 p.m., Los Angeles time, on the fourth Business Day immediately following the day on which Parent delivered the Parent Superior Proposal Notice (such period from the time the Parent Superior Proposal Notice is provided until 5:00 p.m. Los Angeles time on the fourth Business Day immediately following the day on which Parent delivered the Parent Superior Proposal Notice, the "Negotiation Period"), Parent, if requested by the Companies, shall have made its Representatives available to negotiate with the Companies regarding any revisions to the terms of the transactions proposed by the Companies in response to such Acquisition Proposal, and (C) at the end of the four Business Day period described in the foregoing clause (B) the Parent Board continues to believe, in good faith after consultation with its outside legal counsel and financial advisors, and after taking into account any modifications to the terms of the Mergers and the transactions contemplated hereby that are proposed in a written offer by the Companies after their receipt of the Parent Superior Proposal Notice, that such Acquisition Proposal continues to constitute a Parent Superior Proposal and that failure to take such action would be inconsistent with the Parent Board's fiduciary duties under applicable Law. Any material amendment or modification to such Acquisition Proposal prior to a Parent Change of Recommendation shall require a new Parent Superior Proposal Notice and the Negotiation Period shall be extended by an additional two Business Days from the date of receipt of such new Parent Superior Proposal Notice.

(f) If, at any time prior to obtaining the Parent Stockholder Approval, the Parent Board determines in good faith, in response to a Parent Intervening Event that has occurred after the date of this Agreement and is continuing and that did not result from a

breach of this Agreement by Parent, after consultation with its outside legal counsel, that the failure to make a Parent Change of Recommendation in response to any such Parent Intervening Event would be inconsistent with the Parent Board's fiduciary duties under applicable Law, the Parent Board may, prior to obtaining the Parent Stockholder Approval, make a Parent Change of Recommendation; provided that Parent will not be entitled to make, or agree or resolve to make, a Parent Change of Recommendation unless (i) Parent delivers to the Companies a written notice (a "Parent Intervening Event Notice") advising the Companies that the Parent Board proposes to take such action and identifying the related Parent Intervening Event (it being acknowledged that such Parent Intervening Event Notice shall not itself constitute a breach of this Agreement), and (ii) at or after 5:00 p.m., Los Angeles time, on the fourth Business Day immediately following the day on which Parent delivered the Parent Intervening Event Notice (such period from the time the Parent Intervening Event Notice is provided until 5:00 p.m. Los Angeles time on the fourth Business Day immediately following the day on which Parent delivered the Parent Intervening Event Notice (it being understood that any material development with respect to a Parent Intervening Event shall require a new notice but with an additional two Business Day (instead of four Business Day) period from the date of such notice), the "Parent Intervening Event Notice Period"), the Parent Board reaffirms in good faith (after consultation with its outside legal counsel) that, after taking into account the adjustments to the terms and conditions of this Agreement committed to by the Companies in writing, the failure to make a Parent Change of Recommendation in response to such Parent Intervening Event would be inconsistent with its fiduciary duties under applicable Law. During the Parent Intervening Event Notice Period, the Companies shall have the right to propose adjustments to the terms and conditions of this Agreement so as to obviate the need for a Parent Change of Recommendation, which the Parent Board shall consider in good faith.

(g) Parent shall promptly notify the Companies in writing of any request for information or any inquiries, proposals or offers relating to an Acquisition Proposal indicating, in connection with such notice, the name of such person making such request, inquiry, proposal or offer and the material terms and conditions of any proposals or offers and Parent shall provide to the Companies written notice of any such inquiry, proposal or offer within 48 hours of such event and copies of any such written proposals. Parent shall keep the Companies informed in writing within 48 hours of material developments with respect to the status and material terms of any Acquisition Proposal and whether any such proposal or offer has been withdrawn or rejected and Parent shall provide to the Companies written notice within 48 hours of any such withdrawal or rejection and copies of any written proposals or requests for information, within 48 hours of the occurrence of any such material development. Parent also agrees to provide any information to the Companies (not previously provided or made available to the Companies) that it is providing to another person pursuant to this Section 7.4 at substantially the same time it provides such information to such other person.

(h) Parent will take, in accordance with applicable Law and its Organizational Documents, all action necessary to convene the Parent Stockholders Meeting as promptly as reasonably practicable after the execution of this Agreement to consider and vote upon the approval of the Parent Stock Issuance and any other matters required under applicable Law to be considered at the Parent Stockholders Meeting.

(i) Parent shall use its reasonable best efforts to solicit from its stockholders proxies in favor of the approval of the Parent Stock Issuance and take all actions necessary to secure the Parent Stockholder Approval (it being understood that the foregoing shall not require the Parent Board to make the Parent Board Recommendation if a Parent Change of Recommendation has been effected in accordance with Section 7.4(e)). Notwithstanding any other provision hereof, Parent may postpone or adjourn the Parent Stockholders Meeting (i) with the consent of each Company, (ii) for the absence of a quorum, (iii) if additional time is reasonably required to solicit proxies from the holders of Parent Common Stock in favor of the approval of the Parent Stock Issuance; provided that Parent may not postpone or adjourn the Parent Stockholders Meeting more than two times pursuant to this clause (iii) without the prior written consent of each Company (not to be unreasonably withheld, conditioned or delayed); provided, further, no adjournment pursuant to this sentence shall be required to be for a period exceeding 15 calendar days, or (iv) to allow reasonable additional time for the filing and distribution of any supplemental or amended disclosure which the Parent Board has determined in good faith (after consultation with its outside legal counsel) that the failure to so file or distribute such disclosure would reasonably be likely to be inconsistent with applicable Law and for such supplemental or amended disclosure to be disseminated to and reviewed by Parent's stockholders prior to the Parent Stockholders Meeting. Notwithstanding the foregoing, Parent shall, at the request of the Companies, to the extent permitted by Law, adjourn the Parent Stockholders Meeting to a date specified by the Companies for the absence of a quorum or if Parent has not received proxies representing a sufficient number of shares for the Parent Stockholder Approval; provided that Parent shall not be required to adjourn the Parent Stockholders Meeting more than two times pursuant to this sentence, and no such adjournment pursuant to this sentence shall be required to be for a period exceeding 15 calendar days. The Parent Board shall recommend that Parent's stockholders approve of the Parent Stock Issuance, and Parent shall include the Parent Board Recommendation in the Proxy Statement, unless a Parent Change of Recommendation has been effected in accordance with Section 7.4(e). The Parent Board shall not (and no committee or subgroup thereof shall) change, withdraw, withhold, qualify or modify, or publicly propose to change, withdraw, withhold, qualify or modify, the Parent Board Recommendation (a "Parent Change of Recommendation") except as may be permitted by, and only in accordance with, Section 7.4(e). Unless this Agreement has been terminated in accordance with its terms, Parent's obligation to call, give notice of, convene and hold the Parent Stockholders Meeting and solicit proxies from the stockholders of Parent to obtain the Parent Stockholder Approval shall not be limited or otherwise affected by any Acquisition Proposal, Parent Change of Recommendation or Parent Intervening Event.

(j) Concurrently with the execution of this Agreement, Parent has approved this Agreement in its capacity as the sole member of each Merger Sub in accordance with applicable Law and the Organizational Documents of each Merger Sub and delivered to the Companies evidence of its vote or action by written consent so approving this Agreement.

(k) Concurrently with the execution of this Agreement, the Members shall provide the Company Member Approvals, in accordance with applicable Law and the Organizational Documents of the Companies and deliver to Parent evidence of such Company Member Approvals. Each Member agrees not to modify, revoke or rescind the Company Member Approvals executed by such Member or any resolution contained therein, and further

agrees not to adopt any resolutions modifying, rescinding or revoking the Company Member Approvals executed by the Member or any resolution contained therein or otherwise precluding approval of the Mergers or this Agreement unless and until this Agreement is terminated in accordance with its terms. Each Member agrees that it shall not bring, commence, institute, maintain, prosecute, or participate in any Proceeding, in law or in equity, in any court or before any Governmental Entity, that (i) challenges the validity of or seeks to enjoin the operation of any provision of the Company Member Approvals or this Agreement or the consummation of the Mergers and the Parent Stock Issuance or (ii) alleges that the execution and delivery of the Company Member Approvals or this Agreement by such Member breaches any fiduciary duty, whether any of the governing bodies, any Member, or any officer or manager of any Company.

7.5 Access to Information.

(a) Subject to applicable Law and the other provisions of this Section 7.5, the Companies and Parent each shall (and shall cause its Subsidiaries to), upon request by the other, at the sole cost and expense of the requesting Party, furnish the other with all reasonably requested information concerning itself, its Subsidiaries, directors, officers, members and stockholders and such other matters as may be reasonably necessary or advisable in connection with the preparation of the Proxy Statement or any other statement, filing, notice or application required to be made by or on behalf of Parent, the Companies or any of their respective Subsidiaries to any Governmental Entity in connection with the Mergers and the Parent Stock Issuance. Subject to applicable Law, the Companies shall, and shall cause each of their Subsidiaries to, at the sole cost and expense of Parent, afford to Parent and its Representatives, during the period prior to the earlier of the Effective Time and the termination of this Agreement pursuant to the terms of Section 9.1, reasonable access, at reasonable times upon reasonable prior notice, to the officers, key employees, agents, properties, offices and other facilities of the Companies and their Subsidiaries, and to their respective books and records for purposes reasonably related to the consummation of the transactions contemplated by this Agreement and in connection with any Tax matters of any Company or any of their Subsidiaries. Parent and its Representatives shall conduct any such activities in such a manner as not to interfere unreasonably with the business or operations of the Companies or their Subsidiaries or otherwise cause any unreasonable interference with the prompt and timely discharge by the employees of the Companies and their Subsidiaries of their normal duties. Notwithstanding the foregoing:

(i) No Party shall be required to, or to cause any of its Subsidiaries to, grant access or furnish information, as applicable, to the other Party or any of its Representatives to the extent that such information is subject to an attorney/client privilege or the attorney work product doctrine or that such access or the furnishing of such information, as applicable, is prohibited by applicable Law or an existing contract or agreement (provided, however, the Companies or Parent, as applicable, shall inform the other Party as to the general nature of what is being withheld and the Companies and Parent shall reasonably cooperate to make appropriate substitute arrangements to permit reasonable disclosure that does not suffer from any of the foregoing impediments, including through the use of commercially reasonable efforts to (A) obtain the required consent or waiver of any third party required to provide such information and

(B) implement appropriate and mutually agreeable measures to permit the disclosure of such information in a manner to remove the basis for the objection, including by arrangement of appropriate clean room procedures, redaction or entry into a customary joint defense agreement with respect to any information to be so provided, if the Parties determine that doing so would reasonably permit the disclosure of such information without violating applicable Law or jeopardizing such privilege);

(ii) No Party shall have access to personnel records of the other Party or any of its Subsidiaries relating to individual performance or evaluation records, medical histories or other information that in the other Party's good faith opinion the disclosure of which could subject the other Party or any of its Subsidiaries to risk of liability;

(iii) No Party shall have access to the properties of the other Party or any of its Subsidiaries for the purpose of conducting any subsurface or other invasive or intrusive sampling or testing of environmental media; and

(iv) No investigation or information provided pursuant to this Section 7.5 shall affect or be deemed to modify any representation or warranty made by any Party and no Party shall, and each Party shall cause their respective Representatives to not, use any information obtained pursuant to this Section 7.5 for any purpose unrelated to (1) the preparation of the Proxy Statement or any other statement, filing, notice or application required to be made by and behalf of Parent, the Companies or any of their respective Subsidiaries to any Governmental Entity in connection with the Mergers and the Parent Stock Issuance, (2) the transactions contemplated by this Agreement, as applicable or (3) Tax matters of any Company; provided, no such access or disclosure shall be permitted for a purpose related to an ongoing dispute with or involving any Company, any Member, Parent or any Merger Sub.

(b) The Confidentiality Agreement dated as of August 9, 2023 between Parent and Green Gate Resources Holdings, LLC (as amended, the "Confidentiality Agreement") shall survive the execution and delivery of this Agreement and shall apply to all information furnished thereunder or hereunder. From and after the date of this Agreement until the earlier of the Effective Time and termination of this Agreement in accordance with Article IX, each Party shall continue to provide access to the other Party and its Representatives to the data relating to the Mergers and the Parent Stock Issuance maintained by or on behalf of it to which the other Party and its Representatives were provided access prior to the date of this Agreement.

7.6 HSR, FERC and Other Approvals.

(a) Reasonable Best Efforts. Upon the terms and subject to the conditions set forth in this Agreement and provided that at all times the provisions of Section 7.6(b) -(e) shall govern the matters set forth therein, including efforts required to obtain any approvals or clearances applicable to the consummation of the Mergers in accordance with the HSR Act (the "Antitrust Approval"), the Companies and Parent shall cooperate with each other and use (and shall cause their respective Subsidiaries to use) their respective reasonable best efforts to

obtain all consents, registrations, approvals, permits, and authorizations, in each case, necessary or advisable in order to consummate the transactions contemplated by this Agreement as promptly as reasonably practicable and in any event prior to the End Date.

(b) Antitrust and FERC Approval. Subject to the terms of this Section 7.6(b) and Section 7.6(d), the Companies and Parent shall cooperate with each other and use (and shall cause their respective Subsidiaries to use) their respective reasonable best efforts to (x) file with the FTC and the Antitrust Division of the DOJ a Notification and Report Form relating to this Agreement and the Mergers as required by the HSR Act promptly, and in any event within 10 Business Days, following the date of this Agreement and (y) file with FERC an application pursuant to Section 203 of the FPA seeking the FERC Approval, and in any event within 20 calendar days, following the date of this Agreement. Each of the Companies and Parent, as applicable, shall (and shall cause their respective Subsidiaries to):

(i) cooperate and coordinate with the other in the making of the filings referenced in this Section 7.6(b);

(ii) use its respective reasonable best efforts to supply the other with any information that may be required in order to make such filings;

(iii) use its respective reasonable best efforts to supply any additional information that reasonably may be required or requested by FERC, the FTC or DOJ;

(iv) use its respective reasonable best efforts to take all action necessary to (a) cause the expiration or termination of the applicable waiting periods pursuant to the HSR Act applicable to the Mergers, and (b) obtain the FERC Approval as soon as practicable, and in any event prior to the End Date;

(v) use its respective commercially reasonable efforts to contest, defend and appeal any legal Proceedings, whether judicial or administrative, challenging this Agreement or the consummation of the Mergers; and

(vi) prior to independently participating in any meeting, or engaging in any substantive conversation, with FERC, the FTC or DOJ in respect of any such filings or any investigations or other inquiries relating thereto, to the extent reasonably practicable, provide notice to the other Party of such meeting or conversation and, unless prohibited by FERC, the FTC or DOJ, the opportunity to attend or participate.

Parent and the Companies shall jointly control all communications, negotiations, timing decisions, and strategy relating to any approval or clearance applicable to the Mergers under the HSR Act, and the parties shall take all reasonable actions to support each other in connection therewith; provided, however, that in the event of a disagreement between the Parties with respect to the scope of any condition, obligation, requirement, limitation or remedy necessary to obtain approval under the HSR Act, the determination of Parent shall prevail subject to consultation with the Companies. Each of the Companies and Parent will permit the other Party and its Representatives to review in advance any written communication proposed to be made by such party to the FTC or DOJ regarding the Mergers and will consider in good faith the views of the other Party and promptly inform the other Party of any substantive communication from the

FTC or DOJ regarding the Mergers in connection with such filings. If any party or Affiliate thereof receives a request for additional information or documentary material from the FTC or DOJ with respect to the Mergers pursuant to the HSR Act, then such party will use reasonable best efforts to make (or cause to be made), as soon as reasonably practicable and after consultation with the other parties, an appropriate response in compliance with such request. Parent shall not (i) withdraw, or offer or commit to withdraw, its Notification and Report Form relating to this Agreement or (ii) commit to or agree with any Governmental Entity to stay, toll or extend any applicable waiting period under the HSR Act or not consummate the transactions contemplated by the Agreement, in each case, without the prior written consent of each Company (not to be unreasonably withheld, conditioned or delayed). Each Party will bear its own filing fees and costs of preparing its own pre-merger notifications and related expenses incurred to make or obtain any approval, clearance or notice under the HSR Act.

(c) Notwithstanding any other requirement in this Section 7.6, where a Party (a "Disclosing Party") is required under this Section 7.6 to provide information to another Party (a "Receiving Party") that the Disclosing Party deems to be competitively sensitive information, the Disclosing Party may comply with such requirement by restricting the provision of such competitively sensitive only to antitrust counsel of the Receiving Party and providing to the Receiving Party, upon request of the Receiving Party, a redacted version of such information which does not contain any such competitively sensitive information.

(d) *Regulatory Remedies*. Notwithstanding anything in this Agreement to the contrary, Parent will use its reasonable best efforts to take all actions necessary to avoid or eliminate each and every impediment under the Antitrust Laws so as to enable Closing to occur as promptly as practicable, including an obligation to: (i) make any commitment to or undertake or enter into agreements or agree to the entry of an order or decree with any Governmental Entity, (ii) commit to sell or dispose of, or hold separate or agree to sell or otherwise dispose of, assets, categories of assets or business of Parent, the Companies, the Surviving Companies or any other Subsidiary of Parent or the Companies, or the assets or business of any Party, (iii) commit to or accept any operational restriction or take or commit to take any action related to Parent, the Companies, the Surviving Companies or any other Subsidiary of Parent or the Companies or any other Party, (iv) commit to terminate, amend or replace any existing relationships and contractual rights and obligations of Parent, the Companies, the Surviving Companies or any other Subsidiary of Parent or the Companies or any other Party, (v) terminate any relevant venture or other arrangement of Parent, the Companies, the Surviving Companies or any other Subsidiary of Parent or the Companies or any other Party or (vi) effectuate any other change or restructuring of Parent, the Companies, the Surviving Companies or any other Subsidiary of Parent or the Companies or any Party; provided, that, notwithstanding anything to the contrary in this Agreement, (A) no Party will be required to take or agree or commit to take any action that is not conditioned upon the Closing and, and (B) that nothing in this Section 7.6 or otherwise in this Agreement shall require Parent and its respective Affiliates to offer, propose, negotiate, commit to, take or effect any action that would constitute a Burdensome Condition. For the purposes of this Agreement, "Burdensome Condition" means any term, condition, obligation, requirement, limitation, prohibition, remedy, sanction or other action imposed upon Parent, the Companies or any of their respective Subsidiaries that would reasonably be expected to result in, (a) with respect to Parent, the Companies or their respective Subsidiaries, (x) payments or expenditures (including

reasonable counsel and advisor fees) or (y) concessions of anything of value (including loss of profits or benefits of the transactions contemplated by this Agreement as a result of any requirement restricting or regulating the conduct of business), that would, individually or in the aggregate, reasonably be expected to result in a material adverse effect on the business, operations, financial condition or results of operations of the Companies and their Subsidiaries, taken as a whole, or Parent and its Subsidiaries, taken as a whole (assuming for purposes of such analysis that any material and adverse effect is measured on a scale relative to the Companies and their Subsidiaries), or (b) the transfer, disposition, divestiture or sale of any businesses, assets or properties of Parent, the Companies or any of their respective Subsidiaries that would, individually or in the aggregate, reasonably be expected to result in a material and adverse effect on the business, operations, financial condition or results of operations of the Companies and their Subsidiaries, taken as a whole, or Parent and its Subsidiaries, taken as a whole (assuming for purposes of such analysis that any material and adverse effect is measured on a scale relative to the Companies and their Subsidiaries). The Companies shall not, and shall cause, their Subsidiaries not to, take any of the foregoing actions in clauses (i) through (vi) with respect to the Companies or any of their Subsidiaries unless consented to in writing by Parent, provided that the Companies shall, and shall cause each Subsidiary of the Companies to, undertake such actions if requested by Parent if the effectiveness of such action is conditioned upon the occurrence of the Closing.

(e) Notwithstanding anything to the contrary in Section 7.1(b) or Section 7.2(b), as applicable, between the date of this Agreement and the Closing, neither Parent nor the Companies shall engage in, or permit any of its Subsidiaries to engage in, any merger or acquisition, including any business combinations, asset acquisitions or sales, consolidations, mergers, stock acquisitions or sales, joint ventures, or other strategic transactions, that would, individually or in the aggregate, reasonably be expected to prevent, delay or impair the consummation of the Mergers by the End Date.

7.7 Employee Matters.

(a) For one year following the Effective Time, Parent shall cause each individual who is employed as of the Closing Date by any Company or a Subsidiary thereof (other than individuals covered by a collective bargaining agreement or similar agreement with a Union) (a "Continuing Employee") and who remains employed by Parent or any of its Subsidiaries (including the Surviving Companies or any of their Subsidiaries) to be provided with (i) a base salary or wage rate no less favorable than the base salary or wage rate provided to such Continuing Employee immediately prior to the Effective Time, (ii) a target annual cash incentive opportunity that is no less favorable than the target annual cash incentive opportunity that is provided to such Continuing Employee immediately prior to the Effective Time; and (iii) employee benefits (excluding any equity or equity-based compensation, cash incentive based compensation, post-retirement benefits or defined benefit pension plan benefits) that are no less favorable in the aggregate than the employee benefits (excluding any equity or equity-based compensation, cash incentive based compensation, post-retirement benefits or defined benefit pension plan benefits) that are provided to similarly-situated employees of Parent and its Affiliates immediately prior to the Effective Time. Without limiting the foregoing, with respect to Continuing Employees whose terms and conditions of employment are subject to a collective bargaining agreement or other contract with a Union, the Parent shall, or shall cause

the Surviving Companies and their Subsidiaries to, comply with the terms and conditions of each such applicable collective bargaining agreement or other contract with a Union, in each case, in a manner consistent with applicable Law.

(b) From and after the Effective Time, as applicable, Parent shall, or shall cause the Surviving Companies and their Subsidiaries, to take commercially reasonable efforts to credit the Continuing Employees for purposes of vesting, eligibility and benefit accrual under the Parent Plans (other than with respect to any "defined benefit plan" as defined in Section 3(35) of ERISA, retiree medical, dental or life benefits or disability benefits or to the extent it would result in a duplication of benefits) in which the Continuing Employees participate, for such Continuing Employees' service with the Companies and their Subsidiaries, to the same extent and for the same purposes that such service was taken into account under a corresponding Company Plan immediately prior to the Closing Date, except to the extent it would result in the duplication of any benefits.

(c) From and after the Effective Time, as applicable, Parent shall, or shall cause the Surviving Companies and their Subsidiaries, to take commercially reasonable efforts to (i) waive any limitation on health and welfare coverage of any Continuing Employee and his or her eligible dependents due to pre-existing conditions and/or waiting periods, active employment requirements and requirements to show evidence of good health under the applicable health and welfare maintained, sponsored or contributed to Parent or its Affiliates to the extent such Continuing Employee and his or her eligible dependents are covered under a Company Plan immediately prior to the Closing Date, and such conditions, periods or requirements are satisfied or waived under such Company Plan and (ii) give each Continuing Employee credit for the plan year in which the Closing Date occurs towards applicable deductibles and annual out-of-pocket limits for medical expenses incurred prior to the Closing Date for which payment has been made, in each case, to the extent permitted by the applicable insurance plan provider.

(d) Prior to the Effective Time, if requested by Parent in writing no less than five Business Days prior to the Closing Date, each Company and its Subsidiaries shall adopt resolutions and take all such corporate action as is necessary to terminate each 401(k) plan maintained, sponsored or contributed to by any Company or any of its Subsidiaries (collectively, the "Company 401(k) Plans"), in each case, effective as of the day immediately prior to the Closing Date, and the Companies shall provide Parent with evidence that such Company 401(k) Plans have been terminated. The form and substance of such termination documents shall be subject to the reasonable prior approval of Parent and be delivered to Parent no later than three Business Days following receipt of Parent's request under the preceding sentence. To the extent the Company 401(k) Plans are terminated pursuant to Parent's request, the Continuing Employees shall be eligible to participate in a 401(k) plan maintained by Parent or one of its Subsidiaries on the Closing Date, and such Continuing Employees shall be entitled to effect a direct rollover of any eligible rollover distributions (as defined in Section 402(c)(4) of the Code) and loans to such 401(k) plan maintained by Parent or its Subsidiaries.

(e) (1) At least two calendar days prior to the Closing Date, each Company shall submit for approval by the Members, in accordance with Section 280G of the Code and

the regulations thereunder (the "280G Member Vote"), any payments that could constitute a "parachute payment" pursuant to Section 280G of the Code (each, a "Parachute Payment"), (2) at least three calendar days prior to the Closing Date, each Company shall obtain, prior to the initiation of the 280G Member Vote, from each of the applicable "disqualified individuals" (as defined under Section 280G of the Code and the regulations promulgated thereunder) to whom a Parachute Payment is required or proposed to be made, a written agreement waiving such disqualified individual's right to receive some or all of such Parachute Payment, to the extent necessary so that all remaining payments and benefits applicable to such disqualified individual shall not be deemed a Parachute Payment (the "Waived Benefits") and such disqualified individual shall only receive such Waived Benefits only if approved pursuant to the 280G Member Vote, and (3) each Company shall have delivered to Parent true and complete copies of all disclosure and documents that comprise the Waived Benefits and materials subject to the 280G Member Vote in sufficient time to allow Parent to comment thereon but no less than five Business Days prior to the 280G Member Vote, and shall reflect all reasonable comments that are made timely by Parent thereon; provided that in no event shall any Company be deemed to be in breach of this Section 7.7(e) if any of the applicable "disqualified individuals" refused to waive any existing rights under any contract or if the Members fail to approve any Waived Benefits. In connection with the foregoing, Parent shall provide the Companies at least seven calendar days prior to the Closing Date with all information and documents that are reasonably necessary to allow the Companies to determine whether any payments made or to be made or benefits granted or to be granted pursuant to any employment agreement or other agreement, arrangement or contract entered into or negotiated by Parent or its Affiliates, if any (the "Purchaser Payments") (including information necessary to determine the estimated value of such arrangements for purposes of the 280G Member Vote and Waived Benefits and the terms and conditions thereof) together with all other payments and benefits, could reasonably be considered to be a Parachute Payment (and shall further provide any such updated information as is necessary prior to the Closing Date). Notwithstanding anything to the contrary in this Section 7.7(e) or otherwise in this Agreement, to the extent that Parent or its Affiliates has provided misinformation, or Parent's or its Affiliates omission of information has resulted in misinformation, with respect to any Purchaser Payments, the Companies shall be deemed to be in compliance with the representations contained in Section 4.10(l) and 4.10(m) or the covenant contained herein.

(f) Nothing in this Agreement shall constitute an amendment to, or be construed as amending, any Company Plan or any other employee benefit plan sponsored, maintained or contributed to by the Companies, Parent or any of their respective Subsidiaries. The provisions of this Section 7.7 are for the sole benefit of the Parties and nothing in this Agreement, expressed or implied, is intended or will be construed to confer upon or give to any Person (including, for the avoidance of doubt, any Continuing Employee or other current or former employee of any Company or any of their respective Affiliates), any third-party beneficiary, legal or equitable or other rights or remedies (including with respect to the matters provided for in this Section 7.7) under or by reason of any provision of this Agreement. Nothing in this Agreement is intended to prevent Parent, the Surviving Companies or any of their Affiliates (i) from amending or terminating any of their respective employee benefit plans or, after the Effective Time, any Company Plan in accordance with their terms or (ii) after the Effective Time, from terminating the employment of any Continuing Employee.

7.8 Indemnification; Directors' and Officers' Insurance.

(a) Without limiting any other rights that any Indemnified Person may have pursuant to any employment agreement or indemnification agreement in effect on the date hereof and set forth on Section 7.8(a) of the Company Disclosure Letter or entered into in the Ordinary Course following the date hereof in accordance with this Agreement in a form reasonably acceptable to Parent, from the Subsequent Effective Time, the Subsequent Surviving Company and its Subsidiaries shall, and Parent shall cause the Subsequent Surviving Company and its Subsidiaries to, indemnify, defend and hold harmless each Person who is now, or has been at any time prior to the date of this Agreement or who becomes prior to the Subsequent Effective Time, a director or officer of any Company or any of its Subsidiaries, in each case, when acting in such capacity (the "Indemnified Persons") against all losses, claims, damages, costs, fines, penalties, expenses (including attorneys' and other professionals' fees and expenses), liabilities or judgments or amounts that are paid in settlement, of or incurred in connection with any threatened or actual Proceeding to which such Indemnified Person is a party or is otherwise involved (including as a witness) based, in whole or in part, on or arising, in whole or in part, out of the fact that such Person is or was a director or officer of any Company or any of its Subsidiaries or by reason of anything done or not done by such Person in any such capacity, whether pertaining to any act or omission occurring or existing prior to or at, but not after, the Subsequent Effective Time and whether asserted or claimed prior to, at or after the Subsequent Effective Time ("Indemnified Liabilities"), including all Indemnified Liabilities based in whole or in part on, or arising in whole or in part out of, or pertaining to, this Agreement or the Mergers, in each case to the fullest extent permitted under applicable Law (and the Subsequent Surviving Company and its Subsidiaries shall, and Parent shall cause the Subsequent Surviving Company and its Subsidiaries to, pay expenses incurred in connection therewith in advance of the final disposition of any such Proceeding to each Indemnified Person to the fullest extent permitted under applicable Law, subject to Section 7.8(c). Without limiting the foregoing, in the event any such Proceeding is brought or threatened to be brought against any Indemnified Persons (whether arising before or after the Subsequent Effective Time), (i) the Indemnified Persons may retain the Companies' regularly engaged legal counsel or other counsel satisfactory to them, and the Subsequent Surviving Company and its Subsidiaries shall, and following the Subsequent Effective Time, Parent shall cause the Subsequent Surviving Company and its Subsidiaries to, pay all reasonable fees and expenses of such counsel for the Indemnified Persons as promptly as statements therefor are received (subject to Section 7.8(c)), and (ii) the Subsequent Surviving Company and its Subsidiaries shall, and following the Subsequent Effective Time, Parent shall cause the Subsequent Surviving Company and its Subsidiaries to, use their best efforts to assist in the defense of any such matter. Any Indemnified Person wishing to claim indemnification or advancement of expenses under this Section 7.8, upon learning of any such Proceeding, shall notify the Subsequent Surviving Company (but the failure so to notify shall not relieve a Party from any obligations that it may have under this Section 7.8 except to the extent such failure materially prejudices such Party's position with respect to such claims).

(b) From and after the Subsequent Effective Time, Parent, the Subsequent Surviving Company and its Subsidiaries shall not amend, repeal or otherwise modify any provision in the Organizational Documents of Subsequent Surviving Company or any of its Subsidiaries in any manner that would affect adversely the rights thereunder of any

Indemnified Person to indemnification, exculpation and advancement except to the extent required by applicable Law. From the Subsequent Effective Time, Parent shall cause the Subsequent Surviving Company to fulfill and honor any indemnification, expense advancement or exculpation agreements between any Company or any of its Subsidiaries, on the one hand, and any of their directors or officers existing and in effect prior to the date of this Agreement and set forth on Section 7.8(a) of the Company Disclosure Letter or entered into in the Ordinary Course following the date hereof in accordance with this Agreement in a form reasonably acceptable to Parent.

(c) The Subsequent Surviving Company and its Subsidiaries shall, and from the Subsequent Effective Time, Parent shall cause the Subsequent Surviving Company and its Subsidiaries to, indemnify, defend and hold harmless any Indemnified Person against all reasonable costs and expenses (including reasonable attorneys' fees and expenses), such amounts to be payable in advance upon request as provided in Section 7.8(a), relating to the enforcement of such Indemnified Person's rights under this Section 7.8 or under any charter, bylaw or contract regardless of whether such Indemnified Person is ultimately determined to be entitled to indemnification hereunder or thereunder; provided that the Person to whom costs expenses are advanced provides an undertaking to repay such advances if it is ultimately determined in a final, non-appealable determination by a court of competent jurisdiction that such Person is not entitled to indemnification.

(d) The Companies shall cause to be put in place and fully prepay immediately prior to the Effective Time "tail" insurance policies with a claims period of at least six years from the Effective Time (the "Tail Period") from an insurance carrier with the same or better credit rating as the Financial Statements Entities' current insurance carrier with respect to directors' and officers' liability insurance ("D&O Insurance") in an amount and scope at least as favorable as the Financial Statements Entities' existing policies with respect to matters, acts or omissions existing or occurring at or prior to, but not after, the Effective Time; provided, however, that in no event shall the aggregate cost of the D&O Insurance exceed during the Tail Period 250% of the current aggregate annual premium paid by the Financial Statements Entities for such purpose; and provided, further, that if the cost of such insurance coverage exceeds such amount, the Companies shall obtain a policy with the greatest coverage available for a cost not exceeding such amount.

(e) In the event that Parent or the Subsequent Surviving Company or any of its successors or assignees (i) consolidates with or merges into any other Person and shall not be the continuing or surviving company or entity of such consolidation or merger or (ii) transfers all or substantially all of its properties and assets to any Person, then, in each such case, proper provisions shall be made so that the successors and assigns of Parent or the Subsequent Surviving Company, as the case may be, shall assume the applicable obligations set forth in this Section 7.8. Parent and the Subsequent Surviving Company shall not sell, transfer, distribute or otherwise dispose of any of their assets in a manner that would reasonably be expected to render Parent or the Subsequent Surviving Company unable to satisfy their obligations under this Section 7.8. The provisions of this Section 7.8 are intended to be for the benefit of, and shall be enforceable by, the Parties and each Person entitled to indemnification or insurance coverage or expense advancement pursuant to this Section 7.8, and such Person's heirs and Representatives. The rights of the Indemnified Persons under this

Section 7.8 are in addition to any rights such Indemnified Persons may have under the Organizational Documents of the any Company or any of its Subsidiaries, or under any applicable contracts or Law. The Subsequent Surviving Company shall, and from the Subsequent Effective Time, Parent shall cause the Subsequent Surviving Company to, pay all expenses, including attorneys' fees, that may be incurred by any Indemnified Person in enforcing the indemnity and other obligations provided in this Section 7.8.

7.9 Transaction Litigation. In the event any Proceeding by any Governmental Entity or other Person is brought or, to the knowledge of each Company, threatened in writing against any Company that questions the validity or legality of the Mergers or seeks damages or any injunction in connection therewith, including stockholder litigation, other than the matters governed by Section 7.6 ("Transaction Litigation"), such Company shall promptly notify Parent of such Transaction Litigation and shall keep Parent reasonably informed with respect to the status thereof. Such Company shall give Parent a reasonable opportunity to participate (at Parent's cost) in the defense or settlement of any Transaction Litigation and shall consult regularly with Parent in good faith and give reasonable consideration to Parent's advice with respect to such Transaction Litigation; provided that such Company shall not cease to defend, consent to the entry of any judgment, settle or offer to settle any Transaction Litigation without the prior written consent of Parent (which consent shall not be unreasonably withheld, conditioned or delayed).

7.10 Public Announcements. The initial public announcements or disclosures with respect to the execution of this Agreement shall be separate press releases of the Companies and Parent, each to be reasonably agreed upon by the Parties. No Party shall, and each will cause its Representatives not to, issue any public announcements or make other public disclosures regarding this Agreement, the Mergers or the Parent Stock Issuance, without the prior written approval of the other Party. Notwithstanding the foregoing, a Party, its Subsidiaries or their Representatives may issue a public announcement or other public disclosures (a) required by applicable Law, (b) required by the rules of any stock exchange upon which such Party's or its Subsidiary's capital stock is traded or (c) consistent with the final form of the joint press release announcing the Mergers and the investor presentation given to investors on the morning of announcement of the Mergers; provided, in each case, such Party uses reasonable best efforts to afford the other Parties an opportunity to first review the content of the proposed disclosure and provide reasonable comments thereon. No provision in this Agreement shall be deemed to restrict in any manner a Party's ability to communicate with its employees; provided that prior to any Company or any of its Subsidiaries making any written (or prepared broad-based) communications to the employees of any Company or any of its Subsidiaries pertaining to compensation or benefit matters that are affected by the Mergers and the Parent Stock Issuance or compensation or benefits that are payable or to be provided following the Effective Time, such Company or Subsidiary shall (i) provide Parent with a copy of the intended communication (or written summary of any prepared broad-based oral communication), and (ii) provide Parent a reasonable period of time to review and comment on the communication, and consider any timely comments in good faith. Parent shall not be required by any provision of this Agreement to consult with or obtain any approval from the Companies with respect to a public announcement or press release issued in connection with a Parent Change of Recommendation to the extent such Parent Change of Recommendation is permitted by this Agreement. Notwithstanding the foregoing, the Members may provide ordinary course communications

regarding this Agreement and the transactions contemplated hereby to existing or prospective direct and indirect general and limited partners, equity holders, members, managers and investors of Affiliates of such Persons, in each case, who are subject to customary confidentiality restrictions.

7.11 Advice of Certain Matters; Control of Business. Subject to compliance with applicable Law, the Companies and Parent, as the case may be, shall confer on a regular basis with each other and shall promptly advise each other in writing of any change or event having, or which would be reasonably likely to have, individually or in the aggregate, a Company Material Adverse Effect or Parent Material Adverse Effect, as the case may be. Except with respect to Antitrust Laws as provided in Section 7.6, the Companies and Parent shall promptly provide each other (or their respective counsel) copies of all filings made by such Party or its Subsidiaries with the SEC or any other Governmental Entity in connection with this Agreement, the Mergers and the Parent Stock Issuance. Without limiting in any way any Party's rights or obligations under this Agreement, nothing contained in this Agreement shall give any Party, directly or indirectly, the right to control or direct the other Party and their respective Subsidiaries' operations prior to the Effective Time. Prior to the Effective Time, each of the Parties shall exercise, consistent with the terms and conditions of this Agreement, complete control and supervision over its and its Subsidiaries' respective operations.

7.12 Specified Efforts; Notification.

(a) Except to the extent (and subject in all respects thereto) that the Parties' obligations are specifically set forth elsewhere in this Article VII (including filings, notifications, required efforts, actions and other matters with respect to Antitrust Laws governed by Section 7.6), upon the terms and subject to the conditions set forth in this Agreement, each of the Parties shall use commercially reasonable efforts to take, or cause to be taken, all actions, and to do, or cause to be done, and to assist and cooperate with the other Party in doing, all things reasonably necessary, proper or advisable to consummate and make effective, in the most expeditious manner reasonably practicable, the Mergers and the Parent Stock Issuance, including taking such necessary actions to mitigate or prevent from occurring any Disproportionate Effects by making commitments or taking such actions as would not constitute a Burdensome Condition.

(b) Subject to applicable Law and as otherwise required by any Governmental Entity, the Companies and Parent each shall keep the other reasonably apprised of the status of matters relating to the consummation of the Mergers and the Parent Stock Issuance, including reasonably promptly furnishing the other with copies of notices or other communications received by Parent or the Companies, as applicable, or any of their respective Subsidiaries, from any third party or any Governmental Entity with respect to the Mergers and the Parent Stock Issuance (including those alleging that the approval or consent of such Person is or may be required in connection with the Mergers and the Parent Stock Issuance). The Companies shall give reasonably prompt notice to Parent, and Parent shall give reasonably prompt notice to the Companies, upon becoming aware of (i) any condition, event or circumstance that will result in any of the conditions in Sections 8.2(a) or 8.3(a) not being met, or (ii) the failure by such Party to comply with or satisfy in any material respect any covenant, condition or agreement to be complied with or satisfied by it under this Agreement; provided,

however, that no such notification shall affect the representations, warranties, covenants or agreements of the Parties or the conditions to the obligations of the Parties under this Agreement.

7.13 Tax Matters.

(a) Notwithstanding anything to the contrary in this Agreement, all sales, use, value added, transfer, stamp, registration, documentary, excise, real property transfer or gains, or similar Taxes incurred as a result of the transactions contemplated by this Agreement (other than any such Taxes incurred as a result of or in connection with the Restructuring, which Taxes shall be treated as Restructuring Taxes for all purposes of this Agreement) ("Transfer Taxes") related to any Company and any of its Subsidiaries shall be borne 50 percent by Parent and 50 percent by the Members (pro rata in accordance with their Applicable Percentages). The Party responsible under applicable Law for filing any related Tax Returns and any required change of ownership and similar statements (i) shall, at its own expense, prepare and timely file such Tax Returns or statements, (ii) shall pay such Transfer Taxes shown as due and payable on such Tax Returns (subject to prompt reimbursement by the other Party to the extent applicable) and (iii) shall promptly provide a copy of such Tax Returns or statements to the other Party. Each Party shall, and shall cause their respective Affiliates to, use commercially reasonable efforts in minimizing the incidence of any Transfer Taxes and in the timely filing of any Tax Returns relating to such Transfer Taxes.

(b) For purposes of calculating Pre-Lockbox Date Taxes under this Agreement, the aggregate amount of additional allowance of depreciation deduction under Section 168(k) of the Code ("Bonus Depreciation") for Pre-Lockbox Date Tax Periods shall not exceed the amount of Bonus Depreciation shown on Exhibit G.

(i) Each Company shall prepare (or cause to be prepared) all Tax Returns of any Company and any of its Subsidiaries for or that include any Pre-Lockbox Date Tax Period that are required to be filed on or prior to the Closing Date (the "Pre-Closing Tax Returns"), and any such Pre-Closing Tax Return of Green Gate Resources Holdings shall be prepared by Deloitte Tax LLP. The costs and expenses of preparing any such Tax Returns will be borne by such Company, including the costs and expenses of any Tax Return preparer retained by such Company. The Members shall deliver or cause to be delivered to Parent, any such Tax Return for its review and comment at least 60 days prior to the date on which such Tax Return is required to be filed (including extensions) (or, if a Tax Return is due within 60 days of the date hereof, otherwise as soon as reasonably practicable). The Members shall accept any reasonable comments submitted in writing by Parent within 20 days after receiving such draft Tax Return, and will deliver such revised Tax Return to Parent at least 10 days prior to the due date (including extensions) of such Tax Return. Each Company and its Subsidiaries will timely file (or cause to be filed) all Tax Returns prepared pursuant to this Section 7.13(b); provided, such Tax Returns shall not be filed without the written consent of Parent (such consent not to be unreasonably withheld, conditioned or delayed). For purposes of this Section 7.13(b)(i), if the parties cannot reach agreement with respect to any dispute regarding any Pre-Closing Tax Returns, the dispute resolution procedures provided in Section 3.3(c) shall apply, *mutatis mutandis*.

(ii) Parent shall prepare (or cause to be prepared) all Tax Returns of any Company and any of its Subsidiaries for or that include any Pre-Lockbox Date Tax Period that are not also Pre-Closing Tax Returns ("Post-Closing Tax Returns"), and any such Post-Closing Tax Return of Green Gate Resources Holdings shall be prepared by Deloitte Tax LLP. The costs and expenses of preparing any such Tax Returns will be borne by Parent, including the costs and expenses of any Tax Return preparer retained by the Parent. Parent shall deliver or cause to be delivered to the Members any such Tax Return for their review and comment at least 60 days prior to the date on which such Tax Return is required to be filed (including extensions) (or, if such Tax Return is required to be filed within 60 days from the date hereof, as soon as reasonably practicable). Parent shall accept any reasonable comments with respect to any Pre-Lockbox Date Taxes shown on such Tax Returns submitted in writing by the Members within 20 days after receiving such draft Tax Return, and will deliver such revised Tax Return to the Members at least 10 days prior to the due date (including extensions) of such Tax Return. Parent will timely file (or cause to be filed) all Tax Returns prepared pursuant to this Section 7.13(b)(ii); provided, such Tax Returns shall not be filed without the written consent of the Members (such consent shall be limited solely to any Pre-Lockbox Date Taxes shown on such Tax Returns and not to be unreasonably withheld, conditioned or delayed).

(iii) Except as required by applicable Law, Parent shall prepare (or cause to be prepared) any Tax Returns of any Company and any of its Subsidiaries that include any amount of Restructuring Taxes (the "Restructuring Tax Returns"). The costs and expenses of preparing any such Tax Returns will be borne by Parent, including the costs and expenses of any Tax Return preparer retained by Parent. Parent shall deliver or cause to be delivered to the Members any such Tax Return for their review and comment at least 60 days prior to the date on which such Tax Return is required to be filed (including extensions) (or, if such Tax Return is required to be filed within 60 days of the Closing Date, as soon as reasonably practicable), provided that if such Restructuring Tax Return is required to be filed with respect to Parent on a consolidated, combined or unitary basis, only the portion of such Tax Return reflecting Restructuring Taxes shall be delivered. Parent shall accept any reasonable comments with respect to any Restructuring Taxes shown on such Tax Returns submitted in writing by the Members within 20 days after receiving such draft Tax Return, and will deliver such revised Tax Return (or portion thereof) to the Members at least 10 days prior to the due date (including extensions) of such Tax Return. Parent will timely file (or cause to be filed) all Tax Returns prepared pursuant to this Section 7.13(b)(iii); provided, such Tax Returns shall not be filed without the written consent of the Members (such consent shall be limited solely to any Restructuring Taxes shown on such Tax Returns and not to be unreasonably withheld, conditioned or delayed).

(iv) For purposes of this Agreement, in the case of any taxable period beginning on or before and ending after December 31, 2023, Taxes attributable to the portion of such taxable period ending on and including December 31, 2023 shall: (1) in the case real property Taxes, personal property Taxes, intangible property taxes and similar ad valorem Taxes, be equal to the amount of such Taxes for the entire taxable period multiplied by a fraction, the numerator of which is the number of days during such

taxable period that are in the Pre-Lockbox Date Tax Period and the denominator of which is the number of days in such taxable period and (2) in the case of any other Taxes, be computed as if such taxable period hypothetically for the Companies and their Subsidiaries ended as of the close of business on December 31, 2023.

(v) Upon receipt of any written notice of any Member Taxes payable or otherwise shown on a Pre-Closing Tax Return or a Post-Closing Tax Return (A) for which Sellers have an indemnification obligation pursuant to Section 10.2 and (B) that have not been taken into account in the calculation of the Estimated Member Tax Amount or Closing Date Member Tax Amount under Section 3.3, each Member shall severally (and not jointly and severally), within ten days of receiving such notice, pay to Parent, by wire transfer of immediately available funds to an account designated in writing by Parent, the applicable amount reflected on such notice. Any amount paid pursuant to the immediately preceding sentence and any shares of Parent Common Stock issued pursuant to Section 7.13(h) shall be treated by the Parties as adjustments to the Aggregate Consideration paid hereunder for Tax purposes.

(vi) As soon as practicable after the end the taxable year that includes the Closing Date, but in no event later than July 31st of the following year, Parent shall deliver, or cause to be delivered, to IKAV Co-Invest Member its Schedule K-1 with respect to IKAV Co-Invest (along with any corresponding or similar state, local or foreign income tax forms) for such taxable year and such other information as may be reasonably necessary for the preparation of its (or its direct or indirect owners') federal, state, local and foreign income tax returns for such taxable year.

(vii) Parent shall prepare all other Tax Returns in its sole discretion.

(c) If any inquiry, claim, assessment, audit, or similar event with respect to Taxes shall be made by any Taxing Authority, which, if successful, would reasonably be expected to result in an indemnity payment to Parent pursuant to Section 10.2, Parent, the Company and its Subsidiaries, on the one hand, and the Members, on the other hand, shall promptly notify each other upon receipt by such Party of written notice of such inquiry, claim, assessment, audit or similar events (any such inquiry, claim, assessment, audit or similar event, a "Tax Contest"). Upon written notice to Parent, the Members shall control any and all such Tax Contests. The Members shall keep Parent reasonably informed of any material developments or communications relating to any such Tax Contest, and Parent shall be entitled to participate (with counsel of its choosing and at its own cost and expense) in such Tax Contest. If the Members decline to control any such Tax Contest, Parent shall control such Tax Contest and shall keep the Members reasonably informed of any material developments or communications relating to any such Tax Contest, and the Members shall be entitled to participate (with counsel of its choosing and at its own cost and expense) in such Tax Contest. Neither the Members nor, solely to the extent that Members have participated in such Tax Contest, Parent, shall settle or compromise any such Tax Contest without the written consent of the other Party, which consent shall not be unreasonably withheld, conditioned or delayed.

(d) In the sole discretion of Parent, each Company that is treated as a partnership for U.S. federal tax purposes and each Partnership Subsidiary of such Company

shall make an election under Section 754 for the taxable period including the Closing Date to the extent such election is not already in effect with respect to such Partnership Subsidiary.

(e) In its sole discretion, Parent shall make, to the extent legally permissible, a "push-out election" under Section 6226 of the Code with respect to IKAV Co-Invest or any of its Partnership Subsidiaries in any taxable period including the Closing Date, and IKAV Co-Invest Member shall cooperate with each such election, including taking any action reasonably requested by Parent with respect thereto.

(f) For the taxable year in which the Closing occurs, each Company shall cause each of its Partnership Subsidiaries to, (i) to the maximum extent permitted by applicable Law, treat all applicable taxable periods as ending on the Closing Date, and (ii) if any Partnership Subsidiary is required to file a Tax Return for any Straddle Period, allocate between the Pre-Closing Tax Period and the Post-Closing Tax Period of such Straddle Period all items of income, gain, loss, deduction and credit of such Partnership Subsidiary, as applicable, attributable to the Equity Interests using the interim closing of the books method set forth in Section 706(d) of the Code and the Treasury Regulations promulgated thereunder, provided that to the extent permitted under applicable Law at a more-likely-than-not or greater level of comfort, all Transaction Tax Deductions shall be allocated to the Pre-Closing Tax Period.

(g) Following the Closing, the Members and Parent shall provide each other with such cooperation and information as either of them reasonably may request of the other in filing any Tax Return pursuant to this Section 7.13. Such cooperation and information shall include providing copies of relevant Tax Returns or portions thereof, together with accompanying schedules, related work papers and documents relating to rulings or other determinations by Taxing Authorities; provided, Parent shall not be required under this Section 7.13(g) to provide any Tax Returns required to be filed with respect to Parent on a consolidated, combined or unitary basis.

(h) The Members of each Company shall be entitled to any refund or credit of Taxes of such Company attributable to Member Taxes or Taxes for which such Members provided an indemnity payment to Parent pursuant to Section 10.2, which refund or credit is actually recognized by Parent or its Affiliates (including such Company) in cash (or as an offset to tax payments) after the Closing, net of any costs (including Taxes) to Parent and its Affiliates attributable to the obtaining and receipt of such refund or credit. Parent shall, within ten days following the receipt or recognition of such refund or credit, issue to such Members a number of shares of Parent Common Stock determined in accordance with the computation methodology under Section 3.3(e) as if the amount of such refund or credit were a positive Pre-Lockbox Date Tax Adjustment Amount. To the extent reasonably requested by any Member, Parent will reasonably cooperate with such Member in obtaining such refund or credit, provided that Parent shall not be obligated to file any amended Tax Returns or refund claims to the extent such amended Tax Return or refund claim could, determined in Parent's reasonable discretion (exercised in good faith), increase the amount of Taxes or other costs for which Parent could be liable without indemnification therefor. To the extent such refund or credit is subsequently disallowed or required to be returned to the applicable Taxing Authority, such Member agrees promptly to repay the amount of such refund or credit, together with any

interest, penalties or other additional amounts imposed by such Taxing Authority, to Parent. For the avoidance of doubt, to the extent a refund is attributable to an amount of Bonus Depreciation being claimed in a Pre-Lockbox Date Tax Period in excess of the amount set forth in Exhibit G, no Member shall be entitled to such refund.

(i) Without the Members' prior written consent, not to be unreasonably withheld, conditioned or delayed, Parent shall not, and shall not cause or permit any of its Affiliates (including the Companies and their Subsidiaries) to take any of the following actions (i) file, re-file or amend any Pre-Closing Tax Return, Post-Closing Tax Return or Restructuring Tax Return, (ii) make or change any Tax election or accounting method or practice with respect to, or that has retroactive effect to, any Pre-Closing Tax Return, Post-Closing Tax Return or Restructuring Tax Return, or (iii) make any voluntary disclosures to, or initiate discussions or examinations with, Taxing Authorities regarding Taxes with respect to any Pre-Closing Tax Return, Post-Closing Tax Return or Restructuring Tax Return, in each case, to the extent such action would reasonably be expected to result in an indemnity payment to Parent pursuant to Section 10.2.

(j) To the extent that any amount is required to be deducted and withheld for Taxes with respect to the Restructuring under applicable Law, (i) for the avoidance of doubt, such amount of deduction and withholding shall be treated as a Restructuring Tax for all purposes of this Agreement, (ii) unless such Taxes are taken into account in the calculation of the Estimated Member Tax Amount or Closing Date Member Tax Amount under Section 3.3, the applicable Members shall timely pay such amount (or cause such amount to be paid) to the appropriate Taxing Authority in accordance with applicable Law or use commercially reasonable efforts to cooperate with Parent in the timely payment of such withholding Taxes and filing of any Tax Returns relating to such withholding Taxes, (iii) if any such withholding Taxes are paid by any Member, such Member shall promptly provide (or cause to be provided) to Parent evidence of such payment reasonably satisfactory to Parent, and (iv) to the extent any Member claims benefits under an applicable Tax treaty with respect to such deduction and withholding, the Company which such Member owns shall collect from the Member the applicable IRS Form W-8BEN-E of the Member reflecting such claim of Tax treaty benefits and shall hold such Form on the Closing Date and deliver such form to Parent.

(k) For U.S. federal and applicable state and local income Tax purposes,

(i) The Parties acknowledge and agree that (A) the IKAV Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (B) each of Parent, IKAV Merger Sub, Subsequent Merger Sub, IKAV Member, and IKAV Blocker is a party to such reorganization within the meaning of Section 368(b) of the Code, (C) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a), and (D) IKAV Member shall be treated as transferring a "United States real property interest" on which gain is realized solely for a "United States real property interest" which, immediately following the exchange, would be subject to United States taxation upon its disposition (within the

meaning of Treasury Regulations Section 1.897-6T(a)(1), (clauses (A), (B), (C) and (D), collectively, the "IKAV Intended Tax Treatment"). Each of IKAV Member and Parent shall use its reasonable best efforts to deliver to the other Party, a tax representation letter, dated as of the Closing Date, substantially in the form of Exhibit H attached hereto.

(ii) The Parties acknowledge and agree that (A) the CPP Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (B) each of Parent, CPP Merger Sub, Subsequent Merger Sub, CPP Member, and CPP Blocker is a party to such reorganization within the meaning of Section 368(b) of the Code and (C) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a) (clauses (A), (B) and (C), collectively, the "CPP Intended Tax Treatment"). Each of CPP Member and Parent shall use its reasonable best efforts to deliver to the other Party, a tax representation letter, dated as of the Closing Date, substantially in the form of Exhibit H attached hereto.

(iii) The Parties acknowledge and agree that (A) the IKAV Co-Invest Blocker 1 Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (B) each of Parent, COI Merger Sub 2, the Subsequent Merger Sub, IKAV Co-Invest 1 Member, and IKAV Co-Invest Blocker 1 is a party to such reorganization within the meaning of Section 368(b) of the Code and (C) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a) (clauses (A), (B) and (C), collectively, the "IKAV Co-Invest 1 Intended Tax Treatment").

(iv) The Parties acknowledge and agree that (A) the IKAV Co-Invest Blocker 2 Merger and the applicable Subsequent Merger shall be treated as a single integrated transaction that qualifies as a "reorganization" within the meaning of Section 368(a) of the Code and the Treasury Regulations promulgated thereunder, (B) each of Parent, COI Merger Sub 3, the Subsequent Merger Sub, IKAV Co-Invest 2 Member, and IKAV Co-Invest Blocker 2 is a party to such reorganization within the meaning of Section 368(b) of the Code and (C) this Agreement shall constitute, and is hereby adopted as, a "plan of reorganization" for purposes of Sections 354, 361 and 368 of the Code and within the meaning of Treasury Regulations Section 1.368-2(g) and Treasury Regulations Section 1.368-3(a) (clauses (A), (B) and (C), collectively, the "IKAV Co-Invest 2 Intended Tax Treatment", and together with the IKAV Intended Tax Treatment, the CPP Intended Tax Treatment and the IKAV Co-Invest 1 Intended Tax Treatment, the "Intended Tax Treatment").

(v) The Parties shall use their respective reasonable best efforts to cause the Mergers to qualify for the Intended Tax Treatment and shall not take any action, cause any action to be taken, or fail to take any action that is reasonably likely to

prevent, impair or impede the Intended Tax Treatment. Each Party shall promptly notify the other Parties in writing if, before the Closing Date, such Party knows or has reason to believe that the Mergers may not qualify for the Intended Tax Treatment. The Parties shall file all Tax Returns consistently with the Intended Tax Treatment, unless otherwise required pursuant to any change in applicable Law after the Closing or a "determination" within the meaning of Section 1313(a) of the Code.

7.14 Financing.

(a) Parent shall use its reasonable best efforts to take, or cause to be taken, all actions and to do, or cause to be done, all things necessary, proper or advisable to arrange the Financing as promptly as practicable following the date of this Agreement and to consummate the Financing on the Closing Date on the terms and conditions described in or contemplated by the Commitment Letter (including any "flex" provisions) to the extent required, when taken together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, to pay the Required Amounts, including using reasonable best efforts to (i) maintain in effect the Commitment Letter and not cancelling any commitments under the Commitment Letter to the extent required, when taken together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, to pay the Required Amounts, (ii) satisfy or obtain waiver of, on or prior to the Closing Date, all Financing Conditions that are within the control of Parent or any of its controlled Affiliates, (iii) negotiate, execute and deliver Financing Documents that reflect the terms contained in the Commitment Letter (including any "market flex" provisions related thereto) or on such other terms acceptable to Parent and its Financing Sources, (iv) in the event that all Financing Conditions have been satisfied or waived, cause the applicable Financing Sources providing the Financing contemplated by the Commitment Letter to fund on the Closing Date the portion of the Financing contemplated by the Commitment Letter required to pay the Required Amounts. Parent shall give the Companies prompt notice of any material breach or repudiation by any party to any Commitment Letter of which Parent or its Affiliates become aware. In the event a Financing Failure Event occurs (A) Parent shall promptly notify the Companies in writing and (B) Parent shall, and shall cause each of its Subsidiaries to, use its reasonable best efforts to obtain, as promptly as practicable following the occurrence of such event, alternative financing for any such portion from alternative Financing Sources (the "Alternative Financing") in an amount, when taken together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, no less than the Required Amount (which shall not contain new or additional conditions to the consummation of such Alternative Financing) and which would not reasonably be expected to prevent, impede or delay the consummation of the transactions contemplated by this Agreement. Parent shall keep the Companies informed on a reasonably current basis of the status of its efforts to arrange the Financing. Parent shall not (without the prior written consent of each Company, such consent not to be unreasonably withheld, delayed or conditioned) consent or agree to any amendment, replacement, supplement or modification to, or any waiver of any provision under, the Commitment Letter or the definitive agreements relating to the Financing (including, for the avoidance of doubt, any Alternative Financing) if such amendment, replacement, supplement, modification or waiver (1) decreases the aggregate amount of the Financing to an amount that would be less than an amount that would be

required, when taken together with cash or cash equivalents held by Parent and the Companies on the Closing Date and the other sources of funds available to Parent on the Closing Date, to pay the Required Amount, (2) imposes new or additional conditions or otherwise expands, amends or modifies any of the conditions to the receipt of the Financing, or (3) would reasonably be expected to prevent, impede or delay the consummation of the transactions contemplated by this Agreement; provided, however, that, for the avoidance of doubt, Parent may amend, replace, supplement and/or modify the Commitment Letter to add lenders, lead arrangers, bookrunners, syndication agents or similar entities as parties thereto who had not executed the Commitment Letter as of the date of this Agreement or increase the amount of commitments under the Commitment Letter. Upon any amendment, supplement or modification of the Commitment Letter, Parent shall provide a copy thereof to the Companies (with only fee amounts and other economic terms, and the rates and amounts included in the "flex" provisions, redacted, none of which redacted provisions would adversely affect the conditionality, enforceability, termination or amount of the Financing contemplated by the Commitment Letter as so amended, supplemented or modified) and, to the extent such amendment, supplement or modification has been made in compliance with this Section 7.14, the term "Commitment Letter" shall mean the Commitment Letter as so amended, replaced, supplemented or modified. Notwithstanding the foregoing, compliance by Parent with this Section 7.14 shall not relieve Parent of its obligation to consummate the transactions contemplated by this Agreement whether or not the Financing is available and Parent acknowledges that this Agreement and the transactions contemplated hereby are not contingent on Parent's ability to obtain the Financing or any specific term with respect to such Financing. To the extent Parent obtains Alternative Financing pursuant to this Section 7.14, or amends, replaces, supplements, modifies or waives any of the Financing pursuant to this Section 7.14, references to "Financing" shall include the financing contemplated by any Alternative Financing and references to "Commitment Letter", "Debt Fee Letter", "Financing Documents", "Financing Sources", or "Financing" shall include the documents (or commitments or financing sources, as applicable) in connection with any Alternative Financing, the commitments thereunder and the agreements with respect thereto, or the Financing as so amended, replaced, supplemented, modified or waived, and such Alternative Financing shall be required to comply with the provisions of this Agreement to the same extent as the Financing.

(b) From the date of this Agreement until the earlier of the Closing Date or the valid termination of this Agreement in accordance with its terms, the Companies shall, and shall cause their Subsidiaries to, and shall use their reasonable best efforts to cause their respective Representatives to, use reasonable best efforts to provide to Parent such cooperation as is reasonably requested by Parent in connection with arranging, underwriting, obtaining, syndicating and consummating the Financing (or Alternative Financing obtained in accordance with Section 7.14). Such assistance shall include the following, each of which shall be at Parent's request with reasonable prior notice and at Parent's sole cost and expense: (i) promptly furnishing Parent and the Financing Parties with (A) such financial statements, financial data, audit reports and other pertinent information regarding the Companies and their Subsidiaries of the type required by the Commitment Letter to satisfy a Financing Condition, such financial statements to include (1) audited combined balance sheets and related statements of operations, comprehensive income (loss), equity and cash flows and related notes thereto of the Financial Statement Entities (or, at the Companies' option, such other presentation as may be required to be included in the Proxy Statement) for the two fiscal years most recently ended

at least 60 days prior to the Closing Date and (2) unaudited combined balance sheets and related statements of income (loss), equity and cash flows and related notes thereto of the Financial Statement Entities (or, at the Companies' option, such other presentation as may be required to be included in the Proxy Statement) for each subsequent fiscal quarter ended at least 40 days prior to the Closing Date (other than the fourth fiscal quarter of any fiscal year), in each case, with respect to this clause (2), with comparative financing information for the equivalent period of the prior year, (B) information regarding the Companies and their Subsidiaries customarily included in information memoranda and other syndication materials for reserve based revolving credit facilities and term loan facilities, (C) solely with respect to financial information and data derived from each Company's and its Subsidiaries' historical books and records, such other historical financial and other data regarding the Companies and their Subsidiaries required by Parent to permit Parent to prepare customary pro forma financial statements (provided that the Companies shall not be responsible for the preparation of any pro forma financial statements or pro forma adjustments thereto) and (D) such information reasonably required relating to the Companies' and their Subsidiaries' oil and gas reserves that meet the requirements for customary offering documents for private placements of non-convertible high-yield bonds pursuant to Rule 144A under the Securities Act in a "Rule 144A-for-life" offering and reserve based credit facility lenders, including with respect to the underlying property interests held by the Companies and their Subsidiaries (and including, for the avoidance of doubt, reserve reports evaluating the proved reserves and proved developed reserves of the Companies and their Subsidiaries to the extent provided to lenders under either or both of the Company Credit Agreements) (collectively, the "Required Information"); provided that, without limiting the foregoing, the Companies shall not be obligated to provide (or be deemed to require the Companies or their Subsidiaries to prepare) any information that constitutes Debt Financing Excluded Information, (ii) making senior management of the Financial Statements Entities available at reasonable times and locations and upon reasonable prior notice, to participate in a reasonable number of meetings (including one-on-one meetings or conference calls with Financing Sources and potential financing parties), drafting sessions, presentations, road shows, rating agency presentations and due diligence sessions and other syndication activities, in each case which shall be telephonic or held by videoconference (unless otherwise reasonably agreed) and at reasonable times and with reasonable advance notice, (iii) assisting with the preparation and negotiation of the Financing Documents, (iv) providing reasonable and customary assistance to Parent and its Financing Sources in the preparation of (A) customary offering documents, offering memoranda, syndication documents and other customary syndication and marketing documents and (B) materials for rating agency presentations, (v) cooperating with the marketing efforts of Parent and the Financing Sources, including, to the extent applicable, obtaining representation and authorization letters and arranging for customary auditor and reserve engineer consents for use of the Required Information and other financial data in the marketing and offering documentation, (vi) using reasonable best efforts to facilitate customary cooperation and assistance of the Companies' and their Subsidiaries' independent auditors, reserve engineers and internal and external counsel of the Companies and their Subsidiaries including in connection with "comfort" letters and opinions of counsel to be delivered in connection with the Financing, including by (A) using reasonable best efforts to cause the Companies' and their Subsidiaries' independent auditors and reserve engineers to provide customary "comfort" letters (including "negative assurance" comfort, if appropriate) in connection with any capital markets transaction

comprising a part of the Financing to the applicable Financing Parties and to participate in a reasonable number of due diligence sessions and (B) providing customary back-up certificates with respect to oil and gas reserves and financial data for which auditor and reserve engineer "comfort" is not provided, provided that no Sponsor, or individual on behalf of a Sponsor, will be required to deliver such back-up certificate, (vii) using reasonable best efforts to cooperate with internal and external counsel of Parent or any Financing Sources by providing factual information necessary for any customary legal opinion and any accompanying customary back-up certificate that such counsel of Parent or Financing Source may require in order to deliver such legal opinion in connection with the Financing, including using reasonable best efforts to provide all requisite information concerning the Companies' and their Subsidiaries' oil and gas reserves and collateral matters for reserve based revolving credit facilities and other secured financing, (viii) executing and delivering any Financing Documents, provided that no such Financing Document shall be effective prior to the Closing Date, (ix) providing the Financing Deliverables (as and when required in the definition thereof) and other customary documents as may be reasonably requested by Parent or the Financing Sources, and otherwise assisting in facilitating the creation and perfection of the security interests in the collateral contemplated by the Financing, provided that no such document or certificate or the creation or perfection of any security interest in any of the equity of or assets owned by the Companies and their Subsidiaries shall be effective prior to the Closing Date and (x) taking such corporate and other actions as are reasonably requested by Parent to facilitate the satisfaction on a timely basis of the Financing Conditions set forth in the Commitment Letter that are within its control.

Notwithstanding the foregoing, nothing in this Section 7.14(b) shall require any such action to the extent it (1) would unreasonably or materially interfere with the business or operations of any Company or any of its Subsidiaries or require any Company or any of its Subsidiaries to agree to pay any fees, reimburse any expenses or incur any liability or obligation (including any indemnification obligation) in any case prior to the Closing Date, other than fees, expenses, liabilities and obligations that are subject to reimbursement or indemnification pursuant to Section 7.14(f) below, (2) would require any Company or any of its Subsidiaries or their Representatives or Affiliates or Financing Sources to execute, deliver or enter into, or perform any Financing Document, prior to the Closing (other than customary authorization letters, customary representation letters and customary auditors' and reserve engineers' "comfort" and/or negative assurance letters), (3) could subject any director, manager, officer or employee of any Company or any of its Subsidiaries to any actual or potential personal liability other than liabilities that are subject to indemnification pursuant to Section 7.14(f) below, (4) would reasonably be likely to cause any representation or warranty in this Agreement to be breached, cause any condition to the Closing to fail to be satisfied or otherwise cause any breach of this Agreement or (5) would require the delivery of any legal opinions, (x) none of the board of directors (or other similar governing body) of each Company shall be required to adopt resolutions approving the Financing Documents, in each case, the effectiveness of which is not contingent on the occurrence of the Closing and (y) no Company nor any of its Subsidiaries shall be required to provide any information to the extent it (1) would violate applicable material Law or the provisions of any material contract to which such Company or its Subsidiaries is a party or any Organizational Document applicable to such Company or its Subsidiaries, (2) could result in the loss of any attorney-client or other legal privilege as determined by such Company in good faith (in consultation with its counsel); or (3) would violate any applicable confidentiality obligation of such Company or its Subsidiaries in effect as of the date of this Agreement, in the

case of each of clauses (1) through (3), so long as such Company provides Parent written notice of any information so withheld and reasonably cooperates with Parent in seeking to allow disclosure of such information in a manner that is not reasonably likely to cause such violation of material Law or material contract, result in the loss of such attorney-client or other legal privilege or violate any such confidentiality obligation.

(c) From the date hereof through the Effective Time, at Parent's prior written request, each Company shall use its reasonable best efforts to cooperate with, and provide all reasonable assistance to, Parent in connection with such actions as are necessary or desirable (as determined by Parent in consultation with the Company) to take to retire, repay, defease, repurchase, redeem, satisfy and discharge, cancel or otherwise terminate effective at or immediately after the Effective Time, some or all amounts outstanding under the Company Credit Agreements, and, in each case, any replacement indebtedness with respect to such facilities, which cooperation and assistance shall include (A) the repayment or prepayment of any amounts outstanding under the Company Credit Agreements on or after the Closing Date, including, in each case, by preparing and submitting, prior to the Closing Date, customary notices in respect of any such repayment or prepayment; provided that the repayment or prepayment shall be contingent upon the occurrence of the Effective Time unless otherwise agreed in writing by each Company, and (B) obtaining from the applicable lenders and/or agents customary payoff letters, Encumbrances and guarantee releases or instruments of termination or discharge in respect of the existing indebtedness of each Company and its Subsidiaries, including in respect of indebtedness under the Company Credit Agreements.

(d) Each Company shall timely make all notices, and timely take all such other actions, required to be made by it pursuant to the Company Credit Agreements in connection with this Agreement or any of the transactions contemplated hereby.

(e) All documentation prepared by the Companies, the Companies' Subsidiaries or the Representatives of any of the foregoing in connection with this Section 7.14 shall be subject to the prior review, comment and approval of Parent.

(f) Parent (i) will promptly, following the valid termination of this Agreement and upon request by the Companies, reimburse the Companies and their Subsidiaries for all reasonable and documented out-of-pocket costs and expenses (including (A) reasonable and documented outside attorneys' fees and (B) reasonable and documented fees and expenses of the Companies' accounting firms engaged to assist in connection with the Financing, including performing additional requested procedures, reviewing any offering documents, participating in any meetings and providing any comfort letters) incurred by the Companies and their Subsidiaries in connection with any cooperation of the Companies and their respective affiliates requested by Parent under this Section 7.14 (provided that such reimbursement shall not include general auditor and legal expenses that the Companies would have incurred regardless of whether cooperation was requested pursuant to this Section 7.14), (ii) acknowledges and agrees that, except for obligations from and after the Closing that arise under the definitive agreements governing the Financing or closing certificates relating to the Financing, the Companies, their respective Subsidiaries and their respective Representatives shall not have any responsibility for, or incur any liability to, any Person under any arrangement with respect to the Financing that Parent may request in connection with the

transactions contemplated by this Agreement and (iii) will indemnify and hold harmless the Companies and their Subsidiaries and their respective affiliates from and against any and all losses actually suffered or incurred by any of them of any type in connection with the arrangement of any Financing and any information provided or used in connection therewith (other than information provided by any Company and its Subsidiaries for inclusion in connection with the Financing or to the extent arising from the willful misconduct, gross negligence or fraud of any Company or any of its Subsidiaries or any of their affiliates or Representatives).

(g) Each Company hereby consents to the use of its and its Subsidiaries' logos in connection with the Financing; provided that such logos are used solely in a manner that is not intended to, nor reasonably likely to, harm or disparage any Company or any of its Subsidiaries or any Company's or any of its Subsidiaries' reputation or goodwill.

(h) Notwithstanding anything to the contrary herein, (i) it is understood and agreed that the condition precedent set forth in Section 8.2, as applied to the Company's obligations under this Section 7.14, shall be deemed to be satisfied unless the Financing has not been obtained as a direct result of the Company's Willful and Material Breach of its obligations under this Section 7.14 and (ii) Parent and each Merger Sub each acknowledges and agrees that obtaining the Financing is not a condition to any of their obligations under this Agreement.

7.15 Termination of Company Related Party Agreements. The Companies, the Members and their respective Affiliates shall take all actions necessary to (i) terminate all Company Related Party Agreements, with such termination to be effective as of the Closing and (ii) cause all liabilities of any Company and any of its Subsidiaries under any and all Company Related Party Agreements to be extinguished immediately prior to the Closing, without any payment by or liability of any Company or any of its Subsidiaries therefor following the Closing.

7.16 Stock Exchange Listing. Parent shall take all actions reasonably necessary to cause the Parent Common Stock to be issued in the Mergers to be approved for listing on the NYSE prior to the Effective Time, subject to official notice of issuance.

7.17 Takeover Law. None of the Parties shall take any action that would cause the Mergers and the Parent Stock Issuance to be subject to requirements imposed by any Takeover Law, and each of the Parties shall take all reasonable steps within its control to exempt (or ensure the continued exemption of) the Mergers and the Parent Stock Issuance from the Takeover Law of any state that purport to apply to this Agreement, the Mergers or the Parent Stock Issuance.

7.18 No Transfer.

(a) Other than pursuant to the Restructuring, until the earlier of the Effective Time and the termination of this Agreement, no Member shall directly or indirectly: (a) sell, convey, transfer, pledge or otherwise encumber or dispose of any Equity Interest or any capital stock or equity interest of any of the Companies' Subsidiaries; (b) deposit any Equity Interest or any capital stock or equity interest of any of the Companies' Subsidiaries into a voting trust or enter into a voting agreement or any other arrangement with respect to any such shares or

purport to grant any proxy with respect thereto; (c) enter into any contract, option or other arrangement or undertaking with respect to the direct or indirect acquisition or sale, assignment, transfer or other disposition of any Equity Interest or any capital stock or equity interest of any of the Companies' Subsidiaries; (d) otherwise permit any Encumbrance to be created on any Equity Interest or any capital stock or equity interest of any of the Companies' Subsidiaries or (e) commit or agree to take any of the foregoing actions (any foregoing actions, a "Transfer").

(b) Each Company hereby acknowledges the foregoing restrictions on the Transfer of Equity Interests and capital stock or equity interests of any of the Companies' Subsidiaries. Each Company agrees not to, and to cause its Subsidiaries not to, register any Transfer in violation of this Section 7.18.

7.19 Wrong Pockets. If, following the Closing, (a) Parent, the Subsequent Surviving Company or any of its Subsidiaries becomes aware that any asset or property held by such Person is primarily related to or necessary for the ownership, use, occupancy or operation of the assets to the Members or their Affiliates (the "Member Group") pursuant to the Restructuring described on Exhibit D and are not used in any material way in connection with the ownership or operation of the assets and businesses of the Subsequent Surviving Company and its Subsidiaries following the Closing, or (ii) any member of the Member Group becomes aware that any asset or property held by such Person is not primarily related to or necessary for the ownership, use, occupancy or operation of the assets and properties that are distributed to the Member Group pursuant to the Restructuring (such assets and properties in the foregoing clauses (a) and (b), a "Wrong Pocket Asset"), then such member of the Member Group, Parent, the Subsequent Surviving Company or its Subsidiaries, as applicable, that holds such Wrong Pocket Asset shall promptly notify the Member Group, Parent, the Subsequent Surviving Company or its Subsidiaries, as applicable, and shall cooperate as soon as reasonably practicable to ensure that such Wrong Pocket Asset is transferred to such member of the Member Group, Parent, the Subsequent Surviving Company or its Subsidiaries, as applicable, without payment of any further consideration to or from the Person to whom the Wrong Pocket Asset is being transferred.

7.20 R&W Insurance Policy. Parent has conditionally bound a R&W Insurance Policy in the form set forth on Exhibit E. With respect to such R&W Insurance Policy:

(a) The R&W Insurance Policy contains a waiver by the insurer of insurer's rights to bring any claim against the Members and any of their Affiliates, and their respective directors, officers and employees, by way of subrogation, claim for contribution, or otherwise, except in the case of fraud, and such Persons are third-party beneficiaries of such waiver; and

(b) Parent shall not waive or amend, and shall not permit any other Person to waive or amend, the R&W Insurance Policy in a manner inconsistent with Section 7.20(a) without the Members' prior written consent, which consent, if such waiver or amendment is prejudicial to the Members, the Members may grant or withhold in their sole discretion.

For the avoidance of doubt, Parent acknowledges and agrees that the R&W Insurance Policy is not a condition to the Closing.

7.21 Restructuring. Prior to the Closing, the Companies and their Subsidiaries shall cause the transactions set forth on Exhibit C, in respect of restructuring for tax purposes, and Exhibit D, in respect of the restructuring for distribution of certain real property interests and related assets of the Companies and their Subsidiaries (collectively, the "Restructuring"), to be consummated at the sole cost, liability and expense of the Members as set forth on Exhibit C and Exhibit D, as applicable. Prior to consummation of the Restructuring, the Companies shall provide drafts of the material Restructuring documents to Parent. The Companies shall consider in good faith any reasonable comments provided by Parent in writing to the Members not less than three Business Days prior to consummation of the Restructuring.

7.22 Transition Services Agreement. Prior to the Closing Date, the Members and the Parent shall negotiate in good faith and finalize the form of a transition services agreement (the "Transition Services Agreement") to be entered into at the Closing pursuant to which certain Subsidiaries of the Members identified therein will provide to the Subsequent Surviving Company and its Subsidiaries, and the Subsequent Surviving Company and its Subsidiaries will provide to such Subsidiaries of the Members, certain transition, migration and separation services mutually agreed upon by the Members and the Parent and consistent in all material respects with the transition, migration and separation services described on Exhibit D.

7.23 Newport Banning Ranch. Following the Closing Date, upon any release of funds from the escrow account established by Newport Banning Ranch LLC ("NBR") to secure NBR's remediation obligations, NBR or one of its Subsidiaries shall promptly (and in any event within two Business Days of any such release) pay to GG RE Holdings (as defined in Exhibit D) or its designee an amount equal to 50% of the amount by which such released funds exceeds the amount paid by (i) the Companies and their Subsidiaries from and including January 1, 2024 to and including the Closing Date and (ii) Parent and its Subsidiaries (including NBR) after the Closing Date, in each case, to satisfy such remediation obligations (the "NBR Escrow Payment"). For U.S. federal and applicable state and local income Tax purposes, the Parties intend and agree that Green Gate Resources Parent, LLC shall transfer its right to receive the NBR Escrow Payment to GG RE Holdings in connection with the Restructuring (as described in Exhibit D).

ARTICLE VIII
CONDITIONS PRECEDENT

8.1 Conditions to Each Party's Obligation to Consummate the Initial Mergers. The respective obligation of each Party to consummate the Initial Mergers is subject to the satisfaction at or prior to the Effective Time of the following conditions, any or all of which may be waived jointly by the Parties, in whole or in part, to the extent permitted by applicable Law:

(a) Stockholder Approvals. The Company Member Approvals and the Parent Stockholder Approval shall have been obtained in accordance with applicable Law and the Organizational Documents of each Company and Parent, as applicable.

(b) Regulatory Approvals. Any waiting period applicable to the Initial Mergers and the Parent Stock Issuance under the HSR Act shall have been terminated or shall have expired, the FERC Approval and the Consents set forth on Section 4.4(a) of the Company

Disclosure Letter shall have been obtained and shall have become effective in accordance with its terms, in each case, without the imposition of any term, condition, obligation, requirement, limitation, prohibition, remedy, sanction or other action that has resulted in or would reasonably be expected to result in a Burdensome Condition.

(c) No Injunctions or Restraints. No Governmental Entity having jurisdiction over any Party shall have issued any order, decree, ruling, injunction or other action that is in effect (whether temporary, preliminary or permanent) restraining, enjoining or otherwise prohibiting the consummation of the Initial Mergers or the Parent Stock Issuance and no Law shall have been adopted that makes consummation of the Initial Mergers or the Parent Stock Issuance illegal or otherwise prohibited.

(d) NYSE Listing. The shares of Parent Common Stock issuable to the holders of Equity Interests pursuant to this Agreement shall have been authorized for listing on the NYSE, upon official notice of issuance.

8.2 Additional Conditions to Obligations of Parent and Initial Merger Subs. The obligations of Parent and Initial Merger Subs to consummate the Initial Mergers are subject to the satisfaction at or prior to the Effective Time of the following conditions, any or all of which may be waived exclusively by Parent, in whole or in part, to the extent permitted by applicable Law:

(a) Representations and Warranties of the Companies and the Members. (i) The representations and warranties of each Company set forth in the first sentence of Section 4.1 (Organization, Standing and Power), Section 4.2(a) (Capital Structure), the third sentence and fifth sentence of Section 4.2(b) (Capital Structure), Section 4.3(a) (Authority; No Violations; Consents and Approvals), Section 4.5(e) (Financial Statements), Section 4.6(a) (Absence of Certain Changes or Events), Section 4.21 (Brokers) and Section 4.26 (Accredited Investors) shall have been true and correct as of the date of this Agreement and shall be true and correct as of the Closing Date, as though made on and as of the Closing Date (except, with respect to Section 4.2(a) and the third sentence and fifth sentence of Section 4.2(b), for any *De Minimis* Inaccuracies and, with respect to Section 4.5(e), for inaccuracies that are immaterial) (except that representations and warranties that speak as of a specified date or period of time shall have been true and correct only as of such date or period of time), and (ii) all other representations and warranties of each Company set forth in Article IV shall have been true and correct in all respects as of the date of this Agreement and shall be true and correct in all respects as of the Closing Date, as though made on and as of the Closing Date (except that representations and warranties that speak as of a specified date or period of time shall have been true and correct in all respects only as of such date or period of time), except where the failure of such representations and warranties to be so true and correct (without regard to qualification or exceptions contained therein as to "materiality", "in all material respects" or "Company Material Adverse Effect") have not, and would not reasonably be expected, individually or in the aggregate, to have, individually or in the aggregate, a Company Material Adverse Effect. The representations and warranties of each Member set forth in Article V shall have been true and correct as of the date of this Agreement and shall be true and correct as of the Closing Date, as though made on and as of the Closing date (except that representations and warranties that speak as of a specified date or period of time shall have

been true and correct only as of such date or period of time), except as would not, individually or in the aggregate, prevent such Member from performing such Member's obligations under this Agreement.

(b) Performance of Obligations of the Companies and Members. Each Company and Member shall have performed, or complied with, in all material respects all agreements and covenants required to be performed or complied with by it under this Agreement at or prior to the Effective Time.

(c) Compliance Certificate. Parent shall have received a certificate of each Company and Member signed by an executive officer of such Company or Member, dated the Closing Date, confirming that the conditions in Sections 8.2(a) and (b) have been satisfied in respect of such Company or Member and that the conditions in Sections 8.2(d), (e) and (h) have been satisfied.

(d) Company Related Party Agreements. The Companies and their respective Affiliates shall have (i) terminated all Company Related Party Agreements of each Company, with such termination to be effective as of the Closing and (ii) caused all liabilities of the Companies and their Subsidiaries under any and all Company Related Party Agreements to be extinguished immediately prior to the Closing, without any payment by or liability of any Company or any of its Subsidiaries therefor, other than the payments or liabilities not exceeding $100,000 in the aggregate.

(e) Company Material Adverse Effect. Since the date of this Agreement, there shall not have occurred a Company Material Adverse Effect.

(f) Registration Rights Agreement; Stockholder Agreements; Transition Services Agreement. Each applicable Member shall have delivered, or caused to be delivered, to Parent a counterpart to (i) the Registration Rights Agreement, (ii) a Stockholder Agreement and (iii) the Transition Services Agreement, in each case, duly executed by the Members or their Affiliates party thereto.

(g) Tax Forms. Each of CPP Member and IKAV S.a.r.l shall have delivered, or caused to be delivered, to Parent a properly completed and duly executed notice, substantially in the form of Exhibit F hereto, that meets the requirements of Treasury Regulations Section 1.1445-2(d)(2). CPP Member shall have delivered, or caused to be delivered, to Parent a properly completed and duly executed IRS Form W-8EXP, in a form reasonably acceptable to Parent, certifying that CPP Member is not a foreign person for purposes of Section 1445. Each Member other than CPP Member and IKAV S.a.r.l shall have delivered, or caused to be delivered, to Parent a properly completed and duly executed certificate, in a form reasonably acceptable to Parent, certifying that the applicable Member is not a foreign person for purposes of Section 1445 and Section 1446(f) of the Code (including, as applicable, an IRS Form W-9).

(h) Restructuring. The Restructuring shall have been completed in accordance with its terms.

8.3 Additional Conditions to Obligations of the Companies. The obligation of each Company to consummate the Initial Mergers is subject to the satisfaction at or prior to the Effective Time of the following conditions, any or all of which may be waived exclusively by each Company, in whole or in part, to the extent permitted by applicable Law:

(a) Representations and Warranties of Parent and Merger Subs. (i) The representations and warranties of Parent and Merger Subs set forth in the first sentence of Section 6.1 (Organization, Standing and Power), Section 6.2(a) (Capital Structure), the second sentence, fifth sentence and seventh sentence of Section 6.2(b) (Capital Structure), Section 6.3(a) (Authority; No Violations; Consents and Approvals), Section 6.6 (Absence of Certain Changes or Events), Section 6.14 (Opinion of Financial Advisor) and Section 6.15 (Brokers) shall have been true and correct as of the date of this Agreement and shall be true and correct as of the Closing Date, as though made on and as of the Closing Date (except, with respect to Section 6.2(a) and the second sentence, fifth sentence and seventh sentence of Section 6.2(b) for any *De Minimis* Inaccuracies) (except that representations and warranties that speak as of a specified date or period of time shall have been true and correct only as of such date or period of time), (ii) all other representations and warranties of Parent and Merger Subs set forth in Section 6.2(b) (Capital Structure) (except for the third sentence of Section 6.2(b)) shall have been true and correct in all material respects as of the date of this Agreement and shall be true and correct in all material respects as of the Closing Date, as though made on and as of the Closing Date (except that representations and warranties that speak as of a specified date or period of time shall have been true and correct in all material respects only as of such date or period of time), and (iii) all other representations and warranties of Parent and Merger Subs set forth in Article VI shall have been true and correct as of the date of this Agreement and shall be true and correct as of the Closing Date, as though made on and as of the Closing Date (except that representations and warranties that speak as of a specified date or period of time shall have been true and correct only as of such date or period of time), except where the failure of such representations and warranties to be so true and correct (without regard to qualification or exceptions contained therein as to "materiality", "in all material respects" or "Parent Material Adverse Effect") would not reasonably be expected to have, individually or in the aggregate, a Parent Material Adverse Effect.

(b) Performance of Obligations of Parent and Merger Subs. Parent and each Merger Sub each shall have performed, or complied with, in all material respects all agreements and covenants required to be performed or complied with by them under this Agreement at or prior to the Effective Time.

(c) Compliance Certificate. Each Company shall have received a certificate of Parent signed by an executive officer of Parent, dated the Closing Date, confirming that the conditions in Sections 8.3(a), (b) and (d) have been satisfied.

(d) Parent Material Adverse Effect. Since the date of this Agreement, there shall not have occurred a Parent Material Adverse Effect.

(e) Registration Rights Agreement; Stockholder Agreements; Transition Services Agreement. Parent shall have delivered, or caused to be delivered, to the Members counterparts to the (i) Registration Rights Agreement, (ii) Stockholder Agreements and (iii)

Transition Services Agreement, in each case, duly executed by Parent or the Subsequent Surviving Company, as applicable.

8.4 Frustration of Closing Conditions. None of the Parties may rely, either as a basis for not consummating the Initial Mergers or for terminating this Agreement, on the failure of any condition set forth in Sections 8.1, 8.2 or 8.3, as the case may be, to be satisfied if such failure was primarily caused by such Party's breach in any material respect of any provision of this Agreement.

ARTICLE IX
TERMINATION

9.1 Termination. This Agreement may be terminated and the Mergers may be abandoned at any time prior to the Effective Time, whether (except as expressly set forth below) before or after the Parent Stockholder Approval has been obtained:

(a) by mutual written consent of the Companies and Parent;

(b) by either the Companies or Parent:

(i) if any Governmental Entity having jurisdiction over any Party shall have issued any order, decree, ruling or injunction or taken any other action permanently restraining, enjoining or otherwise prohibiting the consummation of the Initial Mergers and such order, decree, ruling or injunction or other action shall have become final and nonappealable, or if there shall be adopted any Law that permanently makes consummation of the Initial Mergers illegal or otherwise permanently prohibited; provided, however, that the right to terminate this Agreement under this Section 9.1(b)(i) shall not be available to any Party whose failure to fulfill any material covenant or agreement under this Agreement has been the primary cause of or resulted in the action or event described in this Section 9.1(b)(i) occurring;

(ii) if the Initial Mergers shall not have been consummated on or before 5:00 p.m. Los Angeles time, on November 7, 2024 (the "Initial End Date", as may be extended pursuant to the immediately succeeding proviso, the "End Date"); provided, however, that (A) (x) if on the Initial End Date all conditions set forth in Article VIII have been satisfied (other than (1) the condition set forth in Section 8.1(b), and (2) those conditions that by their terms are to be satisfied at the Closing (which conditions described in clause (x)(2) are capable of being satisfied at the Closing), then either Parent or the Companies may extend the End Date by three months by delivery of written notice of such extension to the other Party not less than five business days prior to the Initial End Date (the "First Extension End Date"); and (y) if on the First Extension End Date all conditions set forth in Article VII have remained satisfied (other than (1) the condition set forth in Section 8.1(b), and (2) those conditions that by their terms are to be satisfied at the Closing (which conditions described in this clause (y)(2) are capable of being satisfied at the Closing), then either Parent or the Companies may extend the First Extension End Date by three months by delivery of written notice of such extension to the other Party not less than five business days prior to the First Extension End Date, (B)

if the Debt Marketing Period has begun and has not been completed by the Initial End Date or the First Extension End Date, the Initial End Date or the First Extension End Date, as the case may be, shall be automatically extended through the end of the Debt Marketing Period consistent with Section 2.2(c) in order to facilitate the Closing (and the Parties shall give any such required notice under the Commitment Letter that the Initial End Date or the First Extension End Date, as the case may be, has been extended to be coterminous with the Debt Marketing Period), and (C) the right to terminate this Agreement under this Section 9.1(b)(ii) shall not be available to any Party whose failure to fulfill any material covenant or agreement under this Agreement has been the primary cause of or resulted in the failure of the Initial Mergers to occur on or before such date;

(iii) in the event of a breach by the other Party of any representation, warranty, covenant or other agreement contained in this Agreement which would give rise to the failure of a condition set forth in Sections 8.2(a) or (b) or Section 8.3(a) or (b), as applicable (and such breach is not curable prior to the End Date, or if curable prior to the End Date, has not been cured by the earlier of (i) 30 days after the giving of written notice to the breaching Party of such breach and (ii) two Business Days prior to the End Date) (a "Terminable Breach"); provided, however, that the terminating Party is not then in Terminable Breach of any representation, warranty, covenant or other agreement contained in this Agreement;

(iv) if the Parent Stockholder Approval shall not have been obtained upon a vote held at a duly held Parent Stockholders Meeting, or at any adjournment or postponement thereof; or

(c) by the Companies if, prior to obtaining the Parent Stockholder Approval, the Parent Board shall have made a Parent Change of Recommendation; provided however, that no termination may be effected under this Section 9.1(c) after the Parent Stockholder Approval has been obtained; or

(d) by the Companies if (i) all the conditions set forth in Section 8.1 and Section 8.2 have been satisfied or waived (other than such conditions which by their terms are not capable of being satisfied until the Closing Date, subject to such conditions being capable of being satisfied as of the Closing Date), (ii) each Company has irrevocably confirmed by written notice to Parent that the Companies are ready, willing and able to consummate the Initial Mergers and (iii) Parent does not consummate the Initial Mergers and the Parent Stock Issuance within three Business Days after the later of (A) delivery of the notification by the Companies referred to in the foregoing clause (ii) and (B) the date the Closing is required to occur pursuant to Section 2.2.

9.2 Notice of Termination; Effect of Termination.

(a) A terminating Party shall provide written notice of termination to the other Party specifying with particularity the reason for such termination and any termination shall be effective immediately upon delivery of such written notice to the other Party.

(b) In the event of termination of this Agreement by any Party as provided in Section 9.1, this Agreement shall forthwith become void and there shall be no liability or obligation on the part of any Party except with respect to this Section 9.2, Section 7.5(b), Section 7.14 and Articles I and XI (and the provisions that substantively define any related defined terms not substantively defined in Article I); provided, however, that no such termination shall relieve any Party from liability for any damages for a Willful and Material Breach of any covenant, agreement, or obligation hereunder or fraud.

(c) In the event that (i) this Agreement is validly terminated by the Companies pursuant to Section 9.1(c) or (ii) this Agreement is validly terminated by Parent or the Companies pursuant to Section 9.1(b)(iv) at a time when this Agreement was terminable by the Companies pursuant to Section 9.1(c), then Parent shall pay the Parent Termination Payment to the Companies (or one or more of their designees), as promptly as reasonably practicable (and, in any event, within three Business Days following such termination), by wire transfer of immediately available funds to an account designated by the Companies; provided, that in the event (A) such Parent Change of Recommendation was related to such Acquisition Proposal, or (B) such Acquisition Proposal that was publicly announced or disclosed and not withdrawn and this Agreement and this Agreement was terminated by the Company or Parent pursuant to Section 9.1(b)(ii), and (C) within 12 months after such termination Parent enters into a definitive agreement in respect of an Acquisition Proposal or consummates an Acquisition Proposal then upon such termination in the event of clause (A) or upon execution or consummation as described in clause (B), Parent shall pay an additional $50,000,000 to the Companies (or one or more of their designees), as promptly as reasonably practicable (and, in any event, within three Business Days following such termination or upon execution or consummation as described in clause (B)), by wire transfer of immediately available funds to an account designated by the Companies (the "Additional Parent Termination Payment"); provided, further, that for the purposes of the foregoing proviso, references in the definition of the "Acquisition Proposal" to 20% shall be replaced by 50%.

(d) In the event that this Agreement is terminated by either the Companies or Parent pursuant to Section 9.1(b)(iv), Parent shall pay to the Companies, by wire transfer of immediately available funds to an account designated in writing by the Companies, an amount equal to the sum of (in each case, without duplication) (x) all of the Transaction Expenses incurred through the date of such termination, in an amount not to exceed the sum of $10,000,000 plus (y) the Transaction Expenses identified on Section 9.2(d) of the Company Disclosure Letter plus (z) the aggregate amount of expenses incurred by the Companies and their Subsidiaries in connection with making or obtaining any regulatory approval, clearance or notice in connection with the transactions contemplated by this Agreement, within three Business Days after the date following such termination.

(e) The Parties acknowledge and hereby agree that the Parent Termination Payment or Additional Parent Termination Payment if, as and when required pursuant to this Section 9.2, shall not constitute a penalty but will be liquidated damages in a reasonable amount that will compensate the Companies in the circumstances in which it is paid for the efforts and resources expended and opportunities foregone while negotiating this Agreement and in reliance on this Agreement and on the expectation of the consummation of the Mergers, the Parent Stock Issuance and the other transactions contemplated hereby, which amount

would otherwise be impossible to calculate with precision. The Parties acknowledge and hereby agree that in no event shall Parent be required to pay the Parent Termination Payment or Additional Parent Termination Payment on more than one occasion. If Parent fails to promptly pay the Parent Termination Payment or Additional Parent Termination Payment or the Transaction Expenses when due pursuant hereto, interest shall accrue on such amount from the date such payment was required to be paid pursuant to the terms of this Agreement until the date of payment at the rate of 8% per annum. If, in order to obtain such payment, the Companies commence a Proceeding that results in judgment for the Companies for such amount owed, Parent shall pay the Companies' reasonable out-of-pocket costs and expenses (including reasonable attorneys' fees and expenses) incurred in connection with such Proceeding. Each of Parent and each Merger Sub acknowledges that the agreements contained in this Section 9.2 are an integral part of the transactions contemplated by this Agreement and that, without these agreements, the Parties would not enter into this Agreement.

(f) Notwithstanding anything to the contrary in this Agreement, in any circumstance (except in the case of a Willful and Material Breach of this Agreement or fraud where the Companies decline to accept payment of the Parent Termination Payment and, if applicable, the Additional Parent Termination Payment and instead pursues a claim for damages) in which this Agreement is terminated and the Companies are paid the Parent Termination Payment (and, if applicable, the Additional Parent Termination Payment) pursuant to this Section 9.2, the Parent Termination Payment (and, if applicable, the Additional Parent Termination Payment) shall be the sole and exclusive monetary remedy of the Companies against Parent, any Merger Sub or any of their respective Subsidiaries, as applicable, and in no event will Parent, any Merger Sub or any of their respective Subsidiaries, stockholders, Affiliates, officers, directors, employees and Representatives seek to recover any other money damages or seek any other remedy (including any remedy for specific performance) based on a claim in law or equity with respect to, for any loss or damage suffered in connection with the transactions contemplated by this Agreement or as a result of the failure of the Mergers, the Parent Stock Issuance and the other transactions contemplated by this Agreement to be consummated or for a breach of, or failure to perform under, this Agreement or any certificate or other document delivered in connection herewith or otherwise, and upon payment of such amounts, Parent, Merger Subs and their respective Subsidiaries, as applicable, shall have no further liability or obligation relating to or arising out of this Agreement or in respect of representations made or alleged to be made in connection herewith, whether in equity or at law, in contract, in tort or otherwise. Notwithstanding anything to the contrary herein, nothing shall limit the right of each Company to bring or maintain any action, claim or proceeding for injunction, specific performance or other equitable relief prior to the termination of this Agreement or to specifically enforce the obligations set forth in this Section 9.2; provided that, for the avoidance of doubt, if the Companies are paid the Parent Termination Payment (and, if applicable, the Additional Parent Termination Payment) pursuant to this Section 9.2, the Parent Termination Payment (and, if applicable, the Additional Parent Termination Payment) shall be the sole and exclusive monetary remedy of the Companies against Parent, any Merger Sub or any of their respective Subsidiaries, as applicable, and in no event will the Companies, the Members or any of their respective Subsidiaries, stockholders, Affiliates, officers, directors, employees and Representatives seek to recover any other money damages or seek any other remedy (including any remedy for specific performance).

9.3 Expenses; Release.

(a) Except as otherwise provided in this Agreement, each Party shall pay its own expenses incident to preparing for, entering into and carrying out this Agreement and the consummation of the Mergers and the Parent Stock Issuance, whether or not the Merger shall be consummated; provided that, for the avoidance of doubt, the foregoing shall have no effect on the treatment of Transaction Expenses pursuant to Section 3.3.

(b) At the Effective Time, each Member, on behalf of itself and its Affiliates, hereby releases, remises and forever discharges any and all rights, claims and losses of any type that it or any of its Affiliates has against Parent and the Subsequent Surviving Company, and each of their respective Representatives, Affiliates, stockholders, Subsidiaries, successors and assigns in respect of, relating to or arising in connection with the ownership and operation of each Company or its Subsidiaries at or prior to the Effective Time (the "Member Released Claims"). The Parties acknowledge that this Section 9.3 is not an admission of liability or of the accuracy of any alleged fact or claim. The Parties expressly agree that Section 9.3 shall not be construed as an admission in any proceeding as evidence of or an admission by any party of any violation or wrongdoing. Notwithstanding the foregoing, nothing contained herein (i) will operate to release any Member Released Claims with respect to any rights to indemnification pursuant to Section 7.8 or the Organizational Documents of any Company or its Subsidiaries, or (ii) will extend to claims relating to any breach or alleged breach of this Agreement or any other Transaction Document or in the case of fraud.

(c) At the Effective Time, Parent, on behalf of itself and its Affiliates (including the Surviving Companies and their Subsidiaries after the Closing) and Representatives, and its and their respective Affiliates and Representatives, and each of the respective heirs, executors, administrators, successors and permitted assigns of each of the foregoing (each, a "Releasing Person") hereby releases, remises and forever discharges any and all rights, claims and losses of any type that it or any of its Releasing Persons in respect of, relating to or arising in connection with the Members' ownership or operation of each Company and its Subsidiaries at or prior to the Effective Time (the "Parent Released Claims"). The Parties acknowledge that this Section 9.3 is not an admission of liability or of the accuracy of any alleged fact or claim. The Parties expressly agree that Section 9.3 shall not be construed as an admission in any proceeding as evidence of or an admission by any party of any violation or wrongdoing. Notwithstanding the foregoing, nothing contained herein (i) will operate to release any Parent Released Claims with respect to any rights to indemnification pursuant to this Agreement, (ii) will extend to release any rights, claims or losses of IKAV Co-Invest Member or its Affiliates in respect of the Second Lien Credit Facility, or (iii) will extend to claims relating to any breach or alleged breach of this Agreement or the other Transaction Documents or in the case of fraud.

ARTICLE X
INDEMNIFICATION; R&W INSURANCE POLICY

10.1 Survival. Except as otherwise provided in this Agreement, none of the representations, warranties, agreements and covenants contained in this Agreement will survive the Closing; provided, however, that (a) Article I (and the provisions that substantively define

any related defined terms not substantively defined in Article I), this Article X and the agreements of the Parties in Article II, Article III and Article XI, Section 4.258 (No Additional Representations), Section 6.20 (No Additional Representations), Section 7.8 (Indemnification; Directors' and Officers' Insurance), Section 9.3 (Expenses; Release), and those other covenants and agreements contained herein that by their terms apply, or that are to be performed in whole or in part, after the Closing, shall survive the Closing in accordance with their terms, and (b) (i) the representations and warranties set forth in Section 4.12 and Section 5.6 (in each case, to the extent that such representations relate solely to each Company and its Members or a breach or inaccuracy of such representations gives rise to a Tax liability of the Company), the covenants herein relating to indemnifiable Member Taxes described in Section 7.13 and Section 10.2 (b), and any claim for indemnification arising therefrom, shall, in each case of this clause (i), survive the Closing until the expiration of the applicable statute of limitations, giving effect to any extensions thereof, plus ninety (90) days, (ii) Section 4.6(b)(iii) (solely with respect to the covenants set out in Sections 7.1(b)(i) and 7.1(b)(xi) and the period from and including January 1, 2024 to and including the date hereof) and any claim for indemnification arising therefrom, Sections 7.1(b)(i) and 7.1(b)(xi) (this subclause (ii), the "Leakage Covenants") and any claim for indemnification arising therefrom, shall, in each case of this clause (ii), survive the Closing and then expire on the earlier of (x) the date that is one year following the Closing Date and (y) two weeks following the filing with the SEC of Parent's Annual Report on form 10-K for the year in which the Closing occurs (such earlier date, the "Final Date") and (iii) the covenants herein relating to indemnifiable Transaction Expenses described in Section 10.2 (c) and any claim for indemnification arising therefrom, shall, in each case of this clause (iii), survive the Closing and then expire on the Final Date; provided, that there shall be no termination with respect to a claim for indemnification with respect to such matters that is brought on or before the Final Date. The Confidentiality Agreement shall (i) survive termination of this Agreement in accordance with its terms and (ii) terminate as of the Effective Time. The foregoing shall not limit any of the rights and remedies of the Parties for any damages under any insurance policy (including the R&W Insurance Policy against the provider of the R&W Insurance Policy).

10.2 Indemnification. Subject to the terms and conditions of this Section 10.2, effective as of the Closing, the Members severally (and, for the avoidance of doubt, not jointly and severally) agree in accordance with their Applicable Percentages to indemnify Parent and the Subsequent Surviving Company against, and agree to hold each of them harmless from, (a) any and all damages arising from any breach or inaccuracy of Section 4.6(b)(iii) (solely with respect to the covenants set out in Sections 7.1(b)(i) and 7.1(b)(xi) and the period from and including January 1, 2024 to and including the date hereof), any breach for failure to perform the Leakage Covenants in each case by such Member, (b) any and all damages arising from a breach or inaccuracy of the representations and warranties set forth in Section 4.12 and by such Member in Section 5.6 (in each case, to the extent that such representations relate solely to each Company and its Members or a breach or inaccuracy of such representations gives rise to a Tax liability of the Company, and it being understood and agreed that each Member shall only be liable for such damages payable by such Member's Company) and for losses attributable to Member Taxes to the extent (i) not included in the calculation of the Estimated Member Tax Amount or Closing Date Member Tax Amount and (ii) the Members have not made any payment for such Member Taxes pursuant to Section 7.13(b)(v), and (c) any Transaction Expenses not included in the calculation of Estimated Transaction Expense Amount or Closing Date Transaction Expense Amount and only to the extent such Transaction Expenses would have been payable by the

Members to Parent pursuant to Section 3.3(e) (ii) had they been included in Closing Date Transaction Expense Amount. In the event Parent or the Subsequent Surviving Company has a claim for indemnity under this Section 10.2, Parent or the Subsequent Surviving Company, as applicable, shall give reasonably prompt notice thereof in writing to the Members, which notice shall include a written statement setting forth in reasonable detail Parent's good faith estimate of such indemnifiable amount thereof, together with reasonably detailed supporting documentation; provided, however, that the failure to provide such notice shall not release the Members from any of its obligations under this Section 10.2 except to the extent the Members are materially prejudiced by such failure. If the IKAV Member and the CPP Member hold in the aggregate an amount of Parent Common Stock with a fair market value less than (i) an amount equal to the value of 2% of the Parent Common Stock at Closing or (ii) the amount of the aggregate Federal, state and local tax liability of the Company owned by such Member prior to Closing that is indemnifiable under this Agreement at such time of determination (any such lower amount, the "Minimum Amount"), then the IKAV Member and the CPP Member shall provide Parent with a guarantee supporting any such Minimum Amount from a credit-worthy affiliate of such Members or a letter of credit with a principal amount equal to the Minimum Amount from a reasonably acceptable financial institution or retain cash at the IKAV Member and the CPP Member in the aggregate amount equal to the Minimum Amount.

10.3 Characterization of Indemnification Payments. To the extent permitted by Law, any amount paid pursuant to this Article X shall be treated by the Parties as adjustments to the Aggregate Consideration paid hereunder for Tax purposes.

10.4 R&W Insurance Policy. The cost of the premiums together with all taxes and application, underwriting or similar fees or expenses in connection with the R&W Insurance Policy shall be paid by Parent.

ARTICLE XI
GENERAL PROVISIONS

11.1 Disclosure Letter Definitions. All capitalized terms in the Company Disclosure Letter and the Parent Disclosure Letter shall have the meanings ascribed to them herein (including in Annex A) except as otherwise defined therein.

11.2 Notices. All notices, requests and other communications to any Party under, or otherwise in connection with, this Agreement shall be in writing and shall be deemed to have been duly given (a) if delivered in person; (b) if transmitted by electronic mail ("e-mail") (but only if the sender does not receive e-mail notification of failed transmission or delivery); or (c) if transmitted by national overnight courier, in each case as addressed as follows:

(i) if to Parent or Merger Subs, to:

California Resources Corporation
1 World Trade Center, Suite 1500
Long Beach, California 90831
Attn: Michael L. Preston
Email: michael.preston@crc.com

with a required copy to (which copy shall not constitute notice):

Sullivan & Cromwell LLP
1888 Century Park East
Los Angeles, California 90067
Attention: Alison S. Ressler; Bradley S. King
E-mail: resslera@sullcrom.com; kingbrad@sullcrom.com

(ii) if to the Companies, to:

Canada Pension Plan Investment Board
One Queen Street East, Suite 2500
Toronto, ON M5C 2W5, Canada
Attention: Senior Managing Director and General Counsel
Email: legalnotice@cppib.com

IKAV S.a.r.l.
1201 Louisiana Street, Suite 3400
Houston, Texas 77002
Attention: Bobby Saadati
Email: bsaadati@ikav.com

with a required copy to (which copy shall not constitute notice):

Latham & Watkins LLP
1271 Avenue of the Americas
New York, New York 10020
Attention: David S. Allinson; Thomas G. Brandt
E-mail: david.allinson@lw.com; thomas.brandt@lw.com

solely with respect to notices provided to COI, the IKAV Co-Invest Blockers and the IKAV Co-Invest Blocker Members, to:

Kirkland & Ellis LLP
609 Main Street
Houston, TX 77002
Attention: Jhett R. Nelson, P.C.; Adam Garmezy
E-Mail: jhett.nelson@kirkland.com; adam.garmezy@kirkland.com

11.13 Rules of Construction.

(a) Each of the Parties acknowledges that it has been represented by counsel of its choice throughout all negotiations that have preceded the execution of this Agreement and that it has executed the same with the advice of said independent counsel. Each Party and its counsel cooperated in the drafting and preparation of this Agreement and the other Transaction Documents, and any and all drafts relating thereto exchanged between the Parties shall be deemed the work product of the Parties and may not be construed against any Party by reason of its preparation. Accordingly, any rule of law or any legal decision that would require

interpretation of any ambiguities in this Agreement against any Party that drafted it is of no application and is hereby expressly waived.

(b) The inclusion of any information in the Company Disclosure Letter or Parent Disclosure Letter shall not be deemed an admission or acknowledgment, in and of itself and solely by virtue of the inclusion of such information in the Company Disclosure Letter or Parent Disclosure Letter, as applicable, that such information is required to be listed in the Company Disclosure Letter or Parent Disclosure Letter, as applicable, that such items are material to the Companies and their Subsidiaries, taken as a whole, or Parent and its Subsidiaries, taken as a whole, as the case may be, or that such items have resulted in a Company Material Adverse Effect or a Parent Material Adverse Effect. The headings, if any, of the individual sections of each of the Parent Disclosure Letter and the Company Disclosure Letter are inserted for convenience only and shall not be deemed to constitute a part thereof or a part of this Agreement. The Company Disclosure Letter and Parent Disclosure Letter are arranged in sections corresponding to the Sections of this Agreement merely for convenience, and the disclosure of an item in one section of the Company Disclosure Letter or Parent Disclosure Letter, as applicable, as an exception to a particular representation or warranty shall be deemed adequately disclosed as an exception with respect to all other representations or warranties to the extent that the relevance of such item to such representations or warranties is reasonably apparent on its face, notwithstanding the presence or absence of an appropriate section of the Company Disclosure Letter or Parent Disclosure Letter with respect to such other representations or warranties or an appropriate cross reference thereto.

(c) The specification of any dollar amount in the representations and warranties or otherwise in this Agreement or in the Company Disclosure Letter or Parent Disclosure Letter is not intended and shall not be deemed to be an admission or acknowledgment of the materiality of such amounts or items, nor shall the same be used in any dispute or controversy between the Parties to determine whether any obligation, item or matter (whether or not described herein or included in any schedule) is or is not material for purposes of this Agreement.

(d) All references in this Agreement to Annexes, Exhibits, Schedules, Articles, Sections, subsections and other subdivisions refer to the corresponding Annexes, Exhibits, Schedules, Articles, Sections, subsections and other subdivisions of this Agreement unless expressly provided otherwise. Titles appearing at the beginning of any Articles, Sections, subsections or other subdivisions of this Agreement are for convenience only, do not constitute any part of such Articles, Sections, subsections or other subdivisions, and shall be disregarded in construing the language contained therein. The words “this Agreement,” “herein,” “hereby,” “hereunder” and “hereof” and words of similar import, refer to this Agreement as a whole and not to any particular subdivision unless expressly so limited. The words “this Section,” “this subsection” and words of similar import, refer only to the Sections or subsections hereof in which such words occur. The word “including” (in its various forms) means “including, without limitation.” Pronouns in masculine, feminine or neuter genders shall be construed to state and include any other gender and words, terms and titles (including terms defined herein) in the singular form shall be construed to include the plural and vice versa, unless the context otherwise expressly requires. Unless the context otherwise requires, all defined terms contained herein shall include the singular and plural and the conjunctive and

disjunctive forms of such defined terms. Unless the context otherwise requires, all references to a specific time shall refer to Los Angeles time. The word "or" is not exclusive. The word "extent" in the phrase "to the extent" shall mean the degree to which a subject or other thing extends and such phrase shall not mean simply "if." For the avoidance of doubt, the obligations of the Members and Companies hereunder shall be several (not joint and several). The word "severally" shall mean that each such person's liability or obligation is independent of any other person's liability or obligation, and that no Person shall be liable for a breach of such obligation or incurrence of such liability by any other Person. The term "dollars" and the symbol "$" mean United States Dollars. The table of contents and headings herein are for convenience of reference only, do not constitute part of this Agreement and shall not be deemed to limit or otherwise affect any of the provisions hereof.

(e) In this Agreement, except as the context may otherwise require, references to: (i) any agreement (including this Agreement), contract, statute or regulation are to the agreement, contract, statute or regulation as amended, modified, supplemented, restated or replaced from time to time (in the case of an agreement or contract, to the extent permitted by the terms thereof and, if applicable, by the terms of this Agreement); (ii) any Governmental Entity includes any successor to that Governmental Entity; (iii) any applicable Law refers to such applicable Law as amended, modified, supplemented or replaced from time to time (and, in the case of statutes, include any rules and regulations promulgated under such statute) and references to any section of any applicable Law or other law include any successor to such section; (iv) "days" mean calendar days; when calculating the period of time within which, or following which, any act is to be done or step taken pursuant to this Agreement, the date that is the reference day in calculating such period shall be excluded and if the last day of the period is a non-Business Day, the period in question shall end on the next Business Day or if any action must be taken hereunder on or by a day that is not a Business Day, then such action may be validly taken on or by the next day that is a Business Day; and (v) "made available" means, with respect to any document, that such document was previously made available in the virtual data room relating to the Mergers and the Parent Stock Issuance maintained by the Companies or Parent, as applicable, by secure digital file share or email between counsel to Parent and any Merger Sub, on the one hand, and counsel to the Members, the Companies and its Subsidiaries, on the other hand, or pursuant to the exchange of information under the "clean team" agreement between the Parties prior to the execution of this Agreement.

11.4 Counterparts. This Agreement may be executed in two or more counterparts, including via email in "portable document format" (".pdf") form transmission, all of which shall be considered one and the same agreement and shall become effective when two or more counterparts have been signed by each of the Parties and delivered to the other Parties, it being understood that all Parties need not sign the same counterpart.

11.5 Entire Agreement; No Third Party Beneficiaries. This Agreement (together with the other Transaction Documents, the Confidentiality Agreement and any other documents and instruments executed pursuant hereto) constitutes the entire agreement and supersedes all prior agreements and understandings, both written and oral, among the Parties with respect to the subject matter hereof. Except for the provisions of (a) Article III, (b) Section 7.8 and (c) Section 9.3(b) and 9.3(c) (which from and after the Effective Time is intended for the benefit of, and shall be enforceable by, the Persons referred to therein and by their respective heirs and

Representatives) but only from and after the Effective Time, nothing in this Agreement, express or implied, is intended to or shall confer upon any Person other than the Parties any right, benefit or remedy of any nature whatsoever under or by reason of this Agreement; provided, however, that (i) the Members and the Non-Recourse Parties pursuant to Section 11.12, shall be express third party beneficiaries hereunder. Notwithstanding the foregoing, the Financing Sources shall be express third party beneficiaries of Sections 7.14 and 11.12, each of such Sections shall expressly inure to the benefit of the Financing Sources and the Financing Sources shall be entitled to rely on and enforce the provisions of such Sections.

11.6 Governing Law; Venue; Waiver of Jury Trial.

(a) THIS AGREEMENT, AND ALL CLAIMS OR CAUSES OF ACTION (WHETHER IN CONTRACT OR TORT) THAT MAY BE BASED UPON, ARISE OUT OF OR RELATE TO THIS AGREEMENT, OR THE NEGOTIATION, EXECUTION OR PERFORMANCE OF THIS AGREEMENT, SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE, WITHOUT GIVING EFFECT TO THE PRINCIPLES OF CONFLICTS OF LAW THEREOF.

(b) THE PARTIES IRREVOCABLY SUBMIT TO THE JURISDICTION OF THE COURT OF CHANCERY OF THE STATE OF DELAWARE OR, IF THE COURT OF CHANCERY OF THE STATE OF DELAWARE OR THE DELAWARE SUPREME COURT DETERMINES THAT THE COURT OF CHANCERY DOES NOT HAVE OR SHOULD NOT EXERCISE SUBJECT MATTER JURISDICTION OVER SUCH MATTER, THE SUPERIOR COURT OF THE STATE OF DELAWARE AND THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA LOCATED IN THE STATE OF DELAWARE SOLELY IN CONNECTION WITH ANY DISPUTE THAT ARISES IN RESPECT OF THE INTERPRETATION AND ENFORCEMENT OF THE PROVISIONS OF THIS AGREEMENT AND THE DOCUMENTS REFERRED TO IN THIS AGREEMENT OR IN RESPECT OF THE TRANSACTIONS CONTEMPLATED HEREBY, AND HEREBY WAIVE, AND AGREE NOT TO ASSERT, AS A DEFENSE IN ANY ACTION, SUIT OR PROCEEDING FOR INTERPRETATION OR ENFORCEMENT HEREOF OR ANY SUCH DOCUMENT THAT IT IS NOT SUBJECT THERETO OR THAT SUCH ACTION, SUIT OR PROCEEDING MAY NOT BE BROUGHT OR IS NOT MAINTAINABLE IN SAID COURTS OR THAT VENUE THEREOF MAY NOT BE APPROPRIATE OR THAT THIS AGREEMENT OR ANY SUCH DOCUMENT MAY NOT BE ENFORCED IN OR BY SUCH COURTS, AND THE PARTIES IRREVOCABLY AGREE THAT ALL CLAIMS WITH RESPECT TO SUCH ACTION, SUIT OR PROCEEDING SHALL BE HEARD AND DETERMINED EXCLUSIVELY BY SUCH A DELAWARE STATE OR FEDERAL COURT. THE PARTIES HEREBY CONSENT TO AND GRANT ANY SUCH COURT JURISDICTION OVER THE PERSON OF SUCH PARTIES AND OVER THE SUBJECT MATTER OF SUCH DISPUTE AND AGREE THAT MAILING OF PROCESS OR OTHER PAPERS IN CONNECTION WITH SUCH ACTION, SUIT OR PROCEEDING IN THE MANNER PROVIDED IN SECTION 11.2 OR IN SUCH OTHER MANNER AS MAY BE PERMITTED BY LAW SHALL BE VALID AND SUFFICIENT SERVICE THEREOF.

(c) EACH PARTY ACKNOWLEDGES AND AGREES THAT ANY CONTROVERSY WHICH MAY ARISE UNDER THIS AGREEMENT IS LIKELY TO INVOLVE COMPLICATED AND DIFFICULT ISSUES, AND THEREFORE EACH SUCH PARTY HEREBY IRREVOCABLY AND UNCONDITIONALLY WAIVES ANY RIGHT SUCH PARTY MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY LITIGATION DIRECTLY OR INDIRECTLY ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE TRANSACTIONS CONTEMPLATED BY THIS AGREEMENT. EACH PARTY CERTIFIES AND ACKNOWLEDGES THAT (I) NO REPRESENTATIVE, AGENT OR ATTORNEY OF ANY OTHER PARTY HAS REPRESENTED, EXPRESSLY OR OTHERWISE, THAT SUCH OTHER PARTY WOULD NOT, IN THE EVENT OF LITIGATION, SEEK TO ENFORCE THE FOREGOING WAIVER; (II) SUCH PARTY UNDERSTANDS AND HAS CONSIDERED THE IMPLICATIONS OF THE FOREGOING WAIVER; (III) SUCH PARTY MAKES THE FOREGOING WAIVER VOLUNTARILY AND (IV) SUCH PARTY HAS BEEN INDUCED TO ENTER INTO THIS AGREEMENT BY, AMONG OTHER THINGS, THE MUTUAL WAIVER AND CERTIFICATIONS IN THIS SECTION 11.6.

11.7 Severability. Each Party agrees that, should any court or other competent authority hold any provision of this Agreement or part hereof to be invalid, illegal or unenforceable in any jurisdiction, such invalidity, illegality or unenforceability shall not affect any other term or provision of this Agreement or invalidate or render unenforceable such other term or provision in any other jurisdiction. Upon such determination that any term or other provision is invalid, illegal or unenforceable, the Parties shall negotiate in good faith to modify this Agreement so as to effect the original intent of the parties as closely as possible in a mutually acceptable manner in order that the Mergers and the Parent Stock Issuance be consummated as originally contemplated to the greatest extent possible. Except as otherwise contemplated by this Agreement, in response to an order from a court or other competent authority for any Party to take any action inconsistent herewith or not to take an action consistent herewith or required hereby, to the extent that a Party took an action inconsistent with this Agreement or failed to take action consistent with this Agreement or required by this Agreement pursuant to such order, such Party shall not incur any liability or obligation unless such Party did not in good faith seek to resist or object to the imposition or entering of such order.

11.8 Assignment. Neither this Agreement nor any of the rights, interests or obligations hereunder shall be assigned by any of the Parties (whether by operation of Law or otherwise) without the prior written consent of the other Party. Subject to the preceding sentence, this Agreement will be binding upon, inure to the benefit of and be enforceable by the Parties and their respective successors and permitted assigns. Any purported assignment in violation of this Section 11.8 shall be void.

11.9 Specific Performance. The Parties agree that irreparable damage, for which monetary damages would not be an adequate remedy, would occur in the event that any of the provisions of this Agreement were not performed in accordance with their specific terms or were otherwise breached by the Parties. Prior to the termination of this Agreement pursuant to Section 9.1, it is accordingly agreed that the Parties shall be entitled to an injunction or injunctions, or any other appropriate form of specific performance or equitable relief, to prevent breaches of this Agreement and to enforce specifically the terms and provisions hereof in any

court of competent jurisdiction, in each case in accordance with this Section 11.9, this being in addition to any other remedy to which they are entitled under the terms of this Agreement at law or in equity. Each Party accordingly agrees not to raise any objections to the availability of the equitable remedy of specific performance to prevent or restrain breaches or threatened breaches of, or to enforce compliance with, the covenants and obligations of such Party under this Agreement all in accordance with the terms of this Section 11.9. Each Party further agrees that no other Party or any other Person shall be required to obtain, furnish or post any bond or similar instrument in connection with or as a condition to obtaining any remedy referred to in this Section 11.9, and each Party irrevocably waives any right it may have to require the obtaining, furnishing or posting of any such bond or similar instrument. If prior to the End Date, any Party hereto brings an action to enforce specifically the performance of the terms and provisions hereof by any other Party, the End Date shall automatically be extended by such other time period established by the court presiding over such action.

11.10 Amendment. This Agreement may be amended by the Parties, to the extent legally allowed, at any time before the Effective Time by, and only by, an instrument in writing signed on behalf of each of the Parties.

11.11 Extension; Waiver. At any time prior to the Effective Time, the Companies and Parent may, to the extent legally allowed:

(a) extend the time for the performance of any of the obligations or acts of the other Party hereunder;

(b) waive any inaccuracies in the representations and warranties of the other Party contained herein or in any document delivered pursuant hereto; or

(c) waive compliance with any of the agreements or conditions of the other Party contained herein.

Notwithstanding the foregoing, no failure or delay by any Company or Parent in exercising any right hereunder shall operate as a waiver thereof nor shall any single or partial exercise thereof preclude any other or further exercise of any other right hereunder. No agreement on the part of a Party to any such extension or waiver shall be valid unless set forth in an instrument in writing signed on behalf of such Party.

11.12 No Recourse.

(a) This Agreement may only be enforced against, and any Proceeding based upon, arising out of, or related to this Agreement or the transactions contemplated hereby may only be brought against, the Persons that are expressly named as parties hereto and then only with respect to the specific obligations set forth herein with respect to such Person. Except to the extent a named party to this Agreement (and then only to the extent of the specific obligations undertaken such named party in this Agreement and not otherwise), no past, present or future incorporator, member, partner, stockholder, Affiliate, advisor or Representative or Affiliate of any of the foregoing (collectively, the "Non-Recourse Parties") shall have any liability or obligation (whether in contract, tort, equity or otherwise) for any one or more of the representations, warranties, covenants, agreements or other obligations or

liabilities of any one or more of the Members, the Companies, Parent or Merger Subs under this Agreement (whether for indemnification or otherwise) or of or for any Proceeding based on, arising out of, or related to this Agreement or the transactions contemplated hereby.

(b) Notwithstanding anything that may be expressed or implied in this Agreement or any document, agreement, or instrument delivered contemporaneously herewith, in no event shall any Financing Sources have any liability or obligation to, or be subject to any action, suit, proceeding or claim from the Companies, their respective affiliates, or their or their affiliates' respective former, current or future general or limited partners, stockholders, managers, members, controlling persons, officers, directors, employees, agents or Representatives (collectively, the "Company Parties") in connection with this Agreement or the transactions contemplated hereby, including any Financing, whether at law or equity, in contract, in tort or otherwise, and none of Company Parties will have any rights or claims against any Financing Source under this Agreement or any other agreement contemplated by, or entered into in connection with the transactions contemplated by, this Agreement, including any commitments by the Financing Sources in respect of financing the transactions contemplated by this Agreement. Notwithstanding anything herein to the contrary, each Company Party (i) agrees that no Financing Source shall be subject to any special, consequential, punitive or indirect damages or damages of a tortious nature, (ii) agrees that, subject to this Section 11.12, it will not bring or support any action, cause of action, claim, cross-claim or third-party claim of any kind or description, whether in law or in equity, whether in contract or in tort or otherwise, against the Financing Sources in any way relating to this Agreement or any of the transactions contemplated by this Agreement, including any dispute arising out of or relating in any way to the Financing or the performance thereof or the transactions contemplated thereby, in any forum other than exclusively in the Supreme Court of the State of New York, County of New York, sitting in the Borough of Manhattan or, if under applicable law exclusive jurisdiction is vested in the federal courts, the United States District Court for the Southern District of New York sitting in the Borough of Manhattan (and appellate courts thereof), (iii) submits for itself and its property with respect to any such action to the exclusive jurisdiction of such courts, (iv) agrees that service of process, summons, notice or document by registered mail addressed to it at its address provided in Section 11.2 shall be effective service of process against it for any such action brought in any such court, (v) waives and hereby irrevocably waives, to the fullest extent permitted by law, any objection which it may now or hereafter have to the laying of venue of, and the defense of an inconvenient forum to the maintenance of, any such action in any such court, (vi) agrees that a final judgment in any such action shall be conclusive and may be enforced in other jurisdictions by suit on the judgment or in any other manner provided by law and (vii) agrees that any such action, cause of action, claim, cross-claim or third-party claim (except to the extent relating to the interpretation of any provisions in this Agreement (including any provision in any documentation related to the Financing that expressly specifies that the interpretation of such provisions shall be governed by and construed in accordance with the law of the State of Delaware)) shall be governed by the laws of the State of New York (without giving effect to any conflicts of law principles that would result in the application of the laws of another jurisdiction). NOTWITHSTANDING ANYTHING HEREIN TO THE CONTRARY, EACH COMPANY PARTY HEREBY IRREVOCABLY WAIVES, TO THE FULLEST EXTENT PERMITTED BY LAW, ALL RIGHTS OF TRIAL BY JURY IN ANY ACTION, PROCEEDING, OR COUNTERCLAIM (WHETHER BASED UPON CONTRACT, TORT

OR OTHERWISE) ARISING OUT OF OR RELATING TO THIS AGREEMENT, THE ACQUISITION, THE FINANCING OR ANY OF THE OTHER TRANSACTIONS CONTEMPLATED HEREBY OR THEREBY, INCLUDING IN ANY ACTION, PROCEEDING OR COUNTERCLAIM AGAINST ANY FINANCING SOURCE. Notwithstanding anything to the contrary contained herein, this Section 11.12 (and any other provision of this Agreement to the extent an amendment, supplement, waiver or other modification of such provision would modify the substance of this Section) may not be amended, supplement, waived or otherwise modified in any manner that impacts or is otherwise adverse in any respect to the Financing Sources without the prior written consent of the Financing Sources party to the Commitment Letter.

11.13 Provision Respecting Representation of Companies.

(a) It is acknowledged by each of the Parties that the Companies and their Subsidiaries and the Members have retained Latham & Watkins LLP (and, with respect to IKAV Co-Invest Blocker 1 and IKAV Co-Invest Blocker 2, Kirkland & Ellis LLP) to act as their counsel in connection with the transactions contemplated by this Agreement and the other Transaction Documents and that Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) has not acted as counsel for any other Party in connection with the transactions contemplated by this Agreement and the other Transaction Documents and that none of the other Parties has the status of a client of Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) for conflict of interest or any other purposes as a result thereof. The Parties hereby agree that, in the event that any dispute, or any other matter in which the interests of the Members and their respective Affiliates, on the one hand, and Parent and its Affiliates (including the Subsequent Surviving Company and its Subsidiaries), on the other hand, are adverse, arises after the Closing between Parent or the Subsequent Surviving Company and its Subsidiaries, on the one hand, and the Members and their respective Affiliates, on the other hand, Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) may represent any or all of the Members and their respective Affiliates in such dispute even though the interests of the Members and their respective Affiliates may be directly adverse to Parent or the Subsequent Surviving Company and its Subsidiaries, and even though Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) formerly may have represented the Companies and their Subsidiaries in any matter substantially related to such dispute.

(b) The Parties and their respective Affiliates, including following the Closing with respect to the Subsequent Surviving Company and its Subsidiaries, acknowledge and agree that, in connection with any future disputes, lawsuits, actions, proceedings, investigations or other matters, including any dispute between Parent, the Subsequent Surviving Company and its Subsidiaries or any of its or their respective Affiliates, on the one hand, and the Members or any of their respective Affiliates, on the other hand, or with or between any other Persons, with respect to the transactions contemplated by this Agreement and the other Transaction Documents, (i) as to all communications among Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable), each Company and its Subsidiaries with respect to the transactions contemplated by this Agreement and the other Transaction Documents, the attorney-client privilege, attorney work product protection and the expectation of client confidence belongs solely to the Members

or their respective Affiliates (other than the Subsequent Surviving Company and its Subsidiaries), and may be controlled by the Members or their respective Affiliates (other than the Subsequent Surviving Company and its Subsidiaries), and shall not pass to or be claimed by Parent, the Subsequent Surviving Company or its Subsidiaries, or any of their respective Affiliates and (ii) Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) may disclose to the Members or their respective Affiliates any information learned by Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) in the course of its representation of the Members, the Companies and their Subsidiaries or their respective Affiliates with respect to the transactions contemplated by this Agreement and the other Transaction Documents, whether or not such information is subject to attorney-client privilege, attorney work product protection, or Latham & Watkins LLP's (or Kirkland & Ellis LLP's, as applicable) duty of confidentiality. Accordingly, Parent and its Affiliates shall not have access to any such communications, or to the files of Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable), whether or not the Closing occurs. Without limiting the generality of the foregoing, upon and after the Closing, (A) to the extent that files of Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) with respect to the transactions contemplated by this Agreement and the other Transaction Documents constitute property of the client, only the Members and their respective Affiliates shall hold such property rights and (B) Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) shall have no duty whatsoever to reveal or disclose any such attorney-client communications or files with respect to the transactions contemplated by this Agreement and the other Transaction Documents to Parent or any Surviving Company or any of its Subsidiaries by reason of any attorney-client relationship between Latham & Watkins LLP (or Kirkland & Ellis LLP, as applicable) and the Companies and their Subsidiaries or otherwise.

(c) If and to the extent that, at any time subsequent to Closing, Parent or any of its Affiliates (including the Subsequent Surviving Company and its Subsidiaries) shall have the right to assert or waive any attorney-client privilege with respect to any communication between the Subsequent Surviving Company and its Subsidiaries or their respective Affiliates and any Person representing them with respect to the transactions contemplated by this Agreement and the other Transaction Documents that occurred at any time prior to the Closing, Parent, on behalf of itself and its Affiliates (including the Subsequent Surviving Company and its Subsidiaries), shall be entitled to waive such privilege only with the consent of the Members.

[*Signature Page Follows*]

IN WITNESS WHEREOF, each Party hereto has caused this Agreement to be signed by its respective officer thereunto duly authorized, all as of the date first written above.

CALIFORNIA RESOURCES CORPORATION

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: President and Chief Executive Officer

IN WITNESS WHEREOF, each Party hereto has caused this Agreement to be signed by its respective officer thereunto duly authorized, all as of the date first written above.

PETRA MERGER SUB I, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

PETRA MERGER SUB C, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

PETRA MERGER SUB O, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

PETRA MERGER SUB S, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

IN WITNESS WHEREOF, each Party hereto has caused this Agreement to be signed by its respective officer thereunto duly authorized, all as of the date first written above.

PETRA MERGER SUB O2, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

[*Signature Page to Agreement and Plan of Merger*]

IN WITNESS WHEREOF, each Party hereto has caused this Agreement to be signed by its respective officer thereunto duly authorized, all as of the date first written above.

PETRA MERGER SUB O3, LLC

By: /s/ Francisco J. Leon
Name: Francisco J. Leon
Title: Manager

[*Signature Page to Agreement and Plan of Merger*]

CPPIB VEDDER US HOLDINGS LLC

By: /s/ Bill Rogers
Name: Bill Rogers
Title: Authorized Signatory

By: /s/ Maxine Ethier
Name: Maxine Ethier
Title: Authorized Signatory

CPP INVESTMENT BOARD PRIVATE HOLDINGS (6), INC., solely for purposes of the Member Provisions

By: /s/ Bill Rogers
Name: Bill Rogers
Title: Authorized Signatory

By: /s/ Maxine Ethier
Name: Maxine Ethier
Title: Authorized Signatory

IKAV IMPACT USA INC.

By: /s/ Constantin von Wasserschleben
Name: Constantin von Wasserschleben
Title: President

By: /s/ Gregor Gruber
Name: Gregor Gruber
Title: Vice President

IKAV IMPACT S.A.R.L., solely for purposes of the Member Provisions

By: /s/ Constantin von Wasserschleben
Name: Constantin von Wasserschleben
Title: Director

By: /s/ Gregor Gruber
Name: Gregor Gruber
Title: Director

SIMLOG INC., solely for purposes of the Member Provisions

By: /s/ Bobby Saadati
Name: Bobby Saadati
Title: President

By: /s/ Megan Ebadat
Name: Megan Ebadat
Title: Treasurer

IKAV ENERGY INC., solely for purposes of the Member Provisions

By: /s/ Constantin von Wasserschleben
Name: Constantin von Wasserschleben
Title: President

By: /s/ Cindy Green
Name: Cindy Green
Title: Corporate Secretary

GREEN GATE COI LLC

By: /s/ Bobby Saadati
Name: Bobby Saadati
Title: IKAV Manager

By: /s/ Megan Ebadat
Name: Megan Ebadat
Title: IKAV Manager

OPPS XB AERA E CTB, LLC

By: Oaktree Fund GP, LLC
Its: General Partner

By: Oaktree Fund GP I, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

OPPS XI AERA E CTB, LLC

By: Oaktree Fund GP, LLC
Its: General Partner

By: Oaktree Fund GP I, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

OCM AERA E HOLDINGS, LLC., solely for purposes of the Member Provisions

By: Oaktree Fund GP, LLC
Its: General Partner

By: Oaktree Fund GP I, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

OCM OPPS XI AIV HOLDINGS (DELAWARE), L.P., solely for purposes of the Member Provisions

By: Oaktree Fund GP, LLC
Its: General Partner

By: Oaktree Fund GP I, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

OCM OPPS XB AIF HOLDINGS (DELAWARE), L.P., solely for purposes of the Member Provisions

By: Oaktree Fund GP, LLC
Its: General Partner

By: Oaktree Fund GP I, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

OAKTREE HUNTINGTON INVESTMENT FUND II AIF (DELAWARE), L.P. – CLASS C., solely for purposes of the Member Provisions

By: Oaktree Fund AIF Series, L.P. – Series N
Its: General Partner

By: Oaktree Fund GP AIF, LLC
Its: General Partner

By: Oaktree Fund GP III, L.P.
Its: Managing Member

By: /s/ Jordan Mikes
Name: Jordan Mikes
Title: Authorized Signatory

By: /s/ Robert LaRoche
Name: Robert LaRoche
Title: Authorized Signatory

ANNEX A
Certain Definitions

"Acquisition Proposal" means, with respect to Parent and its Subsidiaries, any proposal or offer from any Person or "group" (as defined in the Exchange Act) relating to, in a single transaction or series of related transactions: (a) any direct or indirect acquisition or purchase of a business that constitutes 20% or more of the net revenues, net income or earnings before interest, Taxes, depreciation and amortization for the preceding twelve months of Parent and its Subsidiaries, taken as a whole; (b) any direct or indirect acquisition of 20% or more of the consolidated assets of Parent and its Subsidiaries, taken as a whole (based on the fair market value thereof, as determined in good faith by the Parent Board), including through the acquisition of one or more Subsidiaries of Parent owning such assets; (c) acquisition of beneficial ownership, or the right to acquire beneficial ownership, of 20% or more of the total voting power of the equity interests of Parent, any tender offer or exchange offer that if consummated would result in any Person beneficially owning 20% or more of the total voting power of the equity interests of Parent, or any merger, reorganization, consolidation, share exchange, business combination, recapitalization, liquidation, dissolution or similar transaction involving Parent (or any of its Subsidiaries) that constitutes a majority of the revenues or assets of Parent and its Subsidiaries, taken as a whole; (d) any issuance or sale or other disposition (including by way of merger, reorganization, division, consolidation, share exchange, business combination, recapitalization or other similar transaction) of 20% or more of the total voting power of the equity interests of Parent; or (e) any combination of the foregoing.

"Affiliate" means, with respect to any Person, any other Person directly or indirectly, controlling, controlled by, or under common control with, such Person, through one or more intermediaries or otherwise; provided, notwithstanding anything herein to the contrary, (i) in no event shall Affiliate include (or be considered to include) any (x) any "portfolio company" (as such term is customarily understood among institutional private equity investors) of any investment fund affiliated with, advised or managed by any Sponsor or any of its affiliates, other than each Company and its Subsidiaries, or (y) any limited partners or other direct or indirect investors in any investment fund affiliated with, advised or managed by any Sponsor or any of its affiliates, or any of the respective affiliates of any such limited partners or investors; provided that for purposes of Section 11.12 Affiliate of the Companies shall include any Person described in clauses (x) or (y) above; and (ii) for purposes of this Agreement, from and after the Effective Time, (x) Parent and its Affiliates shall be Affiliates of the Subsequent Surviving Company and its Subsidiaries, and vice versa, and (y) neither any Member nor any of their respective Affiliates shall be an Affiliate of Parent, the Subsequent Surviving Company or any of their respective Subsidiaries or Affiliates, and vice versa.

"Aggregate Consideration" means a number of shares of Parent Common Stock equal to 21,170,357.

"Agreed VWAP" means $51.96.

"Anti-Corruption Laws" means any applicable Law for the prevention or punishment of public or commercial corruption and bribery, including the U.S. Foreign Corrupt Practices Act, U.K. Bribery Act 2010, laws implementing the OECD Convention on Combating Bribery of

Foreign Public Officials in International Business Transactions and any applicable anti-corruption or anti-bribery Law of any other applicable jurisdiction.

"Antitrust Laws" means the HSR Act or any other Law designed to prohibit, restrict or regulate actions for the purpose or effect of mergers, monopolization, restraining trade, lessening of competition or abusing a dominant position.

"Applicable Percentage" means, with respect to IKAV Member, 41.401%, with respect to CPP Member, 49.045%, with respect to IKAV Co-Invest Member, 9.554% (the Applicable Percentages among the foregoing and the IKAV Co-Invest Blockers and IKAV Co-Invest may be updated by such Parties prior to Closing).

"beneficial ownership," including the correlative term "beneficially owning," has the meaning ascribed to such term in Section 13(d) of the Exchange Act.

"Bridge Commitment Letter" means that certain commitment letter, dated as of the date hereof, addressed to Parent in respect of the bridge facility described therein.

"Business Day" means a day other than a day on which banks in the State of California or the State of Delaware are authorized or obligated to be closed.

"Business Plan" means that certain business plan for the Companies and their Subsidiaries for fiscal year 2024 as set forth on Exhibit I attached hereto; provided, however, that if the Closing has not occurred by December 31, 2024, then for fiscal year 2025 "Business Plan" shall mean that certain business plan for fiscal year 2025 determined in good faith by the board of managers of Green Gate Resources Parent LLC.

"Closing Date Member Tax Overage Amount" means, with respect to any Member, the excess, if any, of such Member's Closing Date Member Tax Amount over the sum of (i) the estimated or other tax payments made prior to Closing by the applicable Company to any applicable Taxing Authority with respect to any Pre-Closing Tax Return or Pre-Lockbox Date Tax Period of any Post-Closing Tax Return, and (ii) any withholding for Pre-Lockbox Date Taxes and Restructuring Taxes which, prior to Closing, has been properly remitted to the applicable Taxing Authority; provided, in the case of (i) and (ii), the cash to make such payments or withholding was held by the Company or its Subsidiaries as of December 31, 2023.

"Closing Date Transaction Expense Overage Amount" means an amount (if any) by which the Closing Date Transaction Expense Amount exceeds the Transaction Expenses Threshold Amount.

"Code" means the Internal Revenue Code of 1986.

"Commitment Letter" means, collectively or individually, as applicable, the Bridge Commitment Letter and the RBL Commitment Letter, in each case as amended, supplemented or replaced in compliance with this Agreement or as required pursuant to the terms of this Agreement following a Financing Failure Event, pursuant to which the financial institutions party thereto have agreed, subject only to the conditions set forth therein, to provide or cause to be provided the Financing described therein.

"Company Credit Agreements" means, collectively, (i) that certain Credit Agreement, dated as of February 28, 2023, among Mobil California Exploration & Producing Asset Company LLC, Shell Onshore Ventures LLC, Aera Energy LLC, Aera Energy Services Company, Citibank, N.A., and the lenders party thereto, and (ii) that certain Second Lien Credit Agreement, dated as of February 28, 2023, among Mobil California Exploration & Producing Asset Company LLC, Shell Onshore Ventures LLC, Aera Energy LLC, Aera Energy Services Company, Alter Domus Products Corp., and the lenders party thereto (such clause (i), the "RBL", and such clause (ii), the "Second Lien Credit Facility")

"Company Material Adverse Effect" means any fact, circumstance, effect, change, event or development ("Effect") that (a) would prevent, materially delay or materially impair the ability of each Company or its Subsidiaries to consummate the Mergers or (b) has, or would reasonably be expected to have, a material adverse effect on the financial condition, business or results of operations of the Companies and their Subsidiaries, taken as a whole; provided, however, that with respect to this clause (b) only, except in respect of such Effects directly or indirectly resulting from, arising out of, attributable to or related to any application of any Law following the date of this Agreement, or any Proceeding to enforce any such application, no Effect (by itself or when aggregated or taken together with any and all other Effects) to the extent directly or indirectly resulting from, arising out of, or attributable to any of the following shall be deemed to be or constitute a "Company Material Adverse Effect" or shall be taken into account when determining whether a "Company Material Adverse Effect" has occurred or may, would or could occur:

(i) general economic conditions (or changes in such conditions) or conditions in the global economy generally;

(ii) conditions (or changes in such conditions) in the securities markets, credit markets, currency markets or other financial markets, including (A) changes in interest rates and changes in exchange rates for the currencies of any countries and (B) any suspension of trading in securities (whether equity, debt, derivative or hybrid securities) generally on any securities exchange or over-the-counter market;

(iii) conditions (or changes in such conditions) in the oil and gas exploration, development or production industry (including changes in commodity prices, general market prices);

(iv) political conditions or acts of war, sabotage or terrorism (including any escalation or general worsening of any such acts of war, sabotage or terrorism);

(v) earthquakes, hurricanes, tsunamis, tornadoes, floods, mudslides, wild fires or other natural disasters, pandemics or weather conditions;

(vi) the negotiation, execution or announcement of this Agreement or the pendency or consummation of the Mergers and the Parent Stock Issuance (other than with respect to any representation or warranty that is intended to address the consequences of the execution or delivery of this Agreement or the announcement or consummation of the Mergers and the Parent Stock Issuance);

(vii) compliance with the terms of, or the taking of any action expressly permitted or required by, this Agreement (except for any obligation under this Agreement to operate in the Ordinary Course (or similar obligation) pursuant to Section 7.1);

(vii) changes in Law or other legal or regulatory conditions, or the interpretation thereof;

(ix) changes in GAAP or other accounting standards (or the interpretation thereof), or that result from any action taken for the purpose of complying with any of the foregoing; or

(x) any failure by the Financial Statements Entities to meet any analysts' estimates or expectations of the Financial Statements Entities' revenue, earnings or other financial performance or results of operations for any period, or any failure by the Financial Statements Entities or any of their Subsidiaries to meet any internal budgets, plans or forecasts of its revenues, earnings or other financial performance or results of operations (it being understood that the facts or occurrences giving rise to or contributing to such changes or failures may constitute, or be taken into account in determining whether there has been or will be, a Company Material Adverse Effect);

provided, however, except to the extent such Effects directly or indirectly resulting from, arising out of, attributable to or related to the matters described in the foregoing clauses (i) –(v) disproportionately adversely affect the Companies and their Subsidiaries, taken as a whole, as compared to other similarly situated industry participants, in which case only the incremental disproportionate Effect shall be taken into account when determining whether a "Company Material Adverse Effect" has occurred or may, would or could occur with respect to clause (b).

"Company Plan" means any "employee benefit plan" (within the meaning of Section 3(3) of ERISA, regardless of whether such plan is subject to ERISA), and any personnel policy (oral or written), stock, equity, equity-based or phantom equity plan, collective bargaining agreement, bonus plan or arrangement, incentive award plan or arrangement, vacation or holiday pay policy, retention or severance pay plan, policy or agreement, deferred compensation agreement or arrangement, defined benefit pension plan, retirement or post-retirement plan, policy or agreement, change in control, hospitalization or other medical, dental, vision, accident, disability, life or other insurance, executive compensation or supplemental income arrangement, consulting agreement, employment agreement, and any other employee benefit plan, agreement, arrangement, program, practice, or understanding for any current or former director, employee, consultant or independent contractor of any Company or any of its Subsidiaries, whether or not funded and whether or not in writing, that is sponsored, maintained, or contributed to by any Company or any of its Affiliates or with respect to which any Company or any of its Affiliates have any liability (contingent or otherwise), but excluding Multiemployer Plans, governmental plans, programs or policies and any other plan, program or policy mandated by applicable Laws.

"Company Service Provider" means any current or former employee, officer, director, or independent contractor (who is a natural person) of any Company or any of its Subsidiaries.

"Consent" means any filing, notice, report, registration, approval, consent, ratification, permit, permission, waiver, expiration of waiting periods or authorization.

"control" and its correlative terms, means the possession, directly or indirectly, of the power to direct or cause the direction of the management and policies of a Person, whether through the ownership of voting securities, by contract or otherwise.

"*De Minimis* Inaccuracies" means any inaccuracies that individually or in the aggregate are *de minimis* relative to the total fully diluted equity capitalization of the Companies, collectively, or Parent, as the case may be.

"Debt Compliant" means, with respect to the Debt Financing Required Information, that:

(a) such Debt Financing Required Information does not contain any untrue statement of a material fact or omit to state any material fact necessary in order to make such Debt Financing Required Information not misleading in light of the circumstances in which made; and

(b) (i) the financial statements and other financial and audited reserve based information included in Debt Financing Required Information are, and remain throughout the Debt Marketing Period, sufficient to permit the Parent's financing sources (including underwriters, placement agents or initial purchasers) to receive customary comfort letters with respect to financial and audited reserve based information contained in the Debt Financing Required Information (including customary negative assurance comfort) on any date during the Debt Marketing Period, and (ii) the Financial Statements Entities' auditors and reserve engineers have confirmed they are prepared to issue any such comfort letter upon each of any pricing date occurring during the Debt Marketing Period and any closing date occurring during the Debt Marketing Period.

"Debt Fee Letter" means those certain fee letters relating to the Financing and entered into in connection with the Commitment Letter.

"Debt Financing Required Information" means each of the following:

(a) such information concerning the Companies and their Subsidiaries as may be necessary to prepare a customary summary business description, customary financial and operating data (including, for the avoidance of doubt, customary information regarding the Companies' and their Subsidiaries' oil and gas reserves and the underlying property interests related thereto) and management's discussion and analysis, in each case, for use in a preliminary offering memorandum suitable for use in a customary "high yield road show" for a private placement of non-convertible unsecured debt securities pursuant to Rule 144A (without registration rights) promulgated under the Securities Act (including, without limitation, such information as may be reasonably requested and as may be reasonably available to the Companies and their Subsidiaries as necessary for the Parent to prepare pro forma financial statements customarily included in a customary preliminary offering memorandum suitable for use in a customary "high yield road show" for a private placement of debt securities by the Parent pursuant to Rule 144A (without registration rights) promulgated under the Securities Act, it being agreed that the preparation of any pro forma financial statements will be the responsibility of the Parent and not the Companies or any other party to this Agreement),

(b) (x) the audited combined balance sheets and related statements of income, changes in equity and cash flows of the Financial Statements Entities (or, at the Companies' option, such other presentation as may be required to be included in the Proxy Statement) for the two most recently completed fiscal years ended at least 60 days prior to the Closing Date, and (y) the unaudited combined balance sheets and related statements of income, changes in equity and cash flows of the Financial Statements Entities (or, at the Companies' option, such other presentation as may be required to be included in the Proxy Statement) for each subsequent fiscal quarter ended at least 40 days prior to the Closing Date (but excluding the fourth quarter of any fiscal year), in each case, with respect to this clause (2), with comparative financial information for the equivalent period of the prior year and assuming the Closing Date were to occur on any date during the Marketing Period, and

(c) reserve reports evaluating the proved reserves and proved developed reserves of the Companies and their Subsidiaries to the extent provided to lenders under either or both of the Company Credit Agreements,

provided that such information shall not include the Debt Financing Excluded Information. For the avoidance of doubt, the financial statements referred to in clause (b) above will be prepared in accordance with GAAP and any unaudited financial statements will be reviewed by the independent accountants of the Financial Statements Entities; provided that no opinion shall be required with respect to such review of such unaudited financial statements. For the avoidance of doubt, notwithstanding anything included herein to the contrary, no Debt Financing Required Information shall be required to be provided after the satisfaction of the Debt Marketing Period or the date on which the Financing has been consummated (including, for the avoidance of doubt, if the proceeds of the Financing are placed into escrow upon consummation).

"Debt Financing Excluded Information" means each of the following: (1) a description of all or any portion of the Financing, including any "description of notes," "plan of distribution" or any other information customarily provided by initial purchasers or underwriters in such an offering, (2) any risk factors relating to, or any description of, all or any component of the financing contemplated thereby, (3) any historical financial statements or other information required by Rule 3-09, Rule 3-10, Rule 3-16, Rule 13-01 or Rule 13-02 of Regulation S-X under the Securities Act in each case which are prepared on a basis not consistent with the Company's reporting practices for the periods presented in the Debt Financing Required Information; any compensation discussion and analysis or other information required by Item 10, Item 402 and Item 601 of Regulation S-K under the Securities Act or XBRL exhibits; or any information regarding executive compensation or related persons related to SEC Release Nos. 33-8732A, 34-54302A and IC-27444A, (4) any consolidating financial statements, separate Subsidiary financial statements, related party disclosures, or any segment information, including any required by FASB Accounting Standards Codification Topic 280 in each case which are prepared on a basis not consistent with the Company's reporting practices for the periods presented in the Debt Financing Required Information, (5) any information that the preparation of which would unreasonably or materially interfere with the business or operations of any Company or any of its Subsidiaries, (6) any projections, (7) financial statements or other financial data (including selected financial data) for any period earlier than the fiscal year ended 2021, (8) any pro forma, projected or forward looking information (other than financial information necessary for the

preparation of pro forma financial statements) and (9) such information that would not customarily be included in an offering memorandum for the sale of such debt securities in a Rule 144A and Regulation S private placement.

"Debt Marketing Period" shall mean the first period of 15 consecutive Business Days after the date of this Agreement throughout and at the end of which (i) Parent shall have had Debt Financing Required Information that is Debt Compliant (it being understood that if the Companies in good faith reasonably believe that they have provided Debt Financing Required Information that is Debt Compliant, they may, concurrently with the delivery of such Debt Financing Required Information that is Debt Compliant, deliver to Parent a written notice to that effect (stating when they believe they completed such delivery), in which case the Companies shall be deemed to have delivered the Debt Financing Required Information to Parent on the date on which the Companies believed they completed such delivery and the Debt Financing Required Information shall be deemed to be Debt Compliant, unless Parent in good faith reasonably believes that the Companies have not completed the delivery of the Debt Financing Required Information or that the Debt Financing Required Information is not Debt Compliant at the time such notice is given and, within three Business Days after the delivery of such notice by the Companies, Parent delivers a written notice to the Companies to that effect (identifying with reasonable specificity the Debt Financing Required Information that has not been delivered or is not Debt Compliant) and, following delivery of such Debt Financing Required Information specified in such notice, the Debt Financing Marketing Period will commence (provided that, it is understood that delivery of such written notice from such Company to Parent will not prejudice such Company's right to assert that the Debt Financing Required Information has in fact been delivered and is Debt Compliant)), and (ii) either (x) the conditions set forth in Article VIII (other than those conditions that by their nature can only be satisfied at the Closing) shall be satisfied and nothing has occurred and no condition exists that would cause such condition to fail to be satisfied assuming the Closing were to be scheduled for any time during such 15 consecutive Business Day period or (y) Parent and the Companies, after consultation, shall have reasonably determined in good faith that the conditions set forth in Article VIII (other than those conditions that by their nature can only be satisfied at Closing) will have a substantial likelihood of being satisfied within the succeeding 60 day period and remaining satisfied thereafter; provided, further, that,

(a) the Debt Marketing Period shall end on any earlier date that is the date on which the Financing is otherwise funded in an amount that is not less than the aggregate amount of the Financing contemplated by the Commitment Letter, taking into account, for the purposes of this clause (a) only, any amounts (if any) of the Financing funded into escrow;

(b) such period shall not commence, and shall be deemed not to have commenced, if

prior to the completion of such 15 consecutive Business Day period, the independent registered public accountants of the Financial Statement Entities shall have withdrawn any audit opinion contained in the Debt Financing Required Information, in which case the Debt Marketing Period shall not be deemed to commence unless and until a new audit opinion is issued with respect thereto by such accountants or another independent public accounting firm reasonably acceptable to Parent;

prior to the completion of such 15 consecutive Business Day period, the Financial Statement Entities issue a public statement indicating their intent to, or determine that they are required to, restate any historical financial statements included in Debt Financing Required Information or that any such restatement is under consideration, in which case the Debt Marketing Period shall not be deemed to commence unless and until, as applicable, such restatement has been completed and the relevant Debt Financing Required Information has been amended or the Financial Statement Entities have announced that they have concluded that no restatement shall be required in accordance with GAAP; or

if any Debt Financing Required Information would not be Debt Compliant at any time during such 15 consecutive Business Day period or otherwise ceases to meet the definition of "Debt Financing Required Information", in which case the Debt Marketing Period shall not commence or be deemed to commence unless and until such Debt Financing Required Information is updated or supplemented so that it is Debt Compliant (it being understood that if any Debt Financing Required Information provided at the commencement of the Debt Marketing Period ceases to be Debt Compliant during such 15 consecutive Business Day period, then the Debt Marketing Period shall be deemed not to have commenced) and otherwise meets the definition of "Debt Financing Required Information"; and

(c) (x) if the Debt Marketing Period has not ended on or prior to August 25, 2024, the Debt Marketing Period shall not commence earlier than September 5, 2024, (y) the Debt Marketing Period shall not be required to be consecutive solely with respect to and if it includes November 23, 2024 through November 26, 2024 (any such day to be excluded for purposes of, but shall not reset, the Debt Marketing Period) and (z) if the Debt Marketing Period has not ended on or prior to December 20, 2024, the Debt Marketing Period shall not commence earlier than January 2, 2025.

Notwithstanding anything included herein to the contrary, the Company may provide updates to the Debt Financing Required Information during such Debt Marketing Period with more recent information regarding the Company, including financial statements, related financial data and information related to the financial position, results of operations, cash flows and prospects of the Company, and in such event the fifteen (15) consecutive Business Day period shall not be deemed to have been tolled or recommenced unless the Debt Financing Required Information was not Debt Compliant immediately prior to or upon the delivery of such more recent information.

"Disproportionate Effects" means the Effects described in the first proviso relating to clause (b) thereof in the definitions of Company Material Adverse Effect and Parent Material Adverse Effect, as the case may be.

"DOJ" means the U.S. Department of Justice.

"Economic Sanctions/Trade Laws" means (1) economic or financial sanctions or trade embargoes imposed, administered or enforced from time to time by (a) the U.S. government, including those administered by OFAC or the U.S. Department of State, or (b) the United Nations Security Council, the European Union, any European Union Member State, or the United Kingdom; (2) all applicable trade, export control, import, and antiboycott laws and

regulations imposed, administered, or enforced by the U.S. government, including the Arms Export Control Act (22 U.S.C. § 1778), the International Emergency Economic Powers Act (50 U.S.C. §§ 1701–1706), Section 999 of the Internal Revenue Code, the U.S. customs laws at Title 19 of the U.S. Code, the Export Control Reform Act of 2018 (50 U.S.C. §§ 4801-4861), the International Traffic in Arms Regulations (22 C.F.R. Parts 120–130), the Export Administration Regulations (15 C.F.R. Parts 730-774), the U.S. customs regulations at 19 C.F.R. Chapter 1, and the Foreign Trade Regulations (15 C.F.R. Part 30); and (3) all applicable trade, export control, import, and antiboycott laws and regulations imposed, administered or enforced by any other country, except to the extent inconsistent with U.S. law.

"EDGAR" means the Electronic Data Gathering, Analysis and Retrieval System administered by the SEC.

"Encumbrances" means liens, pledges, charges, encumbrances, claims, hypothecation, mortgages, deeds of trust, security interests, restrictions, rights of first refusal, defects in title, prior assignment, license, sublicense, or other burdens, options or encumbrances of any kind or any agreement, option, right or privilege (whether by Law, contract or otherwise) that expressly provides for any of the foregoing (any action of correlative meaning, to "Encumber").

"Environmental Laws" means any and all applicable Laws pertaining to (a) prevention of pollution or protection of the environment (including, without limitation, any natural resource damages); (b) the generation, use, storage, treatment, disposal, presence or Release of Hazardous Materials into the indoor or outdoor environment; and (c) human health and safety solely as it relates to the handling of or exposure to Hazardous Materials.

"ERISA" means the Employee Retirement Income Security Act of 1974.

"Estimated Member Tax Overage Amount" means, with respect to any Member, the excess, if any, of such Member's Estimated Member Tax Amount over the sum of (i) the estimated or other tax payments made prior to Closing by the applicable Company to any applicable Taxing Authority with respect to any Pre-Closing Tax Return or Pre-Lockbox Date Tax Period of any Post-Closing Tax Return and (ii) any withholding for Pre-Lockbox Date Taxes and Restructuring Taxes which, prior to Closing, has been properly remitted to the applicable Taxing Authority; provided, in the case of (i) and (ii), the cash to make such payments or withholding was held by the Company or its Subsidiaries as of December 31, 2023.

"Estimated Transaction Expense Overage Amount" means an amount (if any) by which the Estimated Transaction Expense Amount exceeds the Transaction Expenses Threshold Amount.

"EWG" means an exempt wholesale generator under PUHCA.

"Excess Balance Sheet Cash Amount" means $11,000,000.00.

"Exchange Act" means the Securities Exchange Act of 1934.

"FERC" means the Federal Energy Regulatory Commission, and any successor thereto.

"FERC Approval" means prior authorization by FERC of the transaction contemplated hereby under Section 203 of the FPA.

"FPA" means the Federal Power Act.

"Financing" means the financing incurred or intended to be incurred pursuant to the Commitment Letter, including any term loan or bank financing or debt securities used in lieu thereof.

"Financing Conditions" means with respect to the Financing, the conditions precedent set forth in Exhibit B of the Bridge Commitment Letter and Exhibit C of the RBL Commitment Letter.

"Financing Deliverables" means the following customary documents to be delivered in connection with the Financing: (i) a customary perfection certificate required in connection with the Financing, (ii) payoff letters and lien release documentation in form and substance reasonably satisfactory to Parent with respect to the Company Credit Agreements and any replacement indebtedness thereof and (iii) at least three Business Days prior to the Closing Date, to the extent reasonably requested in writing at least seven days prior to Closing , all documentation and other information regarding the Companies and their Subsidiaries that any Financing Source reasonably determines is required by regulatory authorities under applicable "know-your-customer" and anti-money laundering rules and regulations, including the USA PATRIOT Act of 2001, and, to the extent required by any Financing Sources, a beneficial ownership certificate (substantially similar in form and substance to the form of Certification Regarding Beneficial Owners of Legal Entity Customers published jointly, in May 2018, by the Loan Syndication and Trading Association and Securities Industry and Financial Markets Association) in respect of any Company or any of its Subsidiaries that qualifies as a "legal entity customer" under the Beneficial Ownership Regulation (31 C.F.R. § 1010.230).

"Financing Documents" means any credit agreements, note purchase agreements, indentures, guarantees, pledge and security documents, definitive financing documents, hedging agreements, agreements, schedules or other certificates or documents contemplated by the Financing.

"Financing Failure Event" means, for any reason, other than as contemplated by the Commitment Letter, including as a result of entering into any term loan or other bank financing or issuing any debt securities, all or any portion of the Financing becoming unavailable and such portion being necessary to pay the Required Amounts on the Closing Date.

"Financing Sources" means the Persons that are party to, and have committed to provide or arrange, all or any part of the Financing pursuant to the Commitment Letter and/or any additional or replacement lender, arranger, bookrunner, agent, syndication agent or other entity acting in a similar capacity for the Financing (but excluding, for the avoidance of doubt, Parent and any Merger Sub) or any entity that has otherwise entered into agreements in connection with all or any part of the Financing or any other financing in connection with the transactions contemplated hereby, including the parties to any joinder agreements, indentures or credit agreements entered into in connection therewith, together with their respective affiliates and their

respective affiliates' officers, directors, employees, controlling persons, agents and representatives and their respective successors and assigns.

"fraud" means, with respect to any Party, any breach or inaccuracy of any representation or warranty of such Party set forth in Article IV, Article V or Article VI, as applicable, or in any certificate delivered pursuant hereto, in either case, that constitutes common law fraud under the Laws of the State of Delaware; provided that "fraud" shall not be deemed to include negligence, recklessness or any equitable fraud or promissory fraud.

"FTC" means the U.S. Federal Trade Commission.

"GAAP" means United States generally accepted accounting principles.

"Governmental Entity" means any court, governmental, regulatory or administrative agency or commission or other governmental authority or instrumentality, domestic or foreign.

"Government Official" means (1) any director, officer, employee or representative of any Governmental Entity; (2) any director, officer, employee or representative of any commercial enterprise that is owned or controlled by a Governmental Entity, including any state-owned or controlled company or organization; (3) any director, officer, employee or representative of any public international organization, such as the United Nations or the World Bank; (4) any person acting in an official capacity for any Governmental Entity, or organization identified above; and (5) any political party, party official or candidate for political office.

"group" has the meaning ascribed to such term in Section 13(d) of the Exchange Act.

"Hazardous Materials" means any (a) chemical, product, substance, waste, pollutant, or contaminant that is defined or listed as hazardous or toxic, or that is otherwise regulated due to its harmful or deleterious properties, under any Environmental Law; (b) asbestos containing materials, lead-containing material, polychlorinated biphenyls, per-and polyfluoroalkyl substances, mold, or radon; and (c) any Hydrocarbons.

"Hedging Transaction" means any swap transaction, option, warrant, forward purchase or sale transaction, futures transaction, cap transaction, floor transaction or collar transaction relating to one or more currencies, commodities (including, without limitation, natural gas, natural gas liquids, crude oil and condensate), bonds, equity securities, loans, interest rates, catastrophe events, weather-related events, credit-related events or conditions or any indexes, or any other similar transaction (including any put, call or other option with respect to any of these transactions) or combination of any of these transactions, including collateralized mortgage obligations or other similar instruments or any debt or equity instruments evidencing or embedding any such types of transactions, and any related credit support, collateral or other similar arrangements related to such transactions.

"Hydrocarbons" means any hydrocarbon-containing substance, crude oil, natural gas, condensate, drip gas and natural gas liquids, coalbed gas, ethane, propane, iso-butane, nor-butane, gasoline, scrubber liquids and other liquids or gaseous hydrocarbons or other substances (including minerals or gases), or any combination thereof, produced or associated therewith.

"Indebtedness" of any Person means, without duplication: (a) indebtedness of such Person for borrowed money; (b) obligations of such Person to pay the deferred purchase or acquisition price for any property of such Person; (c) reimbursement obligations of such Person in respect of drawn letters of credit or similar instruments issued or accepted by banks and other financial institutions for the account of such Person; (d) obligations of such Person under a lease to the extent such obligations are required to be classified and accounted for as a capital lease on a balance sheet of such Person under GAAP; and (e) indebtedness of others as described in clauses (a) through (d) above guaranteed by such Person; but Indebtedness does not include accounts payable to trade creditors, or accrued expenses arising in the Ordinary Course, in each case, that are not yet due and payable, or are being disputed in good faith, and the endorsement of negotiable instruments for collection in the Ordinary Course.

"Independent Accountant" means Ernst & Young LLP, or such other independent accounting firm of recognized national standing in the United States as may be mutually selected by Parent and the Companies.

"Intellectual Property" means any and all intellectual property rights, under the applicable Law of any jurisdiction or rights under international treaties, both statutory and common law rights, including rights in the following: (a) utility models, supplementary protection certificates, invention disclosures, registrations, patents and applications for same, and extensions, divisions, continuations, continuations-in-part, reexaminations, revisions, renewals, substitutes, and reissues thereof; (b) trademarks, service marks, certification marks, collective marks, brand names, d/b/a's, trade names, slogans, domain names, symbols, logos, trade dress and other identifiers of source, and registrations and applications for registrations thereof and renewals of the same (including all common law rights and goodwill associated with the foregoing and symbolized thereby); (c) published and unpublished works of authorship, whether copyrightable or not, copyrights therein and thereto, together with all common law and moral rights therein, database rights, and registrations and applications for registration of the foregoing, and all renewals, extensions, restorations and reversions thereof; (d) trade secrets, know-how, and other rights in information, including designs, formulations, concepts, compilations of information, methods, techniques, procedures, and processes, whether or not patentable (collectively, "Trade Secrets"); (e) Internet domain name registrations; and (f) all other intellectual property, industrial or proprietary rights.

"IT Assets" means computers, software, servers, networks, workstations, routers, hubs, circuits, switches, data communications lines, and all other information technology equipment, and all associated documentation.

"knowledge" means the actual knowledge of, (a) in the case of the Companies, the individuals listed in Section 1.1(a) of the Company Disclosure Letter and (b) in the case of Parent, the individuals listed in Section 1.1(b) of the Parent Disclosure Letter.

"Law" means any law, including common law, rule, regulation, ordinance, code, judgment, order, treaty, convention, governmental directive or other legally enforceable requirement, U.S. or non-U.S., in each case of any Governmental Entity.

"Malicious Code" means disabling codes or instructions, spyware, Trojan horses, back doors, drop dead devices, time bombs, worms, viruses or other software routines, in each case, that facilitate or cause unauthorized access to, or are intended to disrupt, impair or disable the ordinary operation of, or destroy, IT Assets.

"MBR Authority" means an order by FERC pursuant to Section 205 of the FPA (a) authorizing an entity to sell energy, capacity and specified ancillary services at market-based rates, (b) accepting a tariff for filing that provides for such sales, and (c) granting such entity waivers of regulations and blanket authorizations customarily granted by FERC to an entity that sells wholesale power and ancillary services at market-based rates, including blanket authorization for the issuance of securities and assumption of liabilities under Section 204 of the FPA and Part 34 of FERC's regulations.

"Member Provisions" means Article I, Section 2.5, Article III, Article V, Sections 7.3(a), 7.3(c), 7.4(k), 7.10, 7.13, 7.15, 7.18(a), 7.19, 7.20, 7.21, 7.22, Article VII, Sections 9.3(b) and 9.3(c), Article X and Article XI.

"Member Taxes" means, with respect to any Member, the sum of (1) any Pre-Lockbox Date Taxes attributable to the Company in which such Member owns an interest, (2) any Restructuring Taxes attributable to the Company in which such Member owns an interest, and (3) without duplication of clause (2), such Member's Applicable Percentage of any Restructuring Taxes attributable to Green Gate Resources Parent, LLC and any of its Subsidiaries, in each case, calculated in accordance with the methodology described in Section 7.13(b) regardless of the actual amount of Bonus Depreciation shown on the applicable Pre-Closing Tax Return or Post-Closing Tax Return (including, in the case of any taxable period beginning on or before and ending after December 31, 2023, the amount of Tax reflected on such Tax Return attributable to the Pre-Lockbox Date Tax Period of such taxable period) of such Company.

"Money Laundering Laws" means any Law governing financial recordkeeping and reporting requirements, including the U.S. Currency and Foreign Transaction Reporting Act of 1970, the U.S. Money Laundering Control Act of 1986, and any applicable money laundering-related Laws of other jurisdictions where the Companies and their Subsidiaries conduct business, conduct financial transactions or own assets.

"NYSE" means the New York Stock Exchange.

"Oil and Gas Leases" means all leases, subleases, licenses or other occupancy or similar agreements (including any series of related leases with the same lessor) under which a Person leases, subleases or licenses or otherwise acquires or obtains rights to produce Hydrocarbons from real property interests.

"Oil and Gas Properties" means all interests in and rights with respect to (a) oil, gas, mineral, and similar properties of any kind and nature, including working, leasehold and mineral interests and operating rights and royalties, overriding royalties, production payments, net profit interests and other non-working interests and non-operating interests (including all Oil and Gas Leases, operating agreements, unitization and pooling agreements and orders, division orders, transfer orders, mineral deeds, royalty deeds, and in each case, interests thereunder), surface

interests, fee interests, reversionary interests, reservations and concessions and (b) all Wells located on or producing from such leases and properties.

"Ordinary Course" means, with respect to an action taken by any Person, that such action is consistent with the ordinary course of business and past practices of such Person.

"Organizational Documents" means (a) with respect to a corporation, the charter, articles or certificate of incorporation, as applicable, and bylaws thereof, (b) with respect to a limited liability company, the certificate of formation or organization, as applicable, and the operating or limited liability company agreement thereof, (c) with respect to a partnership, the certificate of formation and the partnership agreement, and (d) with respect to any other Person the organizational, constituent and/or governing documents and/or instruments of such Person.

"other Party" means (a) when used with respect to the Companies, Parent and Merger Subs and (b) when used with respect to Parent or Merger Subs, the Companies and the Members.

"Parent Intervening Event" means a material development or material change in circumstance and that was not known and was not reasonably foreseeable to the Parent Board as of the date hereof and that becomes known to the Parent Board after the date of this Agreement; provided that in no event shall any of the following constitute a Parent Intervening Event or be taken into account in determining whether a Parent Intervening Event has occurred: (A) changes in the financial, securities, currency, commodity, real estate, capital or credit markets or general economic, political, social, regulatory, legal or tax conditions in any jurisdiction in which Parent or any of its Subsidiaries operate, including (1) changes in interest rates and changes in exchange rates for the currencies of any countries and (2) any suspension of trading in securities (whether equity, debt, derivative or hybrid securities) generally on any securities exchange or over-the-counter market; (B) the receipt, existence or terms of any inquiry, offer or proposal by Parent or its Subsidiaries that constitutes or would reasonably be expected to lead to, an Acquisition Proposal; (C) failure by Parent, any Company or any of their respective Subsidiaries to meet any internal or published projections, forecasts or predictions in respect of financial performance; (D) any Effect relating to any Company or any of its Subsidiaries that does not amount to a Company Material Adverse Effect; (E) changes in the market price or trading volume of Parent Common Stock or any other securities of Parent, or any change in credit rating of Parent or any Company or any of their respective Subsidiaries; (F) general conditions (or changes in such conditions) in the oil and natural gas exploration and production industry (including political or regulatory changes affecting the industry or any changes in Law); or (G) any Effect relating to Parent's efforts to obtain the Financing or any Alternative Financing, including any failure thereof; provided, further, that the underlying causes of the matters described in clauses (C) and (E) may be deemed to constitute a Parent Intervening Event or be taken into account in determining whether a Parent Intervening Event has occurred.

"Parent Material Adverse Effect" means any Effect that (a) would prevent, materially delay or materially impair the ability of Parent or its Subsidiaries to consummate the Mergers and the Parent Stock Issuance or (b) has, or would reasonably be expected to have, a material adverse effect on the financial condition, business or results of operations of Parent and its Subsidiaries, taken as a whole; provided, however, that with respect to this clause (b) only, except in respect of such Effects directly or indirectly resulting from, arising out of, attributable

to or related to any application of any Law following the date of this Agreement, or any Proceeding to enforce any such application, no Effect (by itself or when aggregated or taken together with any and all other Effects) to the extent directly or indirectly resulting from, arising out of, or attributable to any of the following shall be deemed to be or constitute a "Parent Material Adverse Effect" or shall be taken into account when determining whether a "Parent Material Adverse Effect" has occurred or may, would or could occur:

(i) general economic conditions (or changes in such conditions) or conditions in the global economy generally;

(ii) conditions (or changes in such conditions) in the securities markets, credit markets, currency markets or other financial markets, including (A) changes in interest rates and changes in exchange rates for the currencies of any countries and (B) any suspension of trading in securities (whether equity, debt, derivative or hybrid securities) generally on any securities exchange or over-the-counter market;

(iii) conditions (or changes in such conditions) in the oil and gas exploration, development or production industry (including changes in commodity prices, general market prices);

(iv) political conditions or acts of war, sabotage or terrorism (including any escalation or general worsening of any such acts of war, sabotage or terrorism);

(v) earthquakes, hurricanes, tsunamis, tornadoes, floods, mudslides, wild fires or other natural disasters, pandemics or weather conditions;

(vi) the negotiation, execution or announcement of this Agreement or the pendency or consummation of the Mergers and the Parent Stock Issuance (other than with respect to any representation or warranty that is intended to address the consequences of the execution or delivery of this Agreement) or the announcement or consummation of the Mergers and the Parent Stock Issuance;

(vii) compliance with the terms of, or the taking of any action expressly permitted or required by, this Agreement (except for any obligation under this Agreement to operate in the Ordinary Course (or similar obligation) pursuant to Section 7.2);

(viii) changes in Law or other legal or regulatory conditions, or the interpretation thereof;

(ix) changes in GAAP or other accounting standards (or the interpretation thereof), or that result from any action taken for the purpose of complying with any of the foregoing; or

(x) any changes in Parent's stock price or the trading volume of Parent's stock, or any failure by Parent to meet any analysts' estimates or expectations of Parent's revenue, earnings or other financial performance or results of operations for any period, or any failure by Parent or any of its Subsidiaries to meet any internal budgets, plans or forecasts of its revenues, earnings or other financial performance or results of

operations (it being understood that the facts or occurrences giving rise to or contributing to such changes or failures may constitute, or be taken into account in determining whether there has been or will be, a Parent Material Adverse Effect);

provided, however, except to the extent such Effects directly or indirectly resulting from, arising out of, attributable to or related to the matters described in the foregoing clauses (i) – (v) disproportionately adversely affect Parent and its Subsidiaries, taken as a whole, as compared to other similarly situated industry participants, in which case only the incremental disproportionate Effect shall be taken into account when determining whether a "Parent Material Adverse Effect" has occurred or may, would or could occur with respect to clause (b).

"Parent Plan" means any "employee benefit plan" (within the meaning of Section 3(3) of ERISA, regardless of whether such plan is subject to ERISA), and any personnel policy (oral or written), stock, equity, equity-based or phantom equity plan, collective bargaining agreement, bonus plan or arrangement, incentive award plan or arrangement, vacation or holiday pay policy, retention or severance pay plan, policy or agreement, deferred compensation agreement or arrangement, defined benefit pension plan, retirement or post-retirement plan, policy or agreement, change in control, hospitalization or other medical, dental, vision, accident, disability, life or other insurance, executive compensation or supplemental income arrangement, consulting agreement, employment agreement, and any other employee benefit plan, agreement, arrangement, program, practice, or understanding for any current or former director, employee, consultant or independent contractor of Parent or any of its Subsidiaries, whether or not funded and whether or not in writing, that is sponsored, maintained, or contributed to by Parent or its Affiliates or with respect to which Parent or its Affiliates have any liability (contingent or otherwise), but excluding Multiemployer Plans, governmental plans, programs or policies and any plan, program or policy mandated by applicable Laws.

"Parent Stockholder Approval" means the approval of the Parent Stock Issuance by the affirmative vote of a majority of shares of Parent Common Stock entitled to vote thereon and present in person and represented by proxy at the Parent Stockholders Meeting in accordance with the rules and regulations of the NYSE and the Organizational Documents of Parent.

"Parent Stockholders Meeting" means a meeting of the stockholders of Parent to consider the approval of the Parent Stock Issuance, including any postponement, adjournment or recess thereof.

"Parent Superior Proposal" means a bona fide written Acquisition Proposal (except that references in the definition of the "Acquisition Proposal" to 20% shall be replaced by 50%) made after the date of this Agreement by any person other than any Company or any of its Subsidiaries that is expressly conditioned upon the termination of this Agreement, on terms that the Parent Board determines in good faith, after consultation with its outside legal counsel and financial advisors, and considering such factors as the Parent considers to be appropriate (including the timing and likelihood of consummation of such proposal), are more favorable to the holders of Parent Common Stock than the transactions contemplated by this Agreement, taking into account any change to the transaction proposed by the Companies (including pursuant to Section 7.4(e)).

"Parent Termination Payment" means $50,000,000.

"Party" or "Parties" means Parent, Merger Subs, the Companies and, solely for the Member Provisions, the Members.

"Permitted Acquisitions" means any acquisition (by asset purchase or exchange, stock purchase, merger or otherwise) by Parent or any of its Subsidiaries of another Person that (a) provides for aggregate consideration solely of cash, (b) does not require the approval of the stockholders of Parent, (c) would not reasonably be expected to prevent, impair or delay consummation of the Merger and the transactions contemplated hereby (including any delay in the timing or expiration of the waiting period under the HSR Act).

"Permitted Encumbrances" means:

(a) to the extent not applicable to the transactions contemplated hereby or thereby or otherwise waived prior to the Effective Time, preferential purchase rights, rights of first refusal, purchase options and similar rights granted pursuant to any contracts, including joint operating agreements, joint ownership agreements, stockholders agreements, organic documents and other similar agreements and documents;

(b) contractual or statutory mechanic's, materialmen's, warehouseman's, journeyman's and carrier's liens and other similar Encumbrances arising in the Ordinary Course for amounts not yet delinquent and Encumbrances for Taxes or assessments or other governmental charges that are not yet delinquent or, in all instances, if delinquent, that are being contested in good faith in the Ordinary Course and for which adequate reserves have been established in accordance with GAAP by the party responsible for payment thereof;

(c) Production Burdens payable to third parties that are deducted in the calculation of discounted present value in the Company Reserve Reports and any Production Burdens payable to third parties affecting any Oil and Gas Property that was acquired subsequent to the date of the Company Reserve Reports;

(d) Encumbrances arising in the Ordinary Course under operating agreements, joint venture agreements, partnership agreements, Oil and Gas Leases, farm-out agreements, division orders, contracts for the sale, purchase, transportation, processing or exchange of oil, gas or other Hydrocarbons, unitization and pooling declarations and agreements, area of mutual interest agreements, development agreements, joint ownership arrangements and other agreements that are customary in the oil and gas business, provided, however, that, in each case, such Encumbrance (i) secures obligations that are not Indebtedness or a deferred purchase price and are not delinquent and (ii) would not be reasonably expected to have, individually or in the aggregate, a material and adverse effect on the value, use or operation of the property encumbered thereby;

(e) such Encumbrances as any Company (in the case of Encumbrances with respect to properties or assets of Parent or its Subsidiaries) or Parent (in the case of Encumbrances with respect to properties or assets of any Company or any of its Subsidiaries), as applicable, may have expressly waived in writing;

(f) all easements, encumbrances, zoning restrictions, rights-of-way, servitudes, permits, surface leases, and other similar rights in respect of surface operations, and easements for pipelines, streets, alleys, highways, telephone lines, power lines, railways and other easements and rights-of-way on, over or in respect of any of the properties of any Company or Parent, as applicable, or any of their respective Subsidiaries, and all matters disclosed by the public records or that would be disclosed by a current and accurate survey of the Real Property that do not materially interfere with the operation or use of the property or the asset affected thereby;

(g) any Encumbrances (i) discharged at or prior to the Effective Time (including Encumbrances securing any Indebtedness that will be paid off in connection with Closing) and (ii) arising under the Company Credit Agreements;

(h) Encumbrances imposed or promulgated by applicable Law or any Governmental Entity with respect to real property, including zoning, building or similar restrictions; or

(i) Encumbrances, exceptions, defects or irregularities in title, easements, imperfections of title, claims, charges, security interests, rights-of-way, covenants, restrictions and other matters and encumbrances that would be accepted by a reasonably prudent purchaser of oil and gas interests, that would not reduce the net revenue interest share of Companies or Parent, as applicable, or such Party's Subsidiaries, in any Oil and Gas Lease below the net revenue interest share shown in the Company Reserve Reports, with respect to such lease, or increase the working interest of the Companies or Parent, as applicable, or of such Party's Subsidiaries, in any Oil and Gas Lease above the working interest shown on the Company Reserve Reports, with respect to such lease.

"Permitted Leakage" means each of the following to the extent incurred or paid, or the making of or entering into any agreement or arrangement to give effect to any of the following prior to the Closing Date and any liability of any Company for Taxes incurred or becoming payable in connection therewith or arising therefrom:

(a) payments by any Company or any of its Subsidiaries to third parties (other than to the Members or any of their Related Persons) pursuant to contracts in the Ordinary Course;

(b) payments by any Company or any of its Subsidiaries of Taxes, licensing fees and other operating expenses, in each case, in the Ordinary Course and as disclosed in Section 1.1(c) of the Company Disclosure Letter;

(c) payments to or for the benefit of any directors, officers, or employees of any Company or any of its Subsidiaries, in each case, in the Ordinary Course;

(d) intercompany payments made by any Company or any Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time, on the one hand, to any Company or any Subsidiary that will be wholly owned by the Companies from the date of this Agreement through the Effective Time, on the other hand;

(e) reimbursement payments by any Company or any Subsidiaries of the Companies to the Sponsors or their affiliated entities that provided services to or for the benefit of any Company or any of Subsidiaries of the Companies, in each case, in the Ordinary Course and in an amount not to exceed $300,000 in the aggregate;

(f) any payment by any Company or any of its Subsidiaries (i) that is expressly required by this Agreement, or (ii) required by applicable Law;

(g) any distribution required pursuant to the Restructuring as disclosed in Section 1.1(d) of the Company Disclosure Letter;

(h) the payment of any Transaction Expenses;

(i) any payment made by any Company or any of its Subsidiaries at the request or with the consent of Parent;

(j) payments made with respect to matters (i) accrued or provided for in the Financial Statements, or (ii) expressly and specifically provided for in the 2024 annual budget of the Companies and their Subsidiaries, a copy of which was provided by the Companies to Parent prior to the date hereof; or

(k) cash dividends or distributions by the Companies (i) of an aggregate amount equal to the Excess Balance Sheet Cash Amount or (ii) as disclosed on Section 1.1(d) of the Company Disclosure Letter.

For the avoidance of doubt, any Transaction Expenses paid pursuant to clause (h) shall be taken into account for purposes of Section 3.3 (*Adjustment for Transaction Expenses and Member Taxes*).

"Person" means any individual, partnership, limited liability company, corporation, joint stock company, trust, estate, joint venture, Governmental Entity, association or unincorporated organization, or any other form of business or professional entity.

"Personal Information" means any information or data that is considered "personal information," "personally identifiable information", "sensitive personal information", "private information" or similar term under applicable Laws.

"Post-Closing Tax Period" means any taxable period beginning after the Closing Date and the portion of any Straddle Period beginning after (and excluding) the Closing Date.

"Pre-Closing Tax Period" means any taxable period ending on or prior to the Closing Date and the portion of any Straddle Period ending on and including the Closing Date.

"Pre-Lockbox Date Taxes" means Taxes of any Company for any Pre-Lockbox Date Tax Period or the portion of any taxable period ending on December 31, 2023 (including any such Taxes, payment of which has been deferred).

"Pre-Lockbox Date Tax Period" means any taxable period ending on or prior to December 31, 2023 and the portion of any taxable period ending on and including December 31, 2023.

"Privacy Laws" means any Laws worldwide applicable to any Company or any of its Subsidiaries that are related to privacy, information security, data protection or the processing of Personal Information, including, to the extent so applicable the California Consumer Privacy Act (and its regulations) as amended by the California Privacy Rights Act.

"Proceeding" means any cause of action, action, audit, demand, litigation, suit, proceeding, investigation, grievance, citation, summons, subpoena, inquiry, hearing, originating application to a tribunal, arbitration or other proceeding at law or in equity or order or ruling, in each case whether civil, criminal, administrative, investigative or otherwise, whether in contract, in tort or otherwise, and whether or not such claim, cause of action, action, audit, demand, litigation, suit, proceeding, investigation grievance, citation, summons, subpoena, inquiry, hearing, originating application to a tribunal, arbitration or other proceeding or order or ruling results in a formal civil or criminal litigation or regulatory action, in each case, by or before a Governmental Entity.

"Production Burdens" means any royalties (including lessor's royalties), overriding royalties, production payments, net profit interests or other burdens upon, measured by or payable out of oil, gas or mineral production.

"PUHCA" means the Public Utility Holding Company Act of 2005.

"PURPA" means the Public Utility Regulatory Policies Act of 1978.

"QF" means a "qualifying small power production facility" or a "qualifying cogeneration facility" under PURPA, as such term is defined in PURPA, that also is a "qualifying facility" under PURPA, as such term is defined in PURPA.

"R&W Insurance Policy" means a representations and warranties policy obtained and bound by Parent and paid for by Parent with respect to this Agreement.

"RBL Commitment Letter" means that certain commitment letter, dated as of the date hereof, addressed to Parent in respect of the reserve-based revolving credit facility described therein.

"Registration Rights Agreement" means a registration rights and lock-up agreement, by and among Parent, on the one hand, and each Member, on the other hand, in each case, in substantially the form attached hereto as Exhibit A.

"Related Persons" means, collectively, either Member or its Affiliates (other than any Company or any Subsidiaries that will be wholly owned by the Companies from the date of this Agreement through the Effective Time), any manager or officer of any Company or his or her Affiliates and, in the case of individuals, (i) any child, stepchild, grandchild, parent, stepparent, grandparent, spouse, civil partner, sibling, or in-law of the individual, including adoptive

relationships, and (ii) any trust, partnership or other entity in which the individual or the persons described in clause (i) is the trustee or has a beneficial interest.

"Release" means any depositing, spilling, leaking, pumping, pouring, placing, emitting, discarding, abandoning, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the indoor or outdoor environment.

"Representatives" means, with respect to any Person, the officers, directors, employees, accountants, consultants, agents, legal counsel, financial advisors and other representatives of such Person.

"Restructuring Taxes" means any Taxes arising out of or resulting from the Restructuring, regardless of whether such Taxes are incurred during a Pre-Closing Tax Period or not, which are borne by any Company (or any of their Subsidiaries) or Parent (or any of its Subsidiaries), for the avoidance of doubt, without regard to any loss or deduction that may reduce any such Taxes (unless such loss or deduction arises out of or results from the Restructuring).

"Sanctioned Country" means: at any time, a country or territory that is itself the target of comprehensive Sanctions (currently, Cuba, Iran, North Korea, Syria, the Crimea region of Ukraine, the so-called Donetsk People's Republic, and the so-called Luhansk People's Republic).

"Sanctions Target" means any Person that is the target of Sanctions, including (a) any Person listed in any Sanctions-related list of designated Persons maintained by the Office of Foreign Assets Control of the U.S. Department of the Treasury ("OFAC") or the U.S. Department of State, the United Nations Security Council, the European Union, any Member State of the European Union, or the United Kingdom; (b) any Person operating, organized, or resident in a Sanctioned Country; (c) the government of a Sanctioned Country or the Government of Venezuela; or (d) any Person 50% or more owned or (where relevant under Economic Sanctions/Trade Laws) controlled by any such Person or Persons or acting for or on behalf of such Person or Persons.

"Sarbanes-Oxley Act" means the Sarbanes-Oxley Act of 2002.

"SEC" means the United States Securities and Exchange Commission.

"Securities Act" means the Securities Act of 1933.

"Sponsor" means each of Canada Pension Plan Investment Board and IKAV SICAV-FIS SCA.

"Stockholder's Agreement" means, as applicable, (i) the stockholder agreement, by and between Parent, on the one hand, IKAV Member, on the other hand, and (ii) the stockholder agreement, by and between Parent, on the one hand, and CPP Member, on the other hand, in each case, in substantially the form attached hereto as Exhibit B, and "Stockholder Agreements" means all of the foregoing, collectively.

"Straddle Period" means any taxable period beginning on or before and ending after the Closing Date that are first due after the Closing Date.

"Subsidiary" means, with respect to a Person, any Person, whether incorporated or unincorporated, of which (a) more than 50% of the securities or ownership interests having by their terms ordinary voting power to elect a majority of the board of directors or other Persons performing similar functions, (b) a general partner interest or (c) a managing member interest, is directly or indirectly owned or controlled by the subject Person or by one or more of its respective Subsidiaries; provided, however, that for purposes of this Agreement, Green Gate Resources Parent, LLC and its Subsidiaries shall be deemed Subsidiaries of each Company, except with respect to COI and the IKAV Co-Invest Blockers as it relates to the making of representations, warranties or covenants regarding Green Gate Resources Parent, LLC and its Subsidiaries, but not for the sharing of liability in which event COI and the IKAV Co-Invest Blockers shall bear responsibility as a Company for its proportionate share as described herein.

"Takeover Law" means any "fair price," "moratorium," "control share acquisition," "business combination" or any other anti-takeover statute or similar statute enacted under applicable Law.

"Tax" or "Taxes" means any and all taxes and similar charges, duties, levies or other assessments of any kind, including, but not limited to, income, estimated, business, occupation, corporate, gross receipts, transfer, stamp, employment, occupancy, license, severance, capital, impact fee, production, ad valorem, excise, property, sales, use, turnover, value added and franchise taxes, deductions, withholdings and custom duties, imposed by any Governmental Entity, including interest, penalties, and additions to tax imposed with respect thereto.

"Tax Returns" means any return, report, statement, information return or other document (including any related or supporting information) filed or required to be filed with any Taxing Authority in connection with the determination, assessment, collection or administration of any Taxes, including any schedule or attachment thereto and any amendment thereof.

"Taxing Authority" means any Governmental Entity having jurisdiction in matters relating to Tax matters.

"Transaction Documents" means, collectively, this Agreement, the Stockholder Agreements, the Registration Rights Agreement, the Transition Services Agreement and any other agreements contemplated by the exhibits hereto.

"Transaction Expenses" means the out-of-pocket fees and expenses incurred in connection with the negotiation, preparation, execution and delivery of this Agreement and the other Transaction Documents and the other documents delivered in connection herewith and therewith, and the consummation of the Mergers, in each case, incurred by or on behalf of any Company and any of its Subsidiaries prior to or in connection with the Closing, including the fees and expenses of legal counsel, investment bankers, accountants and other advisors in connection with this Agreement and any Merger-related bonuses payable to any director, manager, officer or employee of the Companies or its Subsidiaries solely as a result of the consummation of the Merger (but excluding any post-Closing payments resulting from the so-

called "double-trigger" provisions), and the employer's portion of any Taxes with respect thereto; provided that Transaction Expenses shall not include (i) costs and expenses incurred by any Company or any of its Subsidiary with respect to Parent's Financing, (ii) out-of-pocket costs and expenses incurred by any Company in connection with the successful enforcement by any Company or any of its Subsidiaries of their rights hereunder (iii) amounts to be paid off pursuant to the Company Credit Agreements, (iv) costs and expenses paid by any Company in connection with the D&O Insurance or (v) the items described on Section 1.1(d) of the Company Disclosure Letter.

"Transaction Expenses Threshold Amount" means an amount equal to $35,000,000.

"Transaction Tax Deductions" means, without duplication, any income Tax deduction resulting from any Transaction Expenses (including amounts paid before the Closing Date that would have been Transaction Expenses if paid on the Closing Date).

"Wells" means all oil or gas wells, whether producing, operating, shut-in or temporarily abandoned, located on an Oil and Gas Lease or any pooled, communitized or unitized acreage that includes all or a part of such Oil and Gas Lease or otherwise associated with an Oil and Gas Property of the applicable Person or any of its Subsidiaries, together with all oil, gas and mineral production from such well.

"Willful and Material Breach" including the correlative term "Willfully and Materially Breach," shall mean (a) a material breach (or the committing of a material breach) that is a consequence of an act or failure to take an act by the breaching party that knew or reasonably should have known that the taking of such act (or the failure to take such act) would be or would be reasonably likely be a material breach of this Agreement, and (b) with respect to Parent or Merger Subs, the failure, for any reason, to consummate the transactions contemplated hereby as and when required hereunder.

REGISTRATION RIGHTS AGREEMENT

by and among

CALIFORNIA RESOURCES CORPORATION

and

EACH OF THE SELLERS PARTY HERETO

[___]

REGISTRATION RIGHTS AGREEMENT

This REGISTRATION RIGHTS AGREEMENT (this "Agreement") is made and entered into as of [___], by and among California Resources Corporation, a Delaware corporation (the "Company"), and each of the parties set forth on the signature pages hereto (each, a "Seller" and collectively, the "Sellers").

RECITALS

WHEREAS, pursuant to the Agreement and Plan of Merger, dated as of February [___], 2024 (the "Merger Agreement"), among the Company, Petra Merger Sub I, LLC, Petra Merger Sub C, LLC and Petra Merger Sub O, LLC, Petra Merger Sub O2, LLC, Petra Merger Sub O3, LLC, each a Delaware limited liability company and a wholly-owned subsidiary of the Company, Petra Merger Sub S, LLC, a Delaware limited liability company and a wholly-owned subsidiary of the Company, IKAV Impact USA Inc., a Delaware corporation, CPPIB Vedder US Holdings LLC, a Delaware limited liability company, Opps Xb Aera E CTB, LLC, a Delaware limited liability company, Opps XI Aera E CTB, LLC, a Delaware limited liability company, Green Gate COI, LLC, a Delaware limited liability company, and solely for purposes of the Member Provisions (as defined in the Merger Agreement), IKAV Impact S.a.r.l., a Luxembourg corporation, Simlog, Inc., a Delaware corporation, IKAV Energy Inc., a Delaware corporation, CPP Investment Board Private Holdings (6), Inc., a Canadian corporation, OCM Opps Xb AIF Holdings (Delaware), L.P., a Delaware limited partnership, Oaktree Huntington Investments Fund II AIF (Delaware), L.P. – Class C, a Delaware limited partnership, OCM XI AIV Holdings (Delaware), L.P., a Delaware limited partnership, and OCM Aera E Holdings, LLC, a Delaware limited liability company, the Company issued the Securities to the Sellers; and

WHEREAS, the parties hereto desire to enter into an agreement to provide for certain rights and obligations associated with ownership of the Securities.

NOW, THEREFORE, in consideration of the mutual covenants and agreements set forth herein and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged by each party hereto, the parties hereby agree as follows:

ARTICLE I
DEFINITIONS

Section 1.1 Definitions. Capitalized terms used herein without definition shall have the meanings given to them in the Merger Agreement, except that the terms set forth below are used herein as so defined:

"Affiliate" has the meaning ascribed to it, on the date hereof, under Rule 405 of the Securities Act; *provided, however*, that solely for purposes of Section 2.6, "Affiliate", with respect to any Person, means any other Person that directly or indirectly through one or more intermediaries controls, is controlled by or is under common control with, the Person in question; it being understood that, with respect to a Holder or any of its Affiliates, (x) "Affiliate" does not include any portfolio company of a Holder or any of its Affiliates and (y) for purposes of this Agreement, the Company and its subsidiaries shall not be deemed to be an Affiliate of any Holder or such Holder's Affiliates. As used herein, the term "control" means the possession, direct or

indirect, of the power to direct or cause the direction of the management and policies of a Person, whether through ownership of voting securities, by contract or otherwise.

"Agreement" has the meaning specified therefor in the introductory paragraph of this Registration Rights Agreement.

"Authority" means any domestic (including federal, state or local) or foreign court, arbitrator, administrative, regulatory or other governmental department, agency, official, commission, tribunal, authority or instrumentality, non-government authority or self-regulatory body (including any domestic or foreign securities exchange).

"Beneficially Own" has the meaning ascribed to it in Section 13(d) of the Exchange Act. "Beneficial Ownership" has a correlative meaning.

"Block Trade" means the sale of Registrable Securities to one or more purchasers that are financial institutions in an offering registered under the Securities Act without a prior public marketing process by means of a block trade.

"Block Trade Notice" has the meaning specified therefor in Section 2.1(c) of this Agreement.

"Bought or Overnight Underwritten Offering" has the meaning specified therefor in Section 2.2(b) of this Agreement.

"Bought or Overnight Underwritten Holder Offering" means the sale of Registrable Securities to one or more purchasers that are financial institutions in an offering registered under the Securities Act (a) without a prior public marketing process by means of a bought deal or (b) pursuant to an "overnight" underwritten offering.

"Business Day" means any day other than a day on which the SEC is closed.

"Closing Date" means the date of this Agreement.

"Common Stock" means the common stock, par value $0.01 per share, of the Company, and any class or classes of securities issued or issuable with respect to such common stock by way of reclassification, dividend or distribution or in connection with any reorganization or other recapitalization, merger, consolidation or otherwise.

"Company" has the meaning specified therefor in the introductory paragraph of this Agreement and includes any successor thereto.

"CPPIB Holder" means CPP Investment Board Private Holdings (6), Inc., a Canadian corporation, and its Affiliates, when any such Person is a holder or owner of any Registrable Securities.

"CPPIB Holder Group" means, as of any time of determination, all CPPIB Holders at such time.

"Delivery Failure" has the meaning specified therefor in Section 2.8(a) of this Agreement.

"e-mail" has the meaning specified therefore in Section 3.1 of this Agreement.

"FINRA" means the Financial Industry Regulatory Authority, Inc.

"Holder" means the Sellers and their respective Affiliates, when such Person is a holder or owner of any Registrable Securities.

"IKAV Holder" means each of IKAV Impact S.a.r.l., a Luxembourg corporation, Simlog, Inc., a Delaware corporation, and IKAV Energy Inc., a Delaware corporation, and each of their respective Affiliates, when any such Person is a holder or owner of any Registrable Securities.

"IKAV Holder Group" means, as of any time of determination, all IKAV Holders at such time.

"Included Registrable Securities" has the meaning specified therefor in Section 2.2(a) of this Agreement.

"Launch Date" has the meaning specified therefor in Section 2.2(b) of this Agreement.

"Losses" has the meaning specified therefor in Section 2.8(b) of this Agreement.

"Managing Underwriter" means, with respect to any Underwritten Offering or Bought or Overnight Underwritten Offering, the book running lead manager of such Underwritten Offering or Bought or Overnight Underwritten Offering.

"Maximum Number of Securities" has the meaning specified therefor in Section 2.1(c) of this Agreement.

"Maximum Piggyback Number of Securities" has the meaning specified therefor in Section 2.2(b) of this Agreement.

"Member Holder Group" means each of the CPPIB Holder Group, the IKAV Holder Group and the Oaktree Holder Group, singly.

"Merger Agreement" has the meaning specified therefor in the recitals of this Agreement.

"Oaktree Holder" means each of OCM Opps Xb AIF Holdings (Delaware), L.P., a Delaware limited partnership, Oaktree Huntington Investments Fund II AIF, L.P. – Class C, a Delaware limited partnership, OCM XI AIV Holdings (Delaware), L.P., a Delaware limited partnership, and OCM Aera E Holdings, LLC, a Delaware limited liability company, and each of their respective Affiliates, when any such Person is a holder or owner of any Registrable Securities.

"Oaktree Holder Group" means, as of any time of determination, all Oaktree Holders at such time.

"Opt-Out Notice" has the meaning specified therefor in Section 2.2(b) of this Agreement.

"Other Holder" has the meaning specified therefor in Section 2.2(c) of this Agreement.

"Person" means any natural person, corporation, partnership, limited liability company, joint venture, association, joint-stock company, trust, foundation, unincorporated organization or government or other agency or political subdivision thereof.

"Piggyback Offering" has the meaning specified therefor in Section 2.2(a) of this Agreement.

"Primary Selling Holder" has the meaning specified therefor in Section 2.1(b) of this Agreement.

"Registrable Securities" means the Securities, upon original issuance thereof, or any shares or other securities issued in respect of such Registrable Securities because of or in connection with any stock dividend, stock distribution, stock split, purchase in any rights offering or in connection with any exchange for or replacement of such Registrable Securities or any combination of shares, recapitalization, merger or consolidation, or any other equity securities issued pursuant to any other pro rata distribution with respect to the Common Stock or other Registrable Securities, until such time as such securities cease to be Registrable Securities pursuant to Section 1.2 hereof.

"Registration Expenses" has the meaning specified therefor in Section 2.7(a) of this Agreement.

"Rule 144" means Rule 144 promulgated under the Securities Act or any similar rule or regulation hereafter adopted by the SEC having substantially the same effect as such rule.

"SEC" means the U.S. Securities and Exchange Commission (or any successor agency).

"Securities" means the shares of Common Stock issued pursuant to the Merger Agreement.

"Seller" has the meaning specified therefor in the introductory paragraph of this Agreement.

"Selling Expenses" means all underwriting discounts, selling commissions or similar fees or arrangements or stock transfer taxes allocable to the sale of the Registrable Securities, and fees and disbursements of counsel to the Selling Holders, other than those fees and disbursements of counsel required to be paid by the Company pursuant to Section 2.6(a) of this Agreement.

"Selling Holder" means a Holder who is selling Registrable Securities pursuant to a registration statement.

"Selling Holder Indemnified Persons" has the meaning specified therefor in Section 2.8(a) of this Agreement.

"Shelf Registration" has the meaning specified therefor in Section 2.1(a) of this Agreement.

"Shelf Registration Statement" has the meaning specified therefor in Section 2.1(a) of this Agreement.

"Stockholder's Agreement" means, with respect to a Seller, that certain Stockholder's Agreement, dated as of the date hereof, by and between such Seller or its Affiliate and the Company.

"Termination Date" has the meaning specified therefor in Section 3.17 of this Agreement.

"Transfer" means to, directly or indirectly, sell, transfer, assign, pledge, encumber, hypothecate or similarly dispose of, either voluntarily or involuntarily, or to enter into any contract, option or other arrangement or understanding with respect to the sale, transfer, assignment, pledge, encumbrance, hypothecation or similar disposition of, Registrable Securities.

"Underwriter" means a securities dealer who purchases any Registrable Securities as principal in an Underwritten Offering and not as part of such dealer's market-making activities.

"Underwritten Offering" has the meaning specified therefor in Section 2.1(b) of this Agreement.

"Underwritten Offering Filing" has the meaning specified therefor in Section 2.2(a) of this Agreement.

"Underwritten Offering Notice" has the meaning specified therefor in Section 2.1(b) of this Agreement.

"Underwritten Offering Request" has the meaning specified therefor in Section 2.1(b) of this Agreement.

Section 1.2 Registrable Securities. Any Registrable Security will cease to be a Registrable Security when (a) a registration statement covering such Registrable Security becomes or has been declared effective by the SEC and such Registrable Security has been sold or disposed of pursuant to such effective registration statement; (b) such Registrable Security has been disposed of pursuant to any section of Rule 144 under circumstances in which all of the applicable conditions of such Rule (then in effect) are met; or (c) such Registrable Security has been sold or disposed of in a transaction in which the Holders' rights under this Agreement are not transferred or assigned pursuant to Section 3.3 of this Agreement.

ARTICLE II
REGISTRATION RIGHTS

Section 2.1 Shelf Registration.

(a) Registration. The Company shall, as soon as practicable after the Closing Date, but in any event within 20 Business Days after the Closing Date, file a "shelf" registration statement to permit the resale of the Registrable Securities from time to time pursuant to Rule 415 promulgated under the Securities Act (a "Shelf Registration"). The registration statement shall be on Form S-3 or, if Form S-3 is not then available to the Company, on Form S-1 or such other form

of registration statement as is then available to effect a registration for the offer and sale of the Registrable Securities (such registration statement, a "Shelf Registration Statement"). If permitted under the Securities Act, such registration statement shall be one that is automatically effective upon filing and, if such registration is not automatically effective, the Company shall use its commercially reasonable efforts to have such registration statement declared effective as soon as practicable after the filing thereof, but no later than the earlier of (a) the 120th calendar day following the filing date thereof if the SEC notifies the Company that it will "review" such registration statement and (b) the 10th Business Day after the date the Company is notified (orally or in writing, whichever is earlier) by the SEC that the registration statement will not be "reviewed" or will not be subject to further review. Subject to the provision by each Holder of all information reasonably requested by the Company for such purposes, the Company shall use commercially reasonable efforts to cause the Shelf Registration Statement to remain effective, and to be supplemented and amended to the extent necessary to ensure that the Shelf Registration Statement is available or, if not available, that another registration statement is available, for the resale of all the Registrable Securities by the Holders until such time as there are no longer any Registrable Securities; *provided, however,* that, other than in connection with an Underwritten Offering, the Company shall not be required to supplement or amend any registration statement to reflect the transfer to a new or existing Holder except upon request of either Seller and in any event not more than four times in any consecutive 12 months (excluding supplements or amendments in connection with an Underwritten Offering). In the event the Company files a registration statement on Form S-1, the Company shall use its commercially reasonable efforts to convert such registration statement into a registration statement on Form S-3 as soon as practicable after Form S-3 is available to the Company.

(b) Right to Effect Underwritten Offerings. Subject to the provisions hereof, members of the CPPIB Holder Group and IKAV Holder Group shall be entitled, at any time and from time to time when a Shelf Registration Statement is effective and until the Termination Date, to sell all or a portion of such Registrable Securities as are then registered pursuant to such registration statement in an underwritten offering or a Bought or Overnight Underwritten Holder Offering (each, an "Underwritten Offering") upon not less than seven Business Days' prior written notice to the Company (such request, an "Underwritten Offering Request"); *provided*, *however*, that (based on then-current market prices) the number of Registrable Securities included in each such Underwritten Offering would reasonably be expected to yield gross proceeds to the Holders of at least $50,000,000, and *provided further* that each of the CPPIB Holder Group and the IKAV Holder Group shall not be entitled to request an Underwritten Offering (i) more than four times in the aggregate and (ii) more than two times in any single calendar year. As soon as reasonably practicable after receipt by the Company of an Underwritten Offering Request from a Holder (the "Primary Selling Holder") in accordance with this Section 2.1(b), the Company shall give written notice (an "Underwritten Offering Notice") of such Underwritten Offering Request to all other Holders and shall, subject to the provisions of this Article II, use commercially reasonable efforts to include in such Underwritten Offering all Registrable Securities with respect to which the Company received written requests for inclusion therein within five Business Days after such Underwritten Offering Notice is given by the Company to such Holders.

(c) Block Trade. Notwithstanding anything in Section 2.1(b), any member of the CPPIB Holder Group and IKAV Holder Group shall be permitted to request that the Company facilitate a Block Trade, subject to the provisions of this Section 2.1(c) up to two times in any

single calendar year. All requests that the Company facilitate a Block Trade by a member of the applicable Member Holder Group (a "Holder Block Trade") shall be made by giving written notice to the Company (a "Block Trade Notice"). Each Block Trade Notice shall specify the approximate number of Registrable Securities proposed to be sold in the Holder Block Trade and the proposed date of such proposed Holder Block Trade, provided that such date must be at least five Business Days after receipt of the Block Trade Notice. Notwithstanding the foregoing, the Company will not be required to take any action pursuant to this Section 2.1(c) if a Block Trade is not expected to yield aggregate gross proceeds of at least $50,000,000. The Company shall use its commercially reasonable efforts to facilitate each such Block Trade, including, the delivery of customary comfort letters and customary legal opinions, subject to receipt by the Company, its auditors and legal counsel of customary representations and other customary documentation as may be reasonably necessary to permit the delivery of such comfort letters and legal opinions.

(d) Priority on Underwritten Offering. With respect to the registration pursuant to this Section 2.1, the Company may include shares of Common Stock other than Registrable Securities in an Underwritten Offering, subject to the terms provided below. If the Managing Underwriter or Underwriters of any Underwritten Offering advises the Company and the Primary Selling Holder that the total amount of securities that the Selling Holders and any other Persons intend to include in such Underwritten Offering exceeds the number that can be sold in such Underwritten Offering without being likely to have an adverse effect on the price, timing or distribution of the securities offered or the market for such securities (the "Maximum Number of Securities"), then the securities to be included in such Underwritten Offering shall include the number of securities that such Managing Underwriter or Underwriters advises the Company and the Primary Selling Holder can be sold without having such adverse effect, with such number to be allocated: (x) first, to the Registrable Securities proposed to be sold by the Primary Selling Holder in such Underwritten Offering up to the Maximum Number of Securities; (y) second, to the extent that the Maximum Number of Securities has not been reached under clause (x), to the Registrable Securities proposed to be sold by all other Selling Holders in such Underwritten Offering, pro rata based upon the number of Registrable Securities owned by each such Selling Holder at the time of such offering, which can be sold without exceeding the Maximum Number of Securities; and (z) third, to the extent that the Maximum Number of Securities has not been reached under clauses (x) and (y), to the securities to be offered and sold by or on behalf of the Company, which can be sold without exceeding the Maximum Number of Securities.

(e) Selection of Underwriters. If any of the Registrable Securities are to be sold (i) in an Underwritten Offering (excluding a Bought or Overnight Underwritten Holder Offering) initiated by the Holders, the Company shall propose three or more reputable nationally recognized investment banks to act as the Managing Underwriter or Underwriters in connection with such Underwritten Offering from which the Primary Selling Holder shall select the Managing Underwriter or Underwriters, and (ii) in a Bought or Overnight Underwritten Holder Offering, the Primary Selling Holder in such Bought or Overnight Underwritten Holder Offering shall be entitled to select the Underwriter or Underwriters for such Bought or Overnight Underwritten Holder Offering (which shall consist of one or more reputable nationally recognized investment banks). The Primary Selling Holder shall determine the pricing of the Registrable Securities offered pursuant to such Underwritten Offering, the applicable underwriting discounts and commissions, and the timing of any such Underwritten Offering, subject to this Agreement.

(f) Basis of Participation. No Holder may sell Registrable Securities in any offering pursuant to an Underwritten Offering unless it (i) agrees to sell such Registrable Securities on the same basis provided in the underwriting or other distribution arrangements approved by the Company and the Primary Selling Holder that apply to the Company and/or the Primary Selling Holder, as applicable, and (ii) completes and executes all questionnaires, powers of attorney, indemnities, underwriting agreements, lockups and other customary documents as may be reasonably required under the terms of such arrangements; *provided, however,* that no Holder shall be required to make any representations or warranties to the Company or any underwriter (other than representations and warranties regarding such Holder's ownership of its Registrable Securities to be sold or transferred, such Holder's power and authority to effect such transfer, and such matters pertaining to compliance with securities laws as may be reasonably requested by the Company or the underwriters, and such other representations, warranties and other provisions relating to such Holder's participation in such Underwritten Offering as may be reasonably requested by the underwriters) or to undertake any indemnification obligations to the Company with respect thereto, except as otherwise provided in Section 2.8(b) or to the Underwriters with respect thereto.

(g) Delay Rights. Notwithstanding anything to the contrary contained herein, the Company may, upon written notice to the Selling Holders, delay the filing or effectiveness of a registration statement or execution of an Underwritten Offering under this Section 2.1 or, suspend the use of any prospectus which is a part of a registration statement filed under this Section 2.1 (in which event the Selling Holders shall discontinue sales of the Registrable Securities pursuant to such registration statement but such Selling Holder may settle any contracted sales of Registrable Securities) if the Company notifies the Selling Holders in writing that the Company (i) is pursuing a bona fide material acquisition, merger, reorganization, disposition, joint venture, financing or other similar transaction and a majority of the board of directors of the Company (the "Board") determines in its reasonable and good faith discretion that any required disclosure of such transaction in the registration statement would have an adverse effect on any such transaction or (ii) is in possession of material non-public information and a majority of the Board determines in its reasonable and good faith discretion that any required disclosure in the registration statement of such information or event would not be in the best interest of the Company; *provided*, *however*, in no event shall (A) such filing of the registration statement under Section 2.1 be delayed under this Section 2.1(f) for a period that exceeds 90 consecutive days or 120 days in the aggregate, in each case, in any 12-month period, or (B) any Selling Holder be suspended under this Section 2.1(f) or Section 2.3(p) from selling Registrable Securities pursuant to such registration statement for a period that exceeds 90 consecutive days or 120 days in the aggregate, in each case, in any 12-month period. Upon notice by the Company to the Selling Holders of any Board determination to delay the filing of a registration statement under Section 2.1 or suspend the use of any prospectus which is a part of a registration statement filed under Section 2.1, the Selling Holders shall refrain from making offers and sales of Registrable Securities during the pendency of such delay or suspension, keep the fact of any such delay or suspension strictly confidential and not use or disclose such notice or information to any Person other than such Selling Holders' legal counsel or as required by law. If, pursuant to this Section 2.1(f), the Company delays an Underwritten Offering requested by the Holders, the Holders shall be entitled to withdraw such Underwritten Offering Request and, if they do so, such request shall not count against the limitations on the number of such registrations set forth in Section 2.1(b). Upon disclosure of such information or the termination of the condition described above, the Company

shall provide prompt notice to the Selling Holders and shall promptly terminate any suspension of sales it has put into effect and shall take such other actions to permit registered sales of Registrable Securities as contemplated in this Agreement. The Company may only exercise its suspension rights under this Section 2.1 if it exercises similar suspension rights with respect to each other holder of securities that is entitled to registration rights under an agreement with the Company.

Section 2.2 Piggyback Rights.

(a) Participation. Except as provided in Section 2.2(b), if at any time after 180 days following the date of this Agreement, the Company proposes to file (i) a shelf registration statement, (ii) a prospectus supplement to an effective shelf registration statement, and Holders could be included without the filing of a post-effective amendment thereto (other than a post-effective amendment that is immediately effective), or (iii) a registration statement, other than the registration statements contemplated by Section 2.1 of this Agreement, in the case of each of clause (i), (ii) or (iii), for the sale of Common Stock in an Underwritten Offering (other than a Bought or Overnight Underwritten Holder Offering) for its own account and/or the account of another Person, then as soon as reasonably practicable but not less than five Business Days prior to the filing of (A) any preliminary prospectus supplement relating to such Underwritten Offering pursuant to Rule 424(b) under the Securities Act, (B) the prospectus supplement relating to such Underwritten Offering pursuant to Rule 424(b) under the Securities Act (if no preliminary prospectus supplement is used) or (C) such registration statement, as the case may be (an "Underwritten Offering Filing"), the Company shall give notice (including, but not limited to, notification by electronic mail) of such proposed Underwritten Offering (a "Piggyback Offering") to the Holders and such notice shall offer the Holders the opportunity to include in such Underwritten Offering such number of the Registrable Securities (the "Included Registrable Securities") as the Holders may request in writing; *provided*, *however*, that if the Company has been advised by the Managing Underwriter, and the Company has advised the Selling Holders, that the inclusion of Registrable Securities for sale for the benefit of the Selling Holders will have an adverse effect on the price, timing or distribution of the Common Stock in the Underwritten Offering, then the amount of Registrable Securities to be offered for the accounts of Selling Holders shall be determined based on the provisions of Section 2.2(c) of this Agreement. The notice required to be provided in this Section 2.2(a) to the Holders shall be provided on a Business Day pursuant to Section 3.1 hereof. The Holders shall then have four Business Days to request inclusion of Registrable Securities in such Underwritten Offering. If no request for inclusion from the Holders is received within such period, the Holders and their Affiliates shall have no further right to participate in such Underwritten Offering. If, at any time after giving written notice of its intention to undertake an Underwritten Offering and prior to the closing of such Underwritten Offering, the Company or such other Persons who have or have been granted registration rights, as applicable, shall determine for any reason not to undertake or to delay such Underwritten Offering, the Company may, at its election, give written notice of such determination to the Selling Holders and, (x) in the case of a determination not to undertake such Underwritten Offering, shall be relieved of its obligation to sell any Included Registrable Securities in connection with such terminated Underwritten Offering, and (y) in the case of a determination to delay such Underwritten Offering, shall be permitted to delay offering any Included Registrable Securities for the same period as the delay in the Underwritten Offering. A Selling Holder shall have the right to withdraw its request for inclusion of such Selling Holder's Registrable Securities in such offering

by giving written notice to the Company of such withdrawal prior to the filing of the registration statement or prospectus supplement relating to such offering.

(b) Bought or Overnight Underwritten Offering Piggyback Rights. If, at any time after 180 days following the date of this Agreement, the Company or any other Person proposes to file an Underwritten Offering Filing and such Underwritten Offering is a bought Underwritten Offering or is expected to be launched (the "Launch Date") after the close of trading on one trading day and priced before the open of trading on the next succeeding trading day (either such execution format, a "Bought or Overnight Underwritten Offering"), then no later than one Business Day after the Managing Underwriter is engaged for the proposed Bought or Overnight Underwritten Offering, the Company shall notify (including, but not limited to, notice by electronic mail) the Holders of the pendency of the Bought or Overnight Underwritten Offering and such notice shall offer the Holders the opportunity to include in such Bought or Overnight Underwritten Offering such number of Registrable Securities as any Holder may request in writing within one Business Day after the Holders receive such notice; *provided*, that if the Managing Underwriter or Underwriters advises the Company that the giving of notice pursuant to this Section 2.2(b) would adversely affect the Bought or Overnight Underwritten Offering, no such notice shall be required (and the Holders shall have no right to include Registrable Securities in such Bought or Overnight Underwritten Offering). The notice required to be provided in this Section 2.2(b) to the Holders shall be provided on a Business Day pursuant to Section 3.1 hereof. The Holders shall then have two Business Days to request inclusion of Registrable Securities in the Bought or Overnight Underwritten Offering. If no request for inclusion from the Holders is received within such period, the Holders and their Affiliates shall have no further right to participate in such Underwritten Offering. If, at any time after giving written notice of such Bought or Overnight Underwritten Offering pursuant to this Section 2.2(b) and prior to the execution of the underwriting agreement or purchase agreement for such Bought or Overnight Underwritten Offering, the Company or the applicable Person initiating such Bought or Overnight Underwritten Offering determines for any reason not to undertake or to delay such Bought or Overnight Underwritten Offering, the Company shall give written notice of such determination to the Selling Holders and, (i) in the case of a determination not to undertake such Bought or Overnight Underwritten Offering, shall be relieved of its obligation to sell any Registrable Securities held by the Selling Holders in connection with such abandoned or delayed Bought or Overnight Underwritten Offering, and (ii) in the case of a determination to delay such Bought or Overnight Underwritten Offering, shall be permitted to delay offering any Registrable Securities held by the Selling Holders for the same period as the delay of the Bought or Overnight Underwritten Offering. Each Selling Holder shall have the right to withdraw its request for inclusion of such Selling Holder's Registrable Securities in such Bought or Overnight Underwritten Offering by giving written notice to the Company of such withdrawal at least one Business Day prior to execution of the underwriting agreement or purchase agreement for such Bought or Overnight Underwritten Offering. Notwithstanding the foregoing, a Holder may deliver a written notice (an "Opt-Out Notice") to the Company requesting that such Holder not receive notice from the Company of any proposed Piggyback Offering; *provided, however,* that such Holder may later revoke such Opt-Out Notice in writing. Following receipt of such Opt-Out Notice from a Holder (unless subsequently revoked), the Company shall not deliver any notice to such Holder pursuant to this Section 2.2 and such Holder shall not be entitled to participate in any such Piggyback Offering pursuant to this Section 2.2.

(c) Priority of Rights. In connection with an Underwritten Offering contemplated by Section 2.2(a) or Section 2.2(b), as applicable, if the Managing Underwriter or Underwriters of any such Underwritten Offering or advises the Company, and the Company advises the Selling Holders in writing, that the total amount of Common Stock that the Selling Holders and any other Persons intend to include in such Underwritten Offering exceeds the number that can be sold in such Underwritten Offering without being likely to have an adverse effect on the price, timing or distribution of the Common Stock offered or the market for the Common Stock (the "Maximum Piggyback Number of Securities"), then the Common Stock to be included in such Underwritten Offering shall include the number of Registrable Securities that such Managing Underwriter or Underwriters advises the Company can be sold without having such adverse effect, with such number to be allocated (i) first, to the shares of Common Stock proposed to be sold by the Company or such other Person that has requested such registration, filing or offering, as the case may be, up to the Maximum Piggyback Number of Securities; (ii) second, to the extent the Maximum Piggyback Number of Securities has not been reached under clause (i), to the Registrable Securities proposed to be included in such Underwritten Offering by the other Selling Holders, pro rata among such Selling Holders based on the number of Registrable Securities owned by such Selling Holder at the time of such offering, which can be sold without exceeding the Maximum Piggyback Number of Securities; and (iii) third, to the extent the Maximum Piggyback Number of Securities has not been reached under clauses (i) and (ii), to the shares of Common Stock proposed to be included in such Underwritten offering by any other holders of shares of Common Stock having rights of registration with respect to such shares ("Other Holders") who have requested participation in such Underwritten Offering, pro rata among such Other Holders based on the number of shares of Common Stock owned by such Other Holder at the time of such offering, which can be sold without exceeding the Maximum Piggyback Number of Securities.

(d) At-the-Market Offerings. Notwithstanding anything in this Section 2.2 to the contrary, no Holder shall have any right to include any securities in any offering by the Company of securities executed pursuant to any "at the market" program that the Company may have in effect from time to time on or after the date of this Agreement.

Section 2.3 Registration Procedures. In connection with its obligations under this Article II, the Company (or the applicable Selling Holder in the case of Section 2.3(p)), will:

(a) prepare and file with the SEC, and use its commercially reasonable efforts to cause to be declared or become effective as soon as reasonably practicable, each registration statement contemplated by this Agreement with respect to all Registrable Securities as provided herein, and make all required filings with FINRA; *provided*, *that*, upon the occurrence of any event that would cause any registration statement or the prospectus contained therein to contain a material misstatement or omission, the Company shall file an appropriate amendment to the registration statement, a supplement to the prospectus, or a report filed with the SEC pursuant to Section 13(a), 14 or 15(d) of the Exchange Act, correcting any such misstatement or omission, and the Company shall use its commercially reasonable efforts to cause such amendment to be declared or become effective and the registration statement and the related prospectus to become usable for their intended purposes as soon as reasonably practicable thereafter;

(b) (i) prepare and file with the SEC such amendments and supplements to each registration statement and the prospectus used in connection therewith as may be necessary to

cause the registration statement to be effective and as may be necessary to comply with the provisions of the Securities Act with respect to the disposition of all securities covered by the registration statement; and (ii) if a prospectus supplement will be used in connection with the marketing of an Underwritten Offering or Bought or Overnight Underwritten Offering from a registration statement contemplated by this Agreement and the Managing Underwriter at any time shall notify each Selling Holder that, in the reasonable judgment of such Managing Underwriter, inclusion of detailed information to be used in such prospectus supplement is of material importance to the success of the Underwritten Offering or Bought or Overnight Underwritten Offering of such Registrable Securities, or if such information is required by applicable law (including the rules and regulations of the SEC), include such information in a prospectus supplement; *provided*, *that*, before filing any registration statement, prospectus or any amendments or supplements thereto the Company shall provide reasonable advance notice thereof to each Selling Holder and, if requested, furnish a reasonable opportunity to review copies of all such documents (including copies of any documents to be incorporated by reference therein and all exhibits thereto) proposed to be filed (in each case at least three Business Days prior to such filing or, in the case of documents filed in connection with an Bought or Overnight Underwritten Offering, at least one Business Day), and the Company shall not file any such registration statement or prospectus or any amendments or supplements thereto in respect of which a Selling Holder has provided or must provide information for the inclusion therein without such Selling Holder being afforded an opportunity to review such documentation;

(c) furnish to each Selling Holder such number of copies of the registration statement and the prospectus included therein and any supplements and amendments thereto as the Selling Holders may reasonably request in order to facilitate the public sale or other disposition of the Registrable Securities covered by the registration statement;

(d) if applicable, use its commercially reasonable efforts to register or qualify the Registrable Securities covered by any registration statement contemplated by this Agreement under the securities or blue sky laws of such jurisdictions as a Selling Holder or, in the case of an Underwritten Offering or Bought or Overnight Underwritten Offering, the Managing Underwriter, shall reasonably request, to use its commercially reasonable efforts to keep such registration or qualification in effect for so long as such registration statement remains in effect, and to take any other action which may be reasonably necessary or advisable to enable each Selling Holder to consummate the disposition in such jurisdictions of the securities owned by such Selling Holder, *provided, that*, the Company will not be required to qualify generally to transact business in any jurisdiction where it is not then required to so qualify, subject itself to taxation in any jurisdiction where it is not then taxed, or to take any action which would subject it to general service of process in any such jurisdiction where it is not then so subject;

(e) promptly notify each Selling Holder and each underwriter of Registrable Securities, at any time when a prospectus relating thereto is required to be delivered under the Securities Act, of (i) the filing of any registration statement contemplated by this Agreement or any prospectus or prospectus supplement to be used in connection therewith, or any amendment or supplement thereto, and, with respect to such registration statement or any post-effective amendment thereto contemplated by this Agreement, when the same has become effective; and (ii) receipt of any written comments from the SEC with respect to any filing referred to in clause

(i) and any written request by the SEC for amendments or supplements to any registration statement contemplated by this Agreement or any prospectus or prospectus supplement thereto;

(f) promptly notify each Selling Holder and each underwriter of Registrable Securities, at any time when a prospectus relating thereto is required to be delivered under the Securities Act, of (i) the happening of any event as a result of which the prospectus or prospectus supplement contained in any registration statement contemplated by this Agreement or any post-effective amendment thereto, as then in effect, includes an untrue statement of a material fact or omits to state any material fact required to be stated therein or necessary to make the statements therein, in the light of the circumstances under which they were made, not misleading; (ii) the issuance by the SEC of any stop order suspending the effectiveness of any registration statement contemplated by this Agreement, or the initiation of any proceedings for that purpose; or (iii) the receipt by the Company of any notification with respect to the suspension of the qualification of any Registrable Securities for sale under the applicable securities or blue sky laws of any jurisdiction. Following the provision of such notice, the Company agrees to, as promptly as reasonably practicable, amend or supplement the prospectus or prospectus supplement or take other appropriate action so that the prospectus or prospectus supplement does not include an untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein, in the light of the circumstances under which they were made, not misleading, and to use its commercially reasonable efforts to take such other action as is necessary to remove a stop order, suspension, threat thereof or proceedings related thereto;

(g) furnish to each Selling Holder copies of any and all transmittal letters or other correspondence with the SEC or any other governmental agency or self-regulatory body or other body having jurisdiction (including any domestic or foreign securities exchange) relating to such offering of Registrable Securities or any such registration statement relating to the offering of Registrable Securities;

(h) in the case of an Underwritten Offering or Bought or Overnight Underwritten Offering, use its commercially reasonable efforts to furnish, or cause to be furnished, upon request and addressed to the underwriters, placement agents or sales agents, as applicable, and to the Selling Holders, (i) an opinion and negative assurance letter of counsel for the Company, dated the effective date of the applicable registration statement or the date of any amendment or supplement thereto, and an opinion and letter of like kind dated the date of the closing under the underwriting agreement, and (ii) a "comfort letter," dated the effective date of the applicable registration statement or the date of any amendment or supplement thereto and a letter of like kind dated the date of the closing under the underwriting agreement or other purchase or sales agreement, in each case, signed by the independent public accountants (and, if applicable, independent reserve engineers who have certified the Company's financial statements (or prepared or reviewed or audited, as applicable, oil and gas reserves) included or incorporated by reference into the applicable registration statement), and each such opinion and "comfort letter" shall be in customary form and cover substantially the same matters with respect to such registration statement (and the prospectus and any prospectus supplement included therein) as are customarily covered in opinions of issuer's counsel and in accountants' (and, if applicable, independent reserve engineers') letters delivered to the underwriters in Underwritten Offerings or Bought or Overnight Underwritten Offerings of securities, and such other matters as such underwriters or placement or sales agents or a Selling Holder may reasonably request;

(i) otherwise use its commercially reasonable efforts to comply with all applicable rules and regulations of the SEC, and make available to its security holders, as soon as reasonably practicable, an earnings statement covering the period of at least 12 months, but not more than 18 months, beginning with the first full calendar month after the effective date of such registration statement, which earnings statement shall satisfy the provisions of Section 11(a) of the Securities Act and Rule 158 promulgated thereunder;

(j) make available to the appropriate representatives of the Managing Underwriter and the Selling Holders access to such information and the Company personnel as is reasonable and customary to enable such parties to establish a due diligence defense under the Securities Act; *provided*, *that*, the Company need not disclose any information to any such representative unless and until such representative has entered into a confidentiality agreement with the Company;

(k) use its commercially reasonable efforts to cause all Registrable Securities registered pursuant to this Agreement to be listed on each securities exchange or nationally recognized quotation system on which similar securities issued by the Company are then listed or quoted;

(l) use its commercially reasonable efforts to cause the Registrable Securities to be registered with or approved by such other governmental agencies or authorities as may be necessary by virtue of the business and operations of the Company to enable the Selling Holders to consummate the disposition of such Registrable Securities;

(m) provide and cause to be maintained a transfer agent and registrar for all Registrable Securities covered by such registration statement not later than the effective date of such registration statement;

(n) enter into customary agreements and use its commercially reasonable efforts to take such other actions as are reasonably requested by the Selling Holders or the underwriters or placement or sales agents, if any, in order to expedite or facilitate the disposition of such Registrable Securities and entry of such Registrable Securities in book-entry with The Depository Trust Company (including, making appropriate officers of the Company available to participate in any "road show" presentations before analysts and other customary marketing activities (including one on one meetings with prospective purchasers of the Registrable Securities));

(o) use its commercially reasonable efforts to cause the Registrable Securities to be initially represented by direct registration with the Company's transfer agent and provide a CUSIP number for all Registrable Securities and, in connection therewith, if reasonably required by the Company's transfer agent, the Company shall promptly deliver any authorizations, certificates and directions required by the transfer agent which authorize and direct the transfer agent to issue such Registrable Securities without legend upon sale by the holder of such shares of Registrable Securities under a shelf registration statement or any other registration statement contemplated by this Agreement;

(p) each Selling Holder, upon receipt of notice from the Company of the happening of any event of the kind described in subsection (f) of this Section 2.3, shall forthwith discontinue disposition of the Registrable Securities until such Selling Holder's receipt of the copies of the supplemented or amended prospectus contemplated by subsection (f) of this Section 2.3 or until it is advised in writing by the Company that the use of the prospectus may be resumed, and has received copies of any additional or supplemental filings incorporated by reference in the prospectus, and, if so directed by the Company, such Selling Holder will, or will request the Managing Underwriter or Underwriters, if any, to deliver to the Company (at the Company's expense) all copies in their possession or control, other than permanent file copies then in such Selling Holder's possession, of the prospectus covering such Registrable Securities current at the time of receipt of such notice;

(q) if requested by a Selling Holder, (i) as soon as reasonably practicable incorporate in a prospectus supplement or post-effective amendment such information as a Selling Holder reasonably requests to be included therein relating to the sale and distribution of Registrable Securities, including information with respect to such Holder or any subsequent Holder, the number of Registrable Securities being offered or sold, the purchase price being paid therefor and any other terms of the offering of the Registrable Securities to be sold in such offering; (ii) as soon as reasonably practicable make all required filings of such prospectus supplement or post-effective amendment after being notified of the matters to be incorporated in such prospectus supplement or post-effective amendment; and (iii) as soon as reasonably practicable, supplement or make amendments to the registration statement; and

(r) use its commercially reasonable efforts to take all other steps reasonably necessary to effect the registration of, and facilitate the disposition of, the Registrable Securities contemplated hereby.

Section 2.4 Cooperation by Holders. The Company shall have no obligation to include in any registration statement contemplated by this Agreement any Registrable Securities of a Holder who has failed to timely furnish such information that the Company, based on the advice of counsel, determines is reasonably required to be furnished or confirmed in order for the registration statement or prospectus supplement thereto, as applicable, to comply with the Securities Act.

Section 2.5 Restrictions on Public Sale by Holders of Registrable Securities. Each Holder of Registrable Securities participating in an Underwritten Offering or Bought or Overnight Underwritten Offering of equity securities by the Company agrees, if requested by such Managing Underwriter or Underwriters with respect to such Underwritten Offering or Bought or Overnight Underwritten Offering such Holder is participating in, not to effect any public sale or distribution of the Registrable Securities for a period of up to 90 days following completion of such Underwritten Offering or Bought or Overnight Underwritten Offering, as applicable, *provided* that (i) the Company gives written notice to the Holders of the date of the commencement and termination of such period with respect to any such Underwritten Offering or Bought or Overnight Underwritten Offering and (ii) the duration of the foregoing restrictions shall be no longer than the duration of the shortest restriction generally imposed by the underwriters of such public sale or distribution on the Company or on the officers or directors or any other shareholder of the Company on whom a restriction is imposed; *provided further*, that this Section 2.5 shall not apply

to a Holder that, together with its Affiliates, Beneficially Owns less than 7.5% of the issued and outstanding shares of Common Stock at the time of the offering unless such Holder (or its Affiliate) has the right to nominate a member of the Board and has not waived such right under the applicable Stockholder's Agreement. Without limiting the generality of the foregoing, (a) no Holder participating in such offering shall be required to sign a lock-up agreement that contains restrictions that are more restrictive than the restrictions contained in the lock-up agreements executed by any other holder of Common Stock participating in such offering, and (b) each Holder shall be released, pro rata, from any lock-up agreement entered into pursuant to this Section 2.5 in the event and to the extent that the Managing Underwriter or the Company permit any discretionary waiver or termination of the restrictions of any lock-up agreement pertaining to any officer, director or participating holder of Common Stock.

Section 2.6 Transfer Restrictions.

(a) Subject to Section 2.6(b) and (c), each Holder agrees that, without the prior written consent of the Company, such Holder shall not Transfer all or any part of the Registrable Securities or any right or economic interest pertaining thereto, including the right to vote or consent on any matter or to receive or have any economic interest in dividends from the Company pursuant thereto (the "Lock-up Restriction"); *provided*, *however*, that the Lock-up Restriction shall not apply with respect to any Transfer to general partners, limited partners, members or stockholders of any such Holder, or to any corporation, partnership, limited liability company, investment fund or other entity that controls or manages or is controlled or managed by any such Holder or its Affiliates, or to any Affiliate under common control or management with any such Holder other than, in each case, a portfolio company of a Holder or any of its Affiliates, provided that, as a condition to the effectiveness of such Transfer, (i) such transferee agrees in writing, for the benefit of the Company, to be bound by the terms of this Agreement applicable to such Holder and (ii) the Company is given written notice prior to any such Transfer, stating the name and address of each such transferee and identifying the Securities to be Transferred.

(b) The Lock-up Restriction shall cease to apply to the Registrable Securities as follows:

(i) on and after the six-month anniversary of the date hereof, the members of each Member Holder Group may Transfer up to 1/3 of the total number of Registrable Securities in the aggregate (rounded up to the nearest whole Registrable Security) Beneficially Owned by such Member Holder Group as of the date hereof;

(ii) on and after the 12-month anniversary of the date hereof, the members of each Member Holder Group may Transfer up to 2/3 of the total number of Registrable Securities in the aggregate (rounded up to the nearest whole Registrable Security), minus the total number of Registrable Securities Transferred by the members of such Member Holder Group pursuant to Section 2.6(b)(i), Beneficially Owned by such Member Holder Group as of the date hereof; and

(iii) on and after the 18-month anniversary of the date hereof, the Lock-up Restriction shall no longer apply and each Holder may Transfer all of the total number of Securities Beneficially Owned by such Holder as of the date hereof.

(c) Notwithstanding the foregoing, the Lock-up Restriction shall not apply to, and nothing in the foregoing shall restrict or prohibit any Holder or any of its Affiliates from, any of the following:

(i) any Transfer in connection with the completion of a liquidation, stock exchange or other similar transaction that results in all of the Company's securityholders having the right to exchange their shares of Common Stock for cash, securities or other property;

(ii) Transferring Registrable Securities to the Company pursuant to agreements under which the Company has the option to repurchase such Securities or pursuant to a share repurchase program approved by the Board;

(iii) engaging in hedging or other transactions or arrangements, in each case, concerning a broad-based index or basket of securities that may involve shares of Common Stock of the Company but do not otherwise involve the Transfer of any Registrable Securities Beneficially Owned by a Holder and would not require any filing by any Holder under the Securities Exchange Act of 1934, as amended, with respect to the Common Stock Beneficially Owned by such Holder; or

(iv) Transferring Registrable Securities by operation of law or pursuant to a final order of a court or regulatory agency.

(d) Any purported Transfer in violation of this Section 2.6 shall be null and void *ab initio*.

Section 2.7 Expenses.

(a) Certain Definitions. "Registration Expenses" means all expenses incident to the Company's performance under or compliance with this Agreement to effect the registration of Registrable Securities on any registration statement, prospectus or prospectus supplement or amendment or supplement contemplated by this Agreement, an Underwritten Offering or Bought or Overnight Underwritten Offering covered under this Agreement, and/or the disposition of such securities, including, without limitation, all registration, filing, securities exchange listing fees, all registration, filing, qualification and other fees and expenses of complying with securities or blue sky laws, fees of FINRA and fees of transfer agents and registrars, all word processing, duplicating and printing expenses, and the reasonable and documented fees and disbursements of (x) one counsel to the CPPIB Holder Group, one counsel to the IKAV Holder Group and one counsel to the Oaktree Holder Group, in each case, to the extent such Member Holder Group is participating in such registration statement or offering, and (y) counsel and independent public accountants (and, if applicable, independent reserve engineers) for the Company, including the expenses of any legal opinions or letters, special audits or "comfort letters" required by or incident to such performance and compliance.

(b) Expenses. The Company will pay all Registration Expenses as determined in good faith, including, in the case of an Underwritten Offering or Bought or Overnight Underwritten Offering, whether or not any sale is made pursuant to a registration statement; *provided* that Selling Holders shall pay any and all applicable Selling Expenses.

Section 2.8 Indemnification.

(a) By the Company. In the event of a registration of any Registrable Securities under the Securities Act pursuant to this Agreement, the Company shall indemnify and hold harmless each Selling Holder thereunder, its Affiliates and their respective directors, officers, managers, employees and agents and each Underwriter pursuant to the applicable underwriting agreement with such Underwriter and each Person, if any, who controls such Selling Holder or Underwriter within the meaning of the Securities Act and the Exchange Act and its directors, officers, employees and agents (collectively, the "Selling Holder Indemnified Persons"), against any losses, claims, damages, expenses or liabilities (including reasonable attorneys', accountants' and experts' fees and expenses) (collectively, "Losses"), joint or several, to which such Selling Holder Indemnified Person may become subject under the Securities Act, the Exchange Act or otherwise, insofar as such Losses (or actions or proceedings, whether commenced or threatened, in respect thereof) arise out of or are based upon (i) any untrue statement or alleged untrue statement of any material fact contained in any registration statement contemplated by this Agreement, any preliminary prospectus, prospectus supplement, free writing prospectus (or roadshow or other similar marketing material) or final prospectus, or any amendment or supplement thereof, or (ii) the omission or alleged omission to state therein a material fact required to be stated therein or necessary to make the statements therein (in the case of a prospectus, in the light of the circumstances under which they were made) not misleading, and will reimburse each such Selling Holder Indemnified Person for any legal or other expenses reasonably incurred by them in connection with investigating or defending any such Loss or actions or proceedings; *provided*, *however*, that the Company will not be liable in any such case if and to the extent that any such Loss arises out of or is based upon an untrue statement or alleged untrue statement or omission or alleged omission so made in strict conformity with information furnished by such Selling Holder Indemnified Person in writing specifically for use in a registration statement or any prospectus contained therein or any amendment or supplement thereof; and *provided*, *further*, that the Company will not be liable to any Selling Holder Indemnified Person with respect to any preliminary prospectus or the final prospectus (including any amended or supplemented preliminary or final prospectus), as the case may be, to the extent that any such Loss of such Selling Holder Indemnified Person results from the fact that such Selling Holder Indemnified Person did not send or give, at or prior to the written confirmation of the applicable sale of Registrable Securities, a copy of the final prospectus as then amended or supplemented, whichever is most recent, if the Company has previously furnished copies thereof to such Selling Holder Indemnified Person and such final prospectus, as then amended or supplemented, has corrected any such misstatement or omission (such failure to send or deliver, a "Delivery Failure"). Such indemnity shall remain in full force and effect regardless of any investigation made by or on behalf of such Selling Holder Indemnified Person and shall survive the transfer of such securities by the applicable Selling Holder.

(b) By Each Selling Holder. Each Selling Holder agrees severally and not jointly to indemnify and hold harmless the Company, its directors and officers, and each Person, if any, who controls the Company (a "Company Indemnified Person") within the meaning of the Securities Act or of the Exchange Act against (i) any Losses to the same extent as the foregoing indemnity from the Company to the Selling Holders, but only with respect to information regarding such Selling Holder furnished in writing by or on behalf of such Selling Holder expressly for inclusion in any registration statement contemplated by this Agreement or any prospectus

contained therein or any amendment or supplement thereof relating to the Registrable Securities and (ii) any Losses of such Company Indemnified Person resulting from any Delivery Failure on the part of such Selling Holder; *provided*, *however*, that the indemnity agreement contained in this Section 2.8(b) shall not apply to amounts paid in settlement of any claim if such settlement is effected without the prior written consent of the Selling Holder, which consent shall not be unreasonably withheld or delayed; and *provided*, *further* that the liability of each Selling Holder shall not be greater in amount than the dollar amount of the proceeds (net of any Selling Expenses) received by such Selling Holder from the sale of the Registrable Securities giving rise to such indemnification.

(c) Notice. Promptly after receipt by an indemnified party hereunder of notice of the commencement of any action, such indemnified party shall, if a claim in respect thereof is to be made against the indemnifying party hereunder, notify the indemnifying party in writing thereof, but such indemnified party's failure to so notify the indemnifying party shall not relieve the indemnifying party from any liability which it may have to any indemnified party other than under this Section 2.8 except to the extent it has been materially prejudiced (through the forfeiture of substantive rights or defenses) by such failure. In any action brought against any indemnified party, it shall notify the indemnifying party of the commencement thereof; *provided*, *however*, that the failure to notify the indemnifying party shall not relieve it from any liability that it may have under this Section 2.8 except to the extent it has been materially prejudiced (through the forfeiture of substantive rights or defenses) by such failure. The indemnifying party shall be entitled to participate in and, to the extent it shall wish, to assume and undertake the defense thereof with counsel reasonably satisfactory to such indemnified party and, after notice from the indemnifying party to such indemnified party of its election so to assume and undertake the defense thereof, the indemnifying party shall not be liable to such indemnified party under this Section 2.8 for any legal expenses subsequently incurred by such indemnified party in connection with the defense thereof other than reasonable costs of investigation and of liaison with counsel so selected; *provided*, *however*, that, (i) if the indemnifying party has failed to assume the defense and employ counsel reasonably acceptable to the indemnified party or (ii) if the defendants in any such action include both the indemnified party and the indemnifying party and counsel to the indemnified party shall have concluded that there may be reasonable defenses available to the indemnified party that are different from or additional to those available to the indemnifying party, or if the interests of the indemnified party reasonably may be deemed to conflict with the interests of the indemnifying party, then the indemnified party shall have the right to select one separate counsel and to assume such legal defense and otherwise to participate in the defense of such action, with the reasonable expenses and fees of one such separate counsel (firm) and other reasonable expenses related to such participation to be reimbursed by the indemnifying party as incurred. Notwithstanding any other provision of this Agreement, no indemnified party shall settle any action brought against it with respect to which it is entitled to indemnification hereunder without the consent of the indemnifying party, in its sole discretion, unless the settlement thereof imposes no liability or obligation on, and includes a complete and unconditional release from all liability of, the indemnifying party.

(d) Contribution. If the indemnification provided for in this Section 2.8 is held by a court or government agency of competent jurisdiction to be unavailable to the Company or any Selling Holder Indemnified Person or is insufficient to hold it harmless in respect of any Losses, then each such indemnifying party, in lieu of indemnifying such indemnified party, shall

contribute to the amount paid or payable by such indemnified party as a result of such Losses as between the Company, on the one hand, and such Selling Holder Indemnified Person, on the other hand, in such proportion as is appropriate to reflect the relative fault of the Company, on the one hand, and of such Selling Holder Indemnified Person, on the other, in connection with the statements or omissions which resulted in such Losses, as well as any other relevant equitable considerations; *provided*, *however*, that in no event shall any Selling Holder be required to contribute an aggregate amount in excess of the dollar amount of proceeds (net of any Selling Expenses) received by any Selling Holder from the sale of Registrable Securities giving rise to such indemnification. The relative fault of the Company, on the one hand, and each Selling Holder Indemnified Person, on the other hand, shall be determined by reference to, among other things, whether the untrue or alleged untrue statement of a material fact or the omission or alleged omission to state a material fact has been made by, or relates to, information supplied by such party, and the parties' relative intent, knowledge, access to information and opportunity to correct or prevent such statement or omission. The parties hereto agree that it would not be just and equitable if contributions pursuant to this paragraph were to be determined by pro rata allocation or by any other method of allocation which does not take account of the equitable considerations referred to in the first sentence of this paragraph. The amount paid by an indemnified party as a result of the Losses referred to in the first sentence of this paragraph shall be deemed to include any legal and other expenses reasonably incurred by such indemnified party in connection with investigating or defending any Loss which is the subject of this paragraph. No person guilty of fraudulent misrepresentation (within the meaning of Section 11(f) of the Securities Act) shall be entitled to contribution from any Person who is not guilty of such fraudulent misrepresentation.

(e) Other Indemnification. The provisions of this Section 2.8 shall be in addition to any other rights to indemnification or contribution which an indemnified party may have pursuant to law, equity, contract or otherwise.

Section 2.9 Rule 144 Reporting. With a view to making available the benefits of certain rules and regulations of the SEC that may permit the sale of the Registrable Securities to the public without registration, the Company agrees to use its commercially reasonable efforts to:

(a) make and keep public information regarding the Company available, as those terms are understood and defined in Rule 144, at all times from and after the Closing Date until there are no Registrable Securities outstanding;

(b) file with the SEC in a timely manner all reports and other documents required of the Company under the Securities Act and the Exchange Act at all times from and after the Closing Date until there are no Registrable Securities outstanding;

(c) so long as a Holder owns any Registrable Securities, furnish to such Holder forthwith upon request a copy of the most recent annual or quarterly report of the Company, and such other reports and documents so filed as such Holder may reasonably request in availing itself of any rule or regulation of the SEC allowing such Holder to sell any such securities without registration; and

(d) take such further action as any Holder may reasonably request to enable the Holders to sell Registrable Securities without registration under the Securities Act within the

limitations of the exemption provided by Rule 144, including, without limitation, delivering customary legal opinions, consents, certificates, resolutions and instructions to the Company's transfer agent without unreasonable delay, and in each case as may be reasonably requested from time to time by the Holder, and otherwise use commercially reasonable efforts to cooperate with Holder and Holder's broker in their efforts to effect such sale of securities pursuant to Rule 144.

Section 2.10 Information by Holder. Any Holder or Holders of Registrable Securities included in any registration statement shall promptly furnish to the Company such information regarding such Holder or Holders and the distribution proposed by such Holder or Holders as the Company may reasonably request and as shall be required in connection with any registration, qualification or compliance referred to herein.

Section 2.11 No Inconsistent Agreements; Limitation on Subsequent Registration Rights. The Company has not entered, as of the date hereof, and the Company shall not enter, after the date of this Agreement, into any agreement with respect to any of its securities that is inconsistent with the rights granted to the Sellers in this Agreement. From and after the date of this Agreement until there are no Registrable Securities outstanding, the Company shall not, without the prior written consent of the Holders of a majority of the then outstanding Registrable Securities held by each Member Holder Group, (i) enter into any agreement with any current or future holder of any securities of the Company that would allow such current or future holder to require the Company to include securities in any Piggyback Offering on a basis that is *pari passu* with or superior in any respect to the Piggyback Offering rights granted to the Holders pursuant to Section 2.2 of this Agreement, or (ii) enter into any agreement, take any action or permit any change to occur with respect to its securities that subordinates, conflicts with, or would impair the rights granted to the Holders pursuant to, and subject to any conditions or limitations thereon contained in, this Agreement.

ARTICLE III
MISCELLANEOUS

Section 3.1 Notices. All notices, requests and other communications to any party under, or otherwise in connection with, this Agreement shall be in writing and shall be deemed to have been duly given (a) if delivered in person; (b) if transmitted by electronic mail ("e-mail") (but only if confirmation of receipt of such e-mail is requested and received; *provided*, *that*, each notice party shall use reasonable best efforts to confirm receipt of any such email correspondence promptly upon receipt of such request); or (c) if transmitted by national overnight courier, in each case as addressed as follows:

If to the Company, to:

California Resources Corporation
1 World Trade Center, Suite 1500
Long Beach, California 90831
Attn: Michael L. Preston
Email: michael.preston@crc.com

With a copy to (which copy shall not constitute notice):

Sullivan & Cromwell LLP
1888 Century Park East
Los Angeles, California 90067-1725
Attn: Alison S. Ressler; Bradley S. King
E-mail: resslera@sullcrom.com; kingbrad@sullcrom.com

If to the Sellers, to:

[*insert address*]
Attn:
Email:

With a copy to (which copy shall not constitute notice):

Latham & Watkins LLP
1271 Avenue of the Americas
New York, New York 10020
Attn: David S. Allinson; Thomas G. Brandt
E-mail: david.allinson@lw.com; thomas.brandt@lw.com

solely with respect to notices provided to any Oaktree Holder, to:

Kirkland & Ellis LLP
609 Main Street
Houston, TX 77002
Attention: Jhett R. Nelson, P.C.; Adam Garmezy
E-Mail: jhett.nelson@kirkland.com; adam.garmezy@kirkland.com

or, if to a transferee of a Holder, to the transferee at the address specified pursuant to Section 3.3 below. All notices and communications shall be deemed to have been duly given: (i) at the time delivered by hand, if personally delivered; (ii) when notice is sent to the sender that the recipient has read the message, if sent by electronic mail; (iii) upon actual receipt if sent by registered or certified mail, return receipt requested, or regular mail, if mailed; and (iv) upon actual receipt when delivered to an air courier guaranteeing overnight deliver.

Section 3.2 Successors and Assigns. This Agreement shall inure to the benefit of and be binding upon the permitted successors and assigns of each of the parties, including subsequent Holders of Registrable Securities to the extent permitted herein.

Section 3.3 Assignment of Rights. All or any portion of the rights and obligations of any Holder under this Agreement may be transferred or assigned by such Holder only in accordance with this Section 3.3. The rights to cause the Company to include Registrable Securities in any registration statement contemplated by this Agreement may be transferred or assigned by any Holder with a transfer of Registrable Securities to any Affiliate of such Holder that is not a portfolio company; *provided*, that (a) the Company is given written notice prior to any said transfer or assignment, stating the name and address of each such transferee and identifying the securities with respect to which such registration rights are being transferred or assigned and (b) as a condition to the effectiveness of such transfer, each such transferee or assignee assumes in

writing responsibility for its portion of the obligations of such Holder under this Agreement. The Company may not transfer or assign any portion of its rights and obligations under this Agreement without the prior written consent of the Holders of at least a majority of the outstanding Registrable Securities, except that the Company may assign this Agreement at any time in connection with a sale or acquisition of the Company, whether by merger, consolidation, sale of all or substantially all of the Company's assets, or similar transaction.

Section 3.4 Recapitalization Affecting the Stock. The Company agrees that it shall not effect or permit to occur any combination or subdivision of shares of Common Stock or other securities constituting Registrable Securities which would adversely affect the ability of any Holder of any Registrable Securities to include such Registrable Securities in any registration contemplated by this Agreement or the marketability of such Registrable Securities in any such registration.

Section 3.5 Specific Performance. The parties agree that irreparable damage, for which monetary damages would not be an adequate remedy, would occur in the event that any of the provisions of this Agreement were not performed in accordance with their specific terms or were otherwise breached by the parties. Prior to the termination of this Agreement pursuant to Section 3.17, it is accordingly agreed that the parties shall be entitled to an injunction or injunctions, or any other appropriate form of specific performance or equitable relief, to prevent breaches of this Agreement and to enforce specifically the terms and provisions hereof in any court of competent jurisdiction, in each case in accordance with this Section 3.5, this being in addition to any other remedy to which they are entitled under the terms of this Agreement at law or in equity. Each party accordingly agrees not to raise any objections to the availability of the equitable remedy of specific performance to prevent or restrain breaches or threatened breaches of, or to enforce compliance with, the covenants and obligations of such party under this Agreement all in accordance with the terms of this Section 3.5. Each party further agrees that no other party or any other Person shall be required to obtain, furnish or post any bond or similar instrument in connection with or as a condition to obtaining any remedy referred to in this Section 3.5, and each party irrevocably waives any right it may have to require the obtaining, furnishing or posting of any such bond or similar instrument.

Section 3.6 Counterparts. This Agreement may be executed in two or more counterparts, including via facsimile or email in "portable document format" (".pdf") form transmission, all of which shall be considered one and the same agreement and shall become effective when two or more counterparts have been signed by each of the parties and delivered to the other parties, it being understood that all parties need not sign the same counterpart.

Section 3.7 Rules of Construction.

(a) Each of the parties acknowledges that it has been represented by counsel of its choice throughout all negotiations that have preceded the execution of this Agreement and that it has executed the same with the advice of said independent counsel. Each party and its counsel cooperated in the drafting and preparation of this Agreement and the documents referred to herein, and any and all drafts relating thereto exchanged between the parties shall be deemed the work product of the parties and may not be construed against any party by reason of its preparation. Accordingly, any rule of law or any legal decision that would require interpretation of any

ambiguities in this Agreement against any party that drafted it is of no application and is hereby expressly waived.

(b) The words "this Agreement," "herein," "hereby," "hereunder" and "hereof" and words of similar import, refer to this Agreement as a whole and not to any particular subdivision unless expressly so limited. The words "this Section," "this subsection" and words of similar import, refer only to the Sections or subsections hereof in which such words occur. The word "including" (in its various forms) means "including, without limitation." Pronouns in masculine, feminine or neuter genders shall be construed to state and include any other gender and words, terms and titles (including terms defined herein) in the singular form shall be construed to include the plural and vice versa, unless the context otherwise expressly requires. Unless the context otherwise requires, all defined terms contained herein shall include the singular and plural and the conjunctive and disjunctive forms of such defined terms. Unless the context otherwise requires, all references to a specific time shall refer to Los Angeles time. The word "or" is not exclusive. The word "extent" in the phrase "to the extent" shall mean the degree to which a subject or other thing extends and such phrase shall not mean simply "if." The term "dollars" and the symbol "$" mean United States Dollars. The headings herein are for convenience of reference only, do not constitute part of this Agreement and shall not be deemed to limit or otherwise affect any of the provisions hereof.

(c) In this Agreement, except as the context may otherwise require, references to: (i) any agreement (including this Agreement), contract, statute or regulation are to the agreement, contract, statute or regulation as amended, modified, supplemented, restated or replaced from time to time (in the case of an agreement or contract, to the extent permitted by the terms thereof and, if applicable, by the terms of this Agreement); (ii) any Authority includes any successor to that Authority; (iii) any applicable law refers to such applicable law as amended, modified, supplemented or replaced from time to time (and, in the case of statutes, include any rules and regulations promulgated under such statute) and references to any section of any applicable law or other law include any successor to such section; and (iv) "days" mean calendar days; when calculating the period of time within which, or following which, any act is to be done or step taken pursuant to this Agreement, the date that is the reference day in calculating such period shall be excluded and if the last day of the period is a non-Business Day, the period in question shall end on the next Business Day or if any action must be taken hereunder on or by a day that is not a Business Day, then such action may be validly taken on or by the next day that is a Business Day.

Section 3.8 Governing Law; Venue; Waiver of Jury Trial.

(a) THIS AGREEMENT, AND ALL CLAIMS OR CAUSES OF ACTION (WHETHER IN CONTRACT OR TORT) THAT MAY BE BASED UPON, ARISE OUT OF OR RELATE TO THIS AGREEMENT, OR THE NEGOTIATION, EXECUTION OR PERFORMANCE OF THIS AGREEMENT, SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE, WITHOUT GIVING EFFECT TO THE PRINCIPLES OF CONFLICTS OF LAW THEREOF.

(b) THE PARTIES IRREVOCABLY SUBMIT TO THE JURISDICTION OF THE COURT OF CHANCERY OF THE STATE OF DELAWARE OR, IF THE COURT OF

CHANCERY OF THE STATE OF DELAWARE OR THE DELAWARE SUPREME COURT DETERMINES THAT THE COURT OF CHANCERY DOES NOT HAVE OR SHOULD NOT EXERCISE SUBJECT MATTER JURISDICTION OVER SUCH MATTER, THE SUPERIOR COURT OF THE STATE OF DELAWARE AND THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA LOCATED IN THE STATE OF DELAWARE SOLELY IN CONNECTION WITH ANY DISPUTE THAT ARISES IN RESPECT OF THE INTERPRETATION AND ENFORCEMENT OF THE PROVISIONS OF THIS AGREEMENT AND THE DOCUMENTS REFERRED TO IN THIS AGREEMENT OR IN RESPECT OF THE TRANSACTIONS CONTEMPLATED HEREBY, AND HEREBY WAIVE, AND AGREE NOT TO ASSERT, AS A DEFENSE IN ANY ACTION, SUIT OR PROCEEDING FOR INTERPRETATION OR ENFORCEMENT HEREOF OR ANY SUCH DOCUMENT THAT IT IS NOT SUBJECT THERETO OR THAT SUCH ACTION, SUIT OR PROCEEDING MAY NOT BE BROUGHT OR IS NOT MAINTAINABLE IN SAID COURTS OR THAT VENUE THEREOF MAY NOT BE APPROPRIATE OR THAT THIS AGREEMENT OR ANY SUCH DOCUMENT MAY NOT BE ENFORCED IN OR BY SUCH COURTS, AND THE PARTIES IRREVOCABLY AGREE THAT ALL CLAIMS WITH RESPECT TO SUCH ACTION, SUIT OR PROCEEDING SHALL BE HEARD AND DETERMINED EXCLUSIVELY BY SUCH A DELAWARE STATE OR FEDERAL COURT. THE PARTIES HEREBY CONSENT TO AND GRANT ANY SUCH COURT JURISDICTION OVER THE PERSON OF SUCH PARTIES AND OVER THE SUBJECT MATTER OF SUCH DISPUTE AND AGREE THAT MAILING OF PROCESS OR OTHER PAPERS IN CONNECTION WITH SUCH ACTION, SUIT OR PROCEEDING IN THE MANNER PROVIDED IN SECTION 3.1 OR IN SUCH OTHER MANNER AS MAY BE PERMITTED BY LAW SHALL BE VALID AND SUFFICIENT SERVICE THEREOF.

(c) EACH PARTY ACKNOWLEDGES AND AGREES THAT ANY CONTROVERSY WHICH MAY ARISE UNDER THIS AGREEMENT IS LIKELY TO INVOLVE COMPLICATED AND DIFFICULT ISSUES, AND THEREFORE EACH SUCH PARTY HEREBY IRREVOCABLY AND UNCONDITIONALLY WAIVES ANY RIGHT SUCH PARTY MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY LITIGATION DIRECTLY OR INDIRECTLY ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE TRANSACTIONS CONTEMPLATED BY THIS AGREEMENT. EACH PARTY CERTIFIES AND ACKNOWLEDGES THAT (I) NO REPRESENTATIVE, AGENT OR ATTORNEY OF ANY OTHER PARTY HAS REPRESENTED, EXPRESSLY OR OTHERWISE, THAT SUCH OTHER PARTY WOULD NOT, IN THE EVENT OF LITIGATION, SEEK TO ENFORCE THE FOREGOING WAIVER; (II) SUCH PARTY UNDERSTANDS AND HAS CONSIDERED THE IMPLICATIONS OF THE FOREGOING WAIVER; (III) SUCH PARTY MAKES THE FOREGOING WAIVER VOLUNTARILY AND (IV) SUCH PARTY HAS BEEN INDUCED TO ENTER INTO THIS AGREEMENT BY, AMONG OTHER THINGS, THE MUTUAL WAIVER AND CERTIFICATIONS IN THIS SECTION 3.8.

Section 3.9 Severability of Provisions. Each party agrees that, should any court or other competent authority hold any provision of this Agreement or part hereof to be invalid, illegal or unenforceable in any jurisdiction, such invalidity, illegality or unenforceability shall not affect any other term or provision of this Agreement or invalidate or render unenforceable such other term or provision in any other jurisdiction. Upon such determination that any term or other provision is

invalid, illegal or unenforceable, the parties shall negotiate in good faith to modify this Agreement so as to effect the original intent of the parties as closely as possible in a mutually acceptable manner in order that the Merger Agreement and this Agreement may be consummated as originally contemplated to the greatest extent possible. Except as otherwise contemplated by this Agreement, in response to an order from a court or other competent authority for any party to take any action inconsistent herewith or not to take an action consistent herewith or required hereby, to the extent that a party took an action inconsistent with this Agreement or failed to take action consistent with this Agreement or required by this Agreement pursuant to such order, such party shall not incur any liability or obligation unless such party did not in good faith seek to resist or object to the imposition or entering of such order.

Section 3.10 Entire Agreement; No Third Party Beneficiaries. This Agreement (together with the Merger Agreement, the Stockholders' Agreements, and any other documents and instruments executed pursuant hereto) constitutes the entire agreement and supersedes all prior agreements and understandings, both written and oral, among the parties with respect to the subject matter hereof. Nothing in this Agreement, express or implied, is intended to or shall confer upon any Person other than the parties any right, benefit or remedy of any nature whatsoever under or by reason of this Agreement. Nothing in this Agreement, express or implied, limits or supersedes the Lock-Up Restriction.

Section 3.11 Amendment. This Agreement may be amended only by means of a written amendment signed by each of the parties hereto or thereto affected by such amendment; *provided*, *however*, that (i) Article II may only be amended by means of a written amendment signed by the Company and the Holders of a majority of the then outstanding Registrable Securities held by each Member Holder Group and (ii) no such amendment shall materially and adversely affect the rights of any Holder hereunder without the consent of such Holder.

Section 3.12 Obligations Limited to Parties to Agreement. Each of the parties hereto covenants, agrees and acknowledges that no Person other than the Sellers (and their transferees or assignees) and the Company shall have any obligation hereunder and that no recourse under this Agreement shall be had against any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any Seller or any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any of the foregoing, whether by the enforcement of any assessment or by any legal or equitable proceeding, or by virtue of any applicable law, it being expressly agreed and acknowledged that no personal liability whatsoever shall attach to, be imposed on or otherwise be incurred by any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any Seller or any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any of the foregoing, as such, for any obligations of any Seller under this Agreement or for any claim based on, in respect of or by reason of such obligation or its creation.

Section 3.13 Confidentiality of Records. Except as otherwise permitted in a Stockholder's Agreement, each of the parties shall, and shall cause its Affiliates to, keep confidential, disclose only to its Affiliates or representatives and use only in connection with the transactions contemplated by this Agreement all information and data obtained by them from the other party or its Affiliates or representatives relating to such other party or the transactions

contemplated hereby (other than information or data that (i) is or becomes available to the public other than as a result of a breach of this Section, (ii) was available on a non-confidential basis prior to its disclosure to or by one party to another, or (iii) becomes available to one party on a non-confidential basis from a source other than the other party; *provided*, that, such source is not known by the receiving party, after reasonable inquiry, to be bound by a confidentiality agreement with either of the non-receiving parties or their representatives and is not otherwise prohibited from transmitting the information to the receiving party by a contractual, legal or fiduciary obligation), unless disclosure of such information or data is required by applicable law, regulation or stock exchange listing standard or is requested by an Authority with competent jurisdiction over the disclosing party.

Section 3.14 Independent Nature of each Seller's Obligations. The obligations of each Seller under this Agreement are several and not joint with the obligations of the other Seller, and no Seller shall be responsible in any way for the performance of the obligations of the other Seller under this Agreement. Nothing contained herein, and no action taken by either Seller pursuant hereto, shall be deemed to constitute such Seller as a partnership, an association, a joint venture or any other kind of group or entity with the other Seller, or create a presumption that such Seller is in any way acting in concert or as a group with the other Seller with respect to such obligations or the transactions contemplated by this Agreement. Each Seller shall be entitled to independently protect and enforce its rights, including, the rights arising out of this Agreement, and it shall not be necessary for the other Seller to be joined as an additional party in any proceeding for such purpose.

Section 3.15 Further Assurances. The Company and each of the Holders shall cooperate with each other and shall take such further action and shall execute and deliver such further documents as may be reasonably requested by any other party in order to carry out the provisions and purposes of this Agreement.

Section 3.16 Cumulative Remedies. The remedies provided herein are cumulative and not exclusive of any remedies provided by law.

Section 3.17 Termination. This Agreement shall terminate with respect to any Holder on such date on which both (i) such Holder together with its Affiliates ceases to hold or Beneficially Own at least one percent of the issued and outstanding Common Stock and (ii) subject to such Holder's compliance with Section 2.6, all Registrable Securities owned by such Holder may be sold without restriction (including any limitation thereunder on volume or manner of sale without the need for current public information) pursuant to Rule 144; *provided, that,* the provisions of Section 2.7, Section 2.8, Section 2.9 and Article III shall survive such termination (such date, the "Termination Date" with respect to such Holder).

[Signature page follows]

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date first written above.

CALIFORNIA RESOURCES CORPORATION

By: _____

Name:
Title:

SELLERS:

CPP INVESTMENT BOARD PRIVATE HOLDINGS (6), INC.

By: _____

Name:
Title:

IKAV IMPACT S.A.R.L.

By: _____
Name:
Title:

SIMLOG, INC.

By: _____
Name:
Title:

IKAV ENERGY INC.

By: _____
Name:
Title:

OCM OPPS XB AIF HOLDINGS (DELAWARE), L.P.

By: _____

Name:
Title:

OAKTREE HUNTINGTON INVESTMENTS FUND II AIF (DELAWARE), L.P. – CLASS C

By: _____

Name:
Title:

OCM XI AIV HOLDINGS (DELAWARE), L.P.

By: _____

Name:
Title:

CM AERA E HOLDINGS, LLC

By: _____

Name:
Title:

EXHIBIT B

STOCKHOLDER AGREEMENT

by and between

CALIFORNIA RESOURCES CORPORATION

and

THE STOCKHOLDER PARTY HERETO

[___]

STOCKHOLDER AGREEMENT

This STOCKHOLDER AGREEMENT (this "Agreement") is made and entered into as of [___], 2024 by and among [Cosmo], a Delaware corporation (the "Company"), and [*Name of Stockholder*] (the "Stockholder"), and each other Person who after the date hereof becomes a party hereto.

RECITALS

WHEREAS, pursuant to the Agreement and Plan of Merger, dated as of February [___], 2024 (the "Merger Agreement"), among the Company, Petra Merger Sub I, LLC, Petra Merger Sub C, LLC and Petra Merger Sub O, LLC, Petra Merger Sub O2, LLC, Petra Merger Sub O3, LLC, each a Delaware limited liability company and a wholly-owned subsidiary of the Company, Petra Merger Sub S, LLC, a Delaware limited liability company and a wholly-owned subsidiary of the Company, IKAV Impact USA Inc., a Delaware corporation, CPPIB Vedder US Holdings LLC, a Delaware limited liability company, Opps Xb Aera E CTB, LLC, a Delaware limited liability company, Opps XI Aera E CTB, LLC, a Delaware limited liability company, Green Gate COI, LLC, a Delaware limited liability company, and solely for purposes of the Member Provisions (as defined in the Merger Agreement), IKAV Impact S.a.r.l., a Luxembourg corporation, Simlog, Inc., a Delaware corporation, IKAV Energy Inc., a Delaware corporation, CPP Investment Board Private Holdings (6), Inc., a Canadian corporation, OCM Opps Xb AIF Holdings (Delaware), L.P., a Delaware limited partnership, Oaktree Huntington Investments Fund II AIF (Delaware), L.P. – Class C, a Delaware limited partnership, OCM XI AIV Holdings (Delaware), L.P., a Delaware limited partnership, and OCM Aera E Holdings, LLC, a Delaware limited liability company, the Company issued the Securities to the Stockholder; and

WHEREAS, the parties hereto desire to enter into an agreement to provide for certain rights and obligations associated with ownership of the Securities.

NOW, THEREFORE, in consideration of the mutual covenants and agreements set forth herein and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged by each party hereto, the parties hereby agree as follows:

ARTICLE I
DEFINITIONS

Section 1.1 Definitions. Capitalized terms used herein without definition shall have the meanings given to them in the Merger Agreement, except that the terms set forth below are used herein as so defined:

"Activist" means, as of any date of the applicable Transfer, any Person or any Affiliate of any Person that is identified in the most recently available "SharkWatch 50" list (or, if "SharkWatch 50" is no longer available, the then-prevailing comparable list, as reasonably determined by the Company in good faith).

"Affiliate" means, with respect to any Person, any other Person that directly or indirectly through one or more intermediaries controls, is controlled by or is under common control with, the Person in question; it being understood that, with respect to a Holder or any of its Affiliates,

(x) "Affiliate" does not include any portfolio company of a Holder or any of its Affiliates other than for purposes of Section 5.2 and (y) for purposes of this Agreement, the Company and its subsidiaries shall not be deemed to be an Affiliate of any Stockholder or such Stockholder's Affiliates. As used herein, the term "control" means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a Person, whether through ownership of voting securities, by contract or otherwise.

"Authority" means any domestic (including federal, state or local) or foreign court, arbitrator, administrative, regulatory or other governmental department, agency, official, commission, tribunal, authority or instrumentality, non-government authority or self-regulatory body (including any domestic or foreign securities exchange).

"Beneficially Own" has the meaning ascribed to it in Section 13(d) of the Exchange Act. "Beneficial Ownership" has a correlative meaning.

"Board" means the Board of Directors of the Company.

"Business Day" means any day other than a day on which the SEC is closed.

"Capital Stock" means any and all shares of Common Stock, preferred stock or other forms of equity authorized and issued by the Company (however designated, whether voting or non-voting) and any instruments convertible into or exercisable or exchangeable for any of the foregoing (including any options or swaps).

"Common Stock" means the common stock, par value $0.01 per share, of the Company.

["CPPIB" means Canadian Pension Plan Investment Board.]

["CPPIB Sustainable Energies Group" means the Sustainable Energies Investment group of CPPIB and any successor group(s) of the Sustainable Energies Investment group of CPPIB that result(s) from any CPPIB internal reorganization or group or department name change.]

"Derivative Securities" means options, warrants, rights to purchase Capital Stock, or any securities that are exercisable, convertible or exchangeable for Capital Stock.

"Director" means a member of the board of directors of the Company.

"Holder" means the Stockholder and any of its permitted transferees, so long as such Person is a holder or owner of any Securities.

["IKAV" means IKAV Impact S.a.r.l., a Luxembourg corporation.]

"NYSE" means the New York Stock Exchange.

"Person" means any natural person, corporation, partnership, limited liability company, joint venture, association, joint-stock company, trust, foundation, unincorporated organization or government or other agency or political subdivision thereof.

"Qualifying Nominee" means, in respect of a Stockholder Nominee, a natural person who, in the good faith determination of the Board or the Governance Committee: (i) is suitable to serve on the Board in accordance with the customary standards of suitability for directors of NYSE-listed companies; (ii) is not prohibited from serving as a director pursuant to any rule or regulation of the U.S. Securities and Exchange Commission or any national securities exchange on which the Securities are listed or admitted to trading; and (iii) is not subject to any order, decree or judgment of any Authority prohibiting service as a director of any public company.

"Permitted Parties" means (a) the full-time members of the formal investment or equivalent committee of [CPPIB/IKAV] responsible for the oversight of a Holder's investment in the Company and (b) [(i)] internal compliance, legal, accounting, tax, insurance and other personnel of a Holder [(clauses (a) and (b)(i), collectively, "Internal Permitted Parties"), and (ii) external compliance, legal, accounting, tax and other professional advisors of a Holder or its Affiliates who are bound by an obligation of confidentiality to the Holder or its Affiliate (either in the course of their professional duties or pursuant to a customary confidentiality agreement) (clause (b)(ii), collectively, "External Permitted Parties")][1], in each case with respect to clauses (a) and (b), who have a need to review information in order to perform the proper functions of their employment or duties to [CPPIB/IKAV].

["Restricted Party" CPPIB Sustainable Energies Group but excludes (a) any other investment department and/or group within CPPIB that is not the CPPIB Sustainable Energies Group (including, for the avoidance of doubt, CPPIB itself), (b) any and all CPPIB portfolio companies, and (c) any CPPIB employee located in an international office of CPPIB (outside of Toronto, New York, London and Sydney) who are members of CPPIB Sustainable Energies Group in addition to other investment departments and/or group; *provided*, that in each case of clause (a) and clause (b), that such other department or group or portfolio company is not acting at the direction of or in coordination with any Restricted Party with respect to the Company or in connection with a Holder's interest therein; *provided further,* that in the case of clause (c), that such individuals are not acting at the direction of the CPPIB Sustainable Energies Group or in support of an investment to be approved by the CPPIB Sustainable Energies Group investment committee.][2]

"SEC" means the U.S. Securities and Exchange Commission (or any successor agency).

"Securities" means the shares of Common Stock issued to the Stockholder pursuant to the Merger Agreement and any securities issued or issuable with respect to such Common Stock by way of reclassification, dividend or distribution or in connection with any reorganization or other recapitalization, merger, consolidation or otherwise.

"Standstill Termination Date" means the first date on which (a) the Stockholder, together with its Affiliates, no longer owns at least 7.5% of the issued and outstanding Common Stock calculated on a fully diluted basis and (b) no Stockholder Nominee designated by the Stockholder

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[1] **Note to Draft:** For CPPIB agreement only

[2] **Note to Draft:** For CPPIB agreement only

is serving on the Board and the Stockholder either is no longer entitled to, or has irrevocably waived, the right to appoint a Stockholder Nominee under Section 4.2(a).

"Stockholder Threshold" means, at any time of determination, 14.9% of the issued and outstanding Common Stock calculated on a fully diluted basis.

"Transfer" means to, directly or indirectly, sell, transfer, assign, pledge, encumber, hypothecate or similarly dispose of, either voluntarily or involuntarily, or to enter into any contract, option or other arrangement or understanding with respect to the sale, transfer, assignment, pledge, encumbrance, hypothecation or similar disposition of, Securities.

ARTICLE II
TRANSFER RESTRICTIONS

Section 2.1 Transfer Restrictions. Until the Standstill Termination Date, each Holder shall not, without the prior written consent of the Company, Transfer all or any part of the Securities or any right or economic interest pertaining thereto, including the right to vote or consent on any matter or to receive or have any economic interest in dividends from the Company pursuant thereto, to an Activist; *provided, however*, that this Section 2.1 shall not restrict or limit any Transfer of the Securities (a) to an Affiliate of such Holder or (b) in an open market transaction effected through a broker-dealer or to a broker-dealer in a block trade, so long as such broker-dealer transferee is purchasing such securities in such block trade for its own account and makes block trades in the ordinary course of its business, or in a underwritten offering, and in each case under this clause (b), to such Holder's knowledge, the ultimate transferee in such Transfer is not an Activist. Any purported Transfer in violation of this Section 2.1 shall be null and void *ab initio*.

ARTICLE III
STANDSTILL

Section 3.1 Standstill. Each Holder hereby agrees that, from the Closing Date until the Standstill Termination Date, unless an exemption or waiver is otherwise approved in advance in writing by the Board, such Holder shall not, and shall cause the Restricted Party not to:

(a) purchase or otherwise acquire, offer or propose to acquire, or solicit an offer to sell or agree to acquire, directly or indirectly, alone or in concert with others, Beneficial Ownership of any Capital Stock or any Derivative Securities (excluding shares and securities received by way of stock dividend, stock reclassification or other distributions or offerings made available on a pro rata basis to the Company's stockholders) if, after giving effect thereto, the Holders and the Restricted Party would collectively Beneficially Own, in the aggregate, an amount of Capital Stock, including any Derivative Securities on an as-exercised, converted or exchanged basis, as applicable, in excess of the Stockholder Threshold; *provided*, *however*, that, if as a result of a reduction in the number of shares of Common Stock outstanding due to the repurchase of shares of Common Stock by the Company, the Holders and the Restricted Party collectively Beneficially Own, in the aggregate, an amount of Capital Stock, including any Derivative Securities on an as-exercised, converted or exchanged basis, as applicable, in excess of the Stockholder Threshold, the Holders and the Restricted Party shall not be in violation of this

Section 3.1(a) so long as the Holders and the Restricted Party do not take any of the actions referred to in the first clause of this Section 3.1(a);

(b) make, or in any way participate in, directly or indirectly, alone or in concert with others (including by or through any group), any "solicitation" of "proxies" (as such terms are defined or used in Regulation 14A under the Exchange Act) to vote Common Stock or other Capital Stock of the Company or to provide or withhold consents with respect to Common Stock or other Capital Stock of the Company, whether subject to or exempt from the proxy rules, or seek to advise or influence any Person or entity with respect to the voting of, or the providing or withholding consent with respect to, any Common Stock or other Capital Stock of the Company; *provided, however,* that the foregoing will not be deemed to restrict or limit in any manner in which any of the Holders or the Restricted Party votes any of its respective shares of Common Stock or Capital Stock, directly or by proxy, subject to compliance with the other terms and conditions of this Agreement;

(c) except as permitted by Section 3.2, either directly or indirectly in concert with others (including by or through any group) make any offer with respect to, or make or submit a proposal with respect to, or ask or request any other Person to make an offer or proposal with respect to, any transaction that would, if consummated, be reasonably likely to result in a change of control of the Company, including a merger, business combination, restructuring, reorganization, recapitalization, tender or exchange offer or asset disposition involving the Company or any of its Affiliates; *provided, however,* that the Holders and the Restricted Party shall be permitted to (i) vote on any such transaction in accordance with the terms and conditions of this Agreement and (ii) tender into any tender offer or exchange offer not commenced by a Holder or the Restricted Party if either (A) the Board recommends (by majority vote) that the stockholders of the Company tender their shares in response to such offer or does not recommend against the tender offer or exchange offer within 10 Business Days after the commencement thereof or such longer period as shall then be permitted under U.S. federal securities laws or (B) the Board later publicly recommends (by majority vote) that the stockholders of the Company tender their shares in response to such offer;

(d) except as provided in this Agreement, either directly or indirectly in concert with others (including by or through any group) seek representation on the Board or the board of directors (or equivalent governing body) of any of the Company's controlled Affiliates, seek to remove any members of the Board or expand or reduce the size of the Board or otherwise act alone or in concert with others (including by or through any group) to seek control of the Board or the board of directors (or equivalent governing body) of any of the Company's controlled Affiliates;

(e) form, join, knowingly encourage the formation of or knowingly engage in discussions relating to the formation of, or participate in, a "group" within the meaning of Section 13(d)(3) of the Exchange Act for purposes of seeking control, or influencing the control or management of, the Company; or

(f) either directly or indirectly in concert with others (including by or through any group) publicly announce any intention, or enter into or disclose any plan or arrangement inconsistent with the foregoing (including publicly making a request that the Company or the Board waive, amend or terminate any provisions of this Section 3.1).

Section 3.2 Permitted Action. Notwithstanding the provisions of Section 3.1, nothing herein shall prohibit or restrict any activities of a Holder or the Restricted Party in connection with: (i) exercising any of its rights under this Agreement, (ii) privately communicating with Company management, the chairman of the Board or the lead independent director of the Board in its capacity as a stockholder of the Company (including by providing its views privately to Company management, the chairman of the Board or the lead independent director of the Board on any matter); *provided,* that such actions are not intended to and would not reasonably be expected to require public disclosure of such actions, (iii) exercising any voting, dividend or liquidation rights attached to any securities that it may own in accordance with its corporate governance policies and proxy voting guidelines, (iv) disclosing its voting intentions in accordance with normal practices, (v) making any disclosure pursuant to Section 13(d) of the Exchange Act that such Holder or such Affiliate reasonably believes, based on the advice of independent legal counsel, is required in connection with any action taken by such Holder or such Affiliate that is not inconsistent with this Agreement or (vi) complying with applicable laws. Nothing contained in Section 3.1 shall in any way restrict or prohibit any actions taken by any Stockholder Nominee acting solely in his or her capacity as a Director consistent with his or her fiduciary duties as a Director, including communicating with, participating in, or otherwise seeking to affect the outcome of, discussions and votes of the Board (or any committee thereof) with respect to any matters coming before it, or otherwise deemed to be subject to Section 3.1 with respect to such person's activities in his or her capacity as a Director; *provided*, that such action does not include any public announcement or disclosure by the Stockholder Nominee.

Section 3.3 Termination. The restrictions contained in Section 3.1 shall terminate and shall cease to apply to each Holder and the Restricted Party on the Standstill Termination Date.

ARTICLE IV
CORPORATE GOVERNANCE

Section 4.1 Initial Appointment to the Board. Promptly following the Effective Time, the Company shall appoint to the Board a natural person designated in writing by the Stockholder prior to the Effective Time after consultation with the Company, provided that such natural person is a Qualifying Nominee (such person, and any other person designated for nomination by the Stockholder pursuant to this Article V, a "Stockholder Nominee"). In determining its initial Stockholder Nominee, the Stockholder shall consider the composition of the Board and the Stockholder's internal voting policies, as well as any other factors the Stockholder determines to consider in its sole discretion. Such Stockholder Nominee shall serve an initial term that will expire no earlier than the annual meeting of the stockholders of the Company to be held in [●][3].

Section 4.2 Stockholder Nominees.

(a) From and after the Closing Date until the first date on which the Stockholder, together with its Affiliates, ceases to Beneficially Own, in the aggregate, at least 5.0% of the issued and outstanding Common Stock calculated on a fully diluted basis, the Stockholder

[3] **Note to Draft:** To be the first meeting of stockholders for the election of directors subsequent to the Closing Date.

shall have the option and right (but not the obligation) to designate for nomination to the Board one Stockholder Nominee.

(b) From and after the first date on which the Stockholder, together with its Affiliates, ceases to Beneficially Own, in the aggregate, at least 5.0% of the issued and outstanding Common Stock calculated on a fully diluted basis, (i) the Stockholder shall not have the right to designate a Stockholder Nominee to the Board pursuant to this Section 4.2 and (ii) the Company shall not be obligated to nominate a Stockholder Nominee to the Board pursuant to this Section 4.2. For the avoidance of doubt, following the termination of the Stockholder's right to designate a Stockholder Nominee to the Board pursuant to the foregoing sentence, such right of designation shall not be reinstated in the event that after such occurrence the Stockholder, together with its Affiliates, Beneficially Own, in the aggregate, at least 5.0% of the issued and outstanding Common Stock calculated on a fully diluted basis.

Section 4.3 Election of Stockholder Nominees to the Board.

(a) In the event that a Stockholder Nominee must stand for an election of the Board in connection with any annual or special meeting of stockholders of the Company at which Directors are to be elected (each annual or special meeting, an "Election Meeting"), the Company shall give written notice, no earlier than 90 days prior to the date of such Election Meeting, to the Stockholder to request that the Stockholder nominate a Stockholder Nominee, and the Stockholder shall give written notice to the Company of the Stockholder Nominee no later than 30 days after receiving such notice; *provided*, that if the Stockholder fails to give such notice in a timely manner, then the Stockholder shall be deemed to have nominated the incumbent Stockholder Nominee elected to the Board.

(b) In connection with any Election Meeting in which a Stockholder Nominee stands for election to the Board (or in the event that the Stockholder is permitted to designate a Replacement pursuant to Section 4.4), the Stockholder shall take all necessary action to cause the Stockholder Nominee to consent to such reference and background checks and to provide such information (including information necessary to determine any disclosure obligations of the Company) as the Board or the Nominating & Corporate Governance Committee of the Board (the "Governance Committee") may reasonably request in connection with the Company's disclosure obligations or in connection with the Company's legal, regulatory or stock exchange requirements, which requests shall be of the same type as the Company requests of all other nominees to the Board.

(c) Subject to the provisions set forth in this Article IV, to the extent that a Stockholder Nominee must stand for an election of the Board in connection with an Election Meeting, subject to applicable requirements or qualifications under applicable Law or applicable stock exchange rules, the Company agrees to take all actions necessary to: (i) nominate and recommend that the holders of Capital Stock of the Company who are entitled to vote at such Election Meeting vote in favor of the election of the Stockholder Nominee (including ensuring that each Stockholder Nominee is included in the proxy statement prepared by the Company in connection with the Company's solicitation of proxies for such Election Meeting) and (ii) support the Stockholder Nominee for election in a manner no less rigorous and favorable than the manner in which the Company supports its other nominees.

(d) Notwithstanding anything to the contrary in this Agreement, none of the Company, the Governance Committee or the Board shall be under any obligation to nominate or recommend a proposed Stockholder Nominee if the Governance Committee determines (by majority vote) in good faith, following consultation with outside legal counsel, that such proposed Stockholder Nominee is not a Qualifying Nominee.

Section 4.4 Qualification and Replacement of Stockholder Nominees.

(a) If the Governance Committee determines (by majority vote) in good faith, following consultation with outside legal counsel, that a Stockholder Nominee elected to the Board is not a Qualifying Nominee, the Stockholder shall take all necessary action to cause such Stockholder Nominee to resign promptly from the Board and any committee of the Board on which he or she then serves.

(b) If a Stockholder Nominee shall cease for any reason to serve as a Director (including by death, disability, retirement, resignation or removal of such Stockholder Nominee), the Stockholder shall have the exclusive right to designate a replacement for such Stockholder Nominee (a "Replacement"). Unless the Governance Committee determines that such Replacement is not a Qualifying Nominee, the Company shall promptly take all action within its control necessary to satisfy the requirements under this Article IV with respect to such Replacement, including by causing the appointment of such Replacement to the Board to fill any such vacancy. If any such Replacement is determined by the Governance Committee not to be a Qualifying Nominee, the Stockholder shall be entitled to continue designating a Replacement until such proposed designee is determined by the Governance Committee to qualify as a Qualifying Nominee. The Company shall not fill the vacancy on the Board during any period in which the appointment of a Stockholder Nominee is pending without the prior written consent of the Stockholder.

Section 4.5 Resignation; Removal.

(a) The Stockholder shall have right at any time and from time to time to cause the Stockholder Nominee elected to the Board to promptly tender his or her resignation from the Board and any committee of the Board on which he or she then serves.

(b) If the Stockholder no longer has the right to designate a Stockholder Nominee then serving on the Board pursuant to the terms of this Article IV, then, unless the Governance Committee and the Stockholder agree in writing that such Stockholder Nominee should remain on the Board, Stockholder shall cause the Stockholder Nominee to promptly tender their resignation from the Board and any committee of the Board on which he or she then serves and, if the Board accepts such resignation, the resulting vacancy shall be filled by the Board.

Section 4.6 Rights of the Stockholder Nominee.

(a) The Company shall notify each Stockholder Nominee, at the same time and in the same manner as such notification is delivered to the other members of the Board, of all regular meetings and special meetings of the Board and of all regular and special meetings of any committee of the Board of which such Stockholder Nominee is a member. The Company and the Board shall provide such Stockholder Nominee with copies of all notices, minutes, consents and

other material that it provides to all other members of the Board and each committee of the Board concurrently as such materials are provided to the other members of the Board or such committee.

(b) Each Stockholder Nominee shall be entitled to the same directors' and officers' insurance coverage as the other non-employee Directors and the same indemnification from the Company as such other Directors, in each case, effective no later than the date on which such Stockholder Nominee joins the Board. If the Company enters into indemnification agreements with its Directors generally, the Company will enter into an indemnification agreement with such Stockholder Nominee in substantially the same form as the other Directors and with such changes as may be reasonably requested by the Stockholder.

(c) Except to the extent that a Holder may otherwise notify the Company, each Stockholder Nominee shall be entitled to compensation (including equity awards) that is consistent with the compensation received by other non-employee Directors; provided, that at the election of a Stockholder Nominee, any Director compensation shall be paid to such Holder or any Affiliate thereof specified by such Stockholder Nominee rather than to such Stockholder Nominee. In addition, while serving as a Director, the Stockholder Nominee shall be entitled to reimbursement for reasonable expenses for his or her service as a Director, consistent with the Company's policies applicable to other non-employee Directors.

ARTICLE V
OTHER COVENANTS OF THE COMPANY

Section 5.1 Committee Access. For so long as the Stockholder is entitled to nominate a Stockholder Nominee pursuant to Section 4.2, with respect to each committee of the Board on which the Stockholder Nominee does not serve as a member, such committee of the Board shall allow the Stockholder Nominee to participate as a non-voting observer of such committee; *provided, however,* that if the Stockholder Nominee is not an independent Director under applicable stock exchange rules and the inclusion of the Stockholder Nominee as a non-voting observer would reasonably be expected to have an adverse effect on the Company, the parties hereto will discuss in good faith the implementation of an alternative arrangement to provide the Stockholder Nominee with an opportunity to review materials furnished to such committees.

Section 5.2 Business Opportunities. Contemporaneously with the execution of this Agreement, the Board has duly approved resolutions (the "Board Resolution") (a) renouncing any interest or expectancy of the Company in, or in being offered an opportunity to participate in, any business opportunities that are presented to the Stockholder, any of its Affiliates or any Stockholder Nominee (the "Stockholder Entities"), other than any opportunity of which a Stockholder Nominee first becomes aware in his or her capacity as a Director and which has not been otherwise presented to the Stockholder or any of its Affiliates and (b) waiving any obligation on the part of any Stockholder Nominee to present any such business opportunity to the Company, in each case pursuant to Section 122(17) of the Delaware General Corporation Law. For the avoidance of doubt, the Stockholder and its Affiliates shall be entitled to and may have business interests and engage in business activities in addition to those relating to the Company and its subsidiaries, including business interests and activities that may be in direct competition with the Company and its subsidiaries. Neither the Company nor any of its subsidiaries shall have any rights by virtue of this Agreement in any business ventures of any Stockholder Entity or any

Stockholder Nominee. For so long as this Agreement is in effect, the Company shall not, and shall not permit the Board to, rescind or retract the Board Resolution, or take any other action that would reduce or eliminate the renunciation or waivers included in the Board Resolution with respect to the Stockholder Entities or any Stockholder Nominee.

Section 5.3 No Amendment of Organizational Documents. Prior to the Termination Date, without the prior written approval of the Stockholder, the Company shall not, and shall cause each of its subsidiaries not to, amend or modify any organizational documents of the Company or any of its subsidiaries in a way that materially, adversely and disproportionately affects the rights or privileges of the Stockholder or any of its Affiliates that owns Common Stock or other equity interests in the Company in their capacity as owners of Common Stock or other equity interests in the Company or any of its subsidiaries in relation to any other owner of equity interests of the Company or any of its subsidiaries.

ARTICLE VI
MISCELLANEOUS

Section 6.1 Notices. All notices, requests and other communications to any party under, or otherwise in connection with, this Agreement shall be in writing and shall be deemed to have been duly given (a) if delivered in person; (b) if transmitted by electronic mail ("e-mail") (but only if confirmation of receipt of such e-mail is requested and received; provided, that, each notice party shall use reasonable best efforts to confirm receipt of any such e-mail correspondence promptly upon receipt of such request); or (c) if transmitted by national overnight courier, in each case as addressed as follows:

If to the Company, to:

[*insert address*]
Attn:
Email:

With a copy to (which copy shall not constitute notice):

Sullivan & Cromwell LLP
1888 Century Park East
Los Angeles, California 90067-1725
Attn: Alison S. Ressler; Bradley S. King
E-mail: resslera@sullcrom.com; kingbrad@sullcrom.com

If to the Stockholder, to:

[*insert address*]
Attn:
Email:

With a copy to (which copy shall not constitute notice):

Latham & Watkins LLP
1271 Avenue of the Americas
New York, New York 10020
Attn: David S. Allinson; Thomas G. Brandt
E-mail: david.allinson@lw.com; thomas.brandt@lw.com

or, if to a transferee of a Holder, to the transferee at the address specified pursuant to Section 2.1(a) above. All notices and communications shall be deemed to have been duly given: (i) at the time delivered by hand, if personally delivered; (ii) when notice is sent to the sender that the recipient has read the message, if sent by e-mail; (iii) upon actual receipt if sent by registered or certified mail, return receipt requested, or regular mail, if mailed; and (iv) upon actual receipt when delivered to an air courier guaranteeing overnight delivery.

Section 6.2 Successors and Assigns. This Agreement shall inure to the benefit of and be binding upon the permitted successors and assigns of each of the parties hereto, including subsequent Holders to the extent permitted herein.

Section 6.3 Assignment of Rights. Unless otherwise specified in this Agreement, neither this Agreement nor any of the rights, interests or obligations under this Agreement shall be assigned, in whole or in part, by the Stockholder or any of its Affiliates without the prior written consent of the Company; *provided, however,* that any of the rights, interests or obligations of the Stockholder may be assigned to any of its Affiliates without the requirement of any such consent. Any purported assignment in breach of this Section 6.3 shall be null and void *ab initio*.

Section 6.4 Specific Performance. The parties agree that irreparable damage, for which monetary damages would not be an adequate remedy, would occur in the event that any of the provisions of this Agreement were not performed in accordance with their specific terms or were otherwise breached by the parties. Prior to the termination of this Agreement pursuant to Section 6.17, it is accordingly agreed that the parties shall be entitled to an injunction or injunctions, or any other appropriate form of specific performance or equitable relief, to prevent breaches of this Agreement and to enforce specifically the terms and provisions hereof in any court of competent jurisdiction, in each case in accordance with this Section 6.4, this being in addition to any other remedy to which they are entitled under the terms of this Agreement at law or in equity. Each party accordingly agrees not to raise any objections to the availability of the equitable remedy of specific performance to prevent or restrain breaches or threatened breaches of, or to enforce compliance with, the covenants and obligations of such party under this Agreement all in accordance with the terms of this Section 6.4. Each party further agrees that no other party or any other Person shall be required to obtain, furnish or post any bond or similar instrument in connection with or as a condition to obtaining any remedy referred to in this Section 6.4, and each party irrevocably waives any right it may have to require the obtaining, furnishing or posting of any such bond or similar instrument.

Section 6.5 Counterparts. This Agreement may be executed in two or more counterparts, including via facsimile or email in "portable document format" (".pdf") form transmission, all of which shall be considered one and the same agreement and shall become effective when two or more counterparts have been signed by each of the parties and delivered to the other parties, it being understood that all parties need not sign the same counterpart.

Section 6.6 Rules of Construction.

(a) Each of the parties acknowledges that it has been represented by counsel of its choice throughout all negotiations that have preceded the execution of this Agreement and that it has executed the same with the advice of said independent counsel. Each party and its counsel cooperated in the drafting and preparation of this Agreement and the documents referred to herein, and any and all drafts relating thereto exchanged between the parties shall be deemed the work product of the parties and may not be construed against any party by reason of its preparation. Accordingly, any rule of law or any legal decision that would require interpretation of any ambiguities in this Agreement against any party that drafted it is of no application and is hereby expressly waived.

(b) The words "this Agreement," "herein," "hereby," "hereunder" and "hereof" and words of similar import, refer to this Agreement as a whole and not to any particular subdivision unless expressly so limited. The words "this Section," "this subsection" and words of similar import, refer only to the Sections or subsections hereof in which such words occur. The word "including" (in its various forms) means "including, without limitation." Pronouns in masculine, feminine or neuter genders shall be construed to state and include any other gender and words, terms and titles (including terms defined herein) in the singular form shall be construed to include the plural and vice versa, unless the context otherwise expressly requires. Unless the context otherwise requires, all defined terms contained herein shall include the singular and plural and the conjunctive and disjunctive forms of such defined terms. Unless the context otherwise requires, all references to a specific time shall refer to Los Angeles time. The word "or" is not exclusive. The word "extent" in the phrase "to the extent" shall mean the degree to which a subject or other thing extends and such phrase shall not mean simply "if." The term "dollars" and the symbol "$" mean United States Dollars. The headings herein are for convenience of reference only, do not constitute part of this Agreement and shall not be deemed to limit or otherwise affect any of the provisions hereof.

(c) In this Agreement, except as the context may otherwise require, references to: (i) any agreement (including this Agreement), contract, statute or regulation are to the agreement, contract, statute or regulation as amended, modified, supplemented, restated or replaced from time to time (in the case of an agreement or contract, to the extent permitted by the terms thereof and, if applicable, by the terms of this Agreement); (ii) any Authority includes any successor to that Authority; (iii) any applicable law refers to such applicable law as amended, modified, supplemented or replaced from time to time (and, in the case of statutes, include any rules and regulations promulgated under such statute) and references to any section of any applicable law or other law include any successor to such section; and (iv) "days" mean calendar days; when calculating the period of time within which, or following which, any act is to be done or step taken pursuant to this Agreement, the date that is the reference day in calculating such period shall be excluded and if the last day of the period is a non-Business Day, the period in question shall end on the next Business Day or if any action must be taken hereunder on or by a day that is not a Business Day, then such action may be validly taken on or by the next day that is a Business Day.

Section 6.7 Governing Law; Venue; Waiver of Jury Trial.

(a) THIS AGREEMENT, AND ALL CLAIMS OR CAUSES OF ACTION (WHETHER IN CONTRACT OR TORT) THAT MAY BE BASED UPON, ARISE OUT OF OR RELATE TO THIS AGREEMENT, OR THE NEGOTIATION, EXECUTION OR PERFORMANCE OF THIS AGREEMENT, SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE, WITHOUT GIVING EFFECT TO THE PRINCIPLES OF CONFLICTS OF LAW THEREOF.

(b) THE PARTIES IRREVOCABLY SUBMIT TO THE JURISDICTION OF THE COURT OF CHANCERY OF THE STATE OF DELAWARE OR, IF THE COURT OF CHANCERY OF THE STATE OF DELAWARE OR THE DELAWARE SUPREME COURT DETERMINES THAT THE COURT OF CHANCERY DOES NOT HAVE OR SHOULD NOT EXERCISE SUBJECT MATTER JURISDICTION OVER SUCH MATTER, THE SUPERIOR COURT OF THE STATE OF DELAWARE AND THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA LOCATED IN THE STATE OF DELAWARE SOLELY IN CONNECTION WITH ANY DISPUTE THAT ARISES IN RESPECT OF THE INTERPRETATION AND ENFORCEMENT OF THE PROVISIONS OF THIS AGREEMENT AND THE DOCUMENTS REFERRED TO IN THIS AGREEMENT OR IN RESPECT OF THE TRANSACTIONS CONTEMPLATED HEREBY, AND HEREBY WAIVE, AND AGREE NOT TO ASSERT, AS A DEFENSE IN ANY ACTION, SUIT OR PROCEEDING FOR INTERPRETATION OR ENFORCEMENT HEREOF OR ANY SUCH DOCUMENT THAT IT IS NOT SUBJECT THERETO OR THAT SUCH ACTION, SUIT OR PROCEEDING MAY NOT BE BROUGHT OR IS NOT MAINTAINABLE IN SAID COURTS OR THAT VENUE THEREOF MAY NOT BE APPROPRIATE OR THAT THIS AGREEMENT OR ANY SUCH DOCUMENT MAY NOT BE ENFORCED IN OR BY SUCH COURTS, AND THE PARTIES IRREVOCABLY AGREE THAT ALL CLAIMS WITH RESPECT TO SUCH ACTION, SUIT OR PROCEEDING SHALL BE HEARD AND DETERMINED EXCLUSIVELY BY SUCH A DELAWARE STATE OR FEDERAL COURT. THE PARTIES HEREBY CONSENT TO AND GRANT ANY SUCH COURT JURISDICTION OVER THE PERSON OF SUCH PARTIES AND OVER THE SUBJECT MATTER OF SUCH DISPUTE AND AGREE THAT MAILING OF PROCESS OR OTHER PAPERS IN CONNECTION WITH SUCH ACTION, SUIT OR PROCEEDING IN THE MANNER PROVIDED IN SECTION 6.1 OR IN SUCH OTHER MANNER AS MAY BE PERMITTED BY LAW SHALL BE VALID AND SUFFICIENT SERVICE THEREOF.

(c) EACH PARTY ACKNOWLEDGES AND AGREES THAT ANY CONTROVERSY WHICH MAY ARISE UNDER THIS AGREEMENT IS LIKELY TO INVOLVE COMPLICATED AND DIFFICULT ISSUES, AND THEREFORE EACH SUCH PARTY HEREBY IRREVOCABLY AND UNCONDITIONALLY WAIVES ANY RIGHT SUCH PARTY MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY LITIGATION DIRECTLY OR INDIRECTLY ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE TRANSACTIONS CONTEMPLATED BY THIS AGREEMENT. EACH PARTY CERTIFIES AND ACKNOWLEDGES THAT (I) NO REPRESENTATIVE, AGENT OR ATTORNEY OF ANY OTHER PARTY HAS REPRESENTED, EXPRESSLY OR OTHERWISE, THAT SUCH OTHER PARTY WOULD NOT, IN THE EVENT OF LITIGATION, SEEK TO ENFORCE THE FOREGOING WAIVER; (II) SUCH PARTY

UNDERSTANDS AND HAS CONSIDERED THE IMPLICATIONS OF THE FOREGOING WAIVER; (III) SUCH PARTY MAKES THE FOREGOING WAIVER VOLUNTARILY AND (IV) SUCH PARTY HAS BEEN INDUCED TO ENTER INTO THIS AGREEMENT BY, AMONG OTHER THINGS, THE MUTUAL WAIVER AND CERTIFICATIONS IN THIS SECTION 6.7.

Section 6.8 Adjustments Upon Changes in Capitalization. In the event of any change in the Common Stock or in the number of outstanding shares of the Common Stock by reason of a stock dividend, subdivision, reclassification, recapitalization, split, combination, exchange of shares or other similar event or transaction or any other change in the corporate or capital structure of the Company as a result of which the number of issued and outstanding shares of Common Stock change or is otherwise adjusted or the Common Stock is converted into other securities of Parent, this Agreement and the obligations hereunder shall attach to any additional shares of Common Stock (or other securities) issued to or acquired by the Stockholders and any provision of this Agreement that requires a particular minimum ownership percentage of Common Stock shall be deemed to be automatically amended to account for such event, transaction or change and shall be construed accordingly.

Section 6.9 Severability of Provisions. Each party agrees that, should any court or other competent authority hold any provision of this Agreement or part hereof to be invalid, illegal or unenforceable in any jurisdiction, such invalidity, illegality or unenforceability shall not affect any other term or provision of this Agreement or invalidate or render unenforceable such other term or provision in any other jurisdiction. Upon such determination that any term or other provision is invalid, illegal or unenforceable, the parties shall negotiate in good faith to modify this Agreement so as to effect the original intent of the parties as closely as possible in a mutually acceptable manner in order that the Merger Agreement and this Agreement may be consummated as originally contemplated to the greatest extent possible. Except as otherwise contemplated by this Agreement, in response to an order from a court or other competent authority for any party to take any action inconsistent herewith or not to take an action consistent herewith or required hereby, to the extent that a party took an action inconsistent with this Agreement or failed to take action consistent with this Agreement or required by this Agreement pursuant to such order, such party shall not incur any liability or obligation unless such party did not in good faith seek to resist or object to the imposition or entering of such order.

Section 6.10 Entire Agreement; No Third-Party Beneficiaries. This Agreement (together with the Merger Agreement and any other documents and instruments executed pursuant hereto) constitutes the entire agreement and supersedes all prior agreements and understandings, both written and oral, among the parties hereto with respect to the subject matter hereof. Nothing in this Agreement, express or implied, is intended to or shall confer upon any Person other than the parties hereto any right, benefit or remedy of any nature whatsoever under or by reason of this Agreement.

Section 6.11 Amendment. Unless otherwise specified in this Agreement, this Agreement may be amended only by means of a written amendment signed by each of the parties hereto or thereto affected by such amendment.

Section 6.12 Obligations Limited to Parties to Agreement. Each of the parties hereto covenants, agrees and acknowledges that no Person other than the Stockholder (and its transferees or assignees) and the Company shall have any obligation hereunder and that no recourse under this Agreement shall be had against any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of the Stockholder or any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any of the foregoing, whether by the enforcement of any assessment or by any legal or equitable proceeding, or by virtue of any applicable law, it being expressly agreed and acknowledged that no personal liability whatsoever shall attach to, be imposed on or otherwise be incurred by any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any Stockholder or any former, current or future director, officer, employee, agent, general or limited partner, manager, member, stockholder or Affiliate of any of the foregoing, as such, for any obligations of the Stockholder under this Agreement or for any claim based on, in respect of or by reason of such obligation or its creation.

Section 6.13 Confidentiality of Records.

(a) Subject to Section 6.13(b), each of the parties hereto shall, and shall cause its Affiliates to, keep confidential, disclose only to its Affiliates or Permitted Parties (in the case of the Holder) or representatives (in the case of the Company) with a *bona fide* need to know, and use only in connection with the transactions contemplated by this Agreement all information and data obtained by them from the other party hereto or its Affiliates or its representatives relating to such other party or the transactions contemplated hereby (other than information or data that (i) is or becomes available to the public other than as a result of a breach of this Section 6.13, (ii) was available on a non-confidential basis prior to its disclosure to or by one party to another, or (iii) becomes available to one party hereto on a non-confidential basis from a source other than the other party hereto; *provided*, that, such source is not known by the receiving party, after reasonable inquiry, to be bound by a confidentiality agreement with either of the non-receiving parties or their representatives and is not otherwise prohibited from transmitting the information to the receiving party by a contractual, legal or fiduciary obligation), unless disclosure of such information or data is required by applicable law, regulation or stock exchange listing standard or is requested by an Authority with competent jurisdiction over the disclosing party.

(b) Notwithstanding the foregoing, but subject to compliance with the Company's *bona fide* internal policies, and excluding any trade or business secrets, a Stockholder Nominee may disclose to the Holder and the Restricted Party, the Permitted Parties and its and their relevant directors, officers and employees, in each case with a *bona fid*e need to know, any and all information received or observed by him or her in his or her capacity as a Stockholder Nominee; *provided*, that such information shall not be (i) used for any purpose other than, to the extent consistent with applicable law, (A) to monitor, oversee and make decisions with respect to the Holder's investment in the Company; (B) to comply with the Holder's obligations under this Agreement; (C) to exercise any of the Holder's rights under this Agreement; (D) to collaborate with the Company and (E) in order to perform the proper functions of a Person's employment or duties (clauses (A) through (D), the "Permitted Purposes") or (ii) disclosed to any Affiliate of [CPPIB/IKAV] other than the Restricted Parties and the Permitted Parties. Notwithstanding anything in this Section 6.13(b) to the contrary but subject to the foregoing proviso, any

competitively sensitive information (as determined in good faith by the Board and identified as such in writing to [CPPIB/IKAV]) or local pricing data may only be disclosed to [(a) Internal] Permitted Parties [and (b) External Permitted Parties to whom such disclosure is made for a Permitted Purpose]; *provided* that with respect to any such disclosure: (i) the Stockholder Nominee shall be subject to his or her fiduciary duties as a Director with respect to sharing such information, which duties shall include, without limitation, a restriction on sharing information regarding (A) any prospective business opportunities presented to the Board and (B) information subject to confidentiality by the Company with third parties if the Company has identified to the Stockholder Nominee in writing that such information is confidential and the disclosure thereof by the Stockholder Nominee would cause a breach of such confidentiality obligation, [and] (ii) [such disclosure to External Permitted Parties is limited to the extent such disclosure is reasonably necessary for a Permitted Purpose and consistent with the the internal policies and practices of CPPIB and its Affiliates, and (iii)][4] no such disclosure shall be permitted to the extent it adversely affects the attorney-client privilege of the Company.

(c) Notwithstanding anything in Section 6.17 to the contrary, the provisions of this Section 6.13 shall terminate with respect to Holder and its Affiliates and representatives on the date that is 12 months following the Termination Date.

Section 6.14 Further Assurances. The Company and the Stockholder shall cooperate with each other and shall take such further action and shall execute and deliver such further documents as may be reasonably requested by any other party in order to carry out the provisions and purposes of this Agreement.

Section 6.15 Cumulative Remedies. The remedies provided herein are cumulative and not exclusive of any remedies provided by law.

Section 6.16 Action in Stockholder Capacity Only. The Stockholder has executed this Agreement solely in its capacity as the record holder or Beneficial Owner of Securities and nothing herein shall limit or affect any actions or omissions taken by, or fiduciary duties of, any Stockholder Nominee in his or her capacity as a Director to the extent permitted by applicable law.

Section 6.17 Termination. Unless otherwise specified herein, this Agreement shall terminate upon the earlier of (a) the first date on which the Stockholder, together with its Affiliates, is no longer entitled to designate a Stockholder Nominee pursuant to Section 4.2(b) and (b) the date on which the Stockholder provides written notice to the Company terminating this Agreement (such earlier date, the "Termination Date" with respect to such Holder); *provided, however,* that the provisions of Section 2.1, Section 3.1 and Article VI shall survive such termination in accordance with their respective terms.

[Signature pages follow]

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[4] **Note to Draft:** For CPPIB agreement only

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date first written above.

CALIFORNIA RESOURCES CORPORATION

By: _____

Name:
Title:

STOCKHOLDER:

[NAME]

By: _____

Name:
Title:

[Signature Page to Stockholder Agreement]

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 8-K

CURRENT REPORT
PURSUANT TO SECTION 13 OR 15(D)
OF THE SECURITIES EXCHANGE ACT OF 1934

Date of Report (Date of earliest event reported): June 28, 2024

California Resources Corporation
(Exact name of registrant as specified in its charter)

Delaware	001-36478	46-5670947
(State or Other Jurisdiction of Incorporation)	(Commission File Number)	(IRS Employer Identification No.)

1 World Trade Center, Suite 1500 Long Beach, California	90831
(Address of Principal Executive Offices)	(Zip Code)

Registrant's Telephone Number, Including Area Code: (888) 848-4754

N/A
(Former Name Or Former Address, if Changed Since Last Report)

Check the appropriate box below if the Form 8-K filing is intended to simultaneously satisfy the filing obligation of the registrant under any of the following provisions:

☐ Written communications pursuant to Rule 425 under the Securities Act (17 CFR 230.425)

☐ Soliciting material pursuant to Rule 14a-12 under the Exchange Act (17 CFR 240.14a-12)

☐ Pre-commencement communications pursuant to Rule 14d-2(b) under the Exchange Act (17 CFR 240.14d-2(b))

☐ Pre-commencement communications pursuant to Rule 13e-4(c) under the Exchange Act (17 CFR 240.13e-4(c))

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock	CRC	New York Stock Exchange

Indicate by check mark whether the registrant is an emerging growth company as defined in Rule 405 of the Securities Act of 1933 (17 CFR §230.405) or Rule 12b-2 of the Securities Exchange Act of 1934 (17 CFR §240.12b-2).

Emerging growth company ☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Introductory Note:

On July 1, 2024, California Resources Corporation, a Delaware corporation ("CRC"), completed the transactions contemplated by the Agreement and Plan of Merger (the "Merger Agreement") described in our Current Report on Form 8-K, filed on February 9, 2024 (collectively, the "Transaction"). As a result of the Transaction, Aera Energy, LLC (together with its wholly-owned subsidiaries, "Aera") and its operating affiliate Aera Energy Services Company (together with Aera, the "Aera Companies") are now wholly-owned subsidiaries of CRC.

Item 1.01. Entry into a Material Definitive Agreement.

Registration Rights Agreement and Stockholder Agreements.

The text set forth under the "Introductory Note" above is incorporated herein by reference.

EX-99.1 2 a20240207exhibit991.htm EX-99.1

Exhibit 99.1

NEWS RELEASE

California Resources Corporation to Combine with Aera Energy

Transaction highly accretive across key 2024E financial metrics
Complementary assets to significantly scale E&P business and expand leading carbon management platform

LONG BEACH, California, February 7, 2024 – California Resources Corporation (NYSE: CRC) today announced the signing of a definitive merger agreement to combine with Aera Energy, LLC (Aera) in an all-stock transaction. The transaction values Aera at approximately $2.1 billion, inclusive of Aera's net debt and certain other obligations[1], and is expected to be immediately accretive. At closing, Aera's owners will receive 21.2 million shares of CRC's common stock, equal to approximately 22.9% of CRC's fully diluted shares.

"This strategic transaction will create scale in our operations, generate significant free cash flow, accelerate cash returns to shareholders and expand our energy transition platform," said Francisco Leon, CRC's President and Chief Executive Officer. *"We remain committed to reducing emissions and this combination will advance our goal to permanently sequester 5 million metric tons per year of CO_2 in our underground storage vaults. We are highly confident in our ability to drive sustainable savings that will enhance shareholder returns and deliver meaningful long-term value for our stakeholders. On behalf of CRC, we look forward to working with our new colleagues at Aera. Together, this combination will create an unquestioned leader in energy transition, producing low carbon intensity fuels that California needs while accelerating the decarbonization of the State's industrial and energy industries."*

Erik Bartsch, Aera's President and Chief Executive Officer added: *"Aera and CRC are two great companies with decades of experience and track records that will serve as a foundation for a strong combination. We are committed to continuing to deliver the energy Californians need today and working to deploy carbon capture at-scale."*

Highlights:

- **Immediately accretive to key financial metrics:** Priced at approximately 2.6x enterprise value[1] / 2024E Adjusted EBITDAX[2,3], the transaction is expected to be immediately accretive to key 2024E financial metrics, and reflects approximately a 45% improvement to operating cash flow per share and 90% accretion to free cash flow per share[3].

- **Creates scale and enhances asset durability:** The transaction adds large, conventional, low decline, oil weighted, proved developed producing reserves and sustainable cash flow. Aera had average third quarter 2023 production of approximately 76 thousand barrels of oil equivalent per day (Boe/d) (95% oil) and estimated proved reserves of approximately 262 million Boe at year-end 2022[4]. On a pro forma 2024E basis, CRC will have estimated production of approximately 150 thousand Boe/d (76% oil) and proved reserves of approximately 680 million Boe[4] (90% proved developed). The combined company will own interests in five of the largest oil fields in California with opportunities to increase oil recovery.

- **Significantly increases free cash flow outlook and expands cash return to shareholders:** Pro forma 2024E free cash flow[2] is expected to more than double to approximately $685 million[3] at strip pricing as of January 25, 2024 of $79.81 Brent and $2.65 Henry Hub, and total nearly $3.0 billion[5] through 2028. Following the close of the transaction, CRC plans to allocate its free cash flow to enhance shareholder returns, reduce debt and fund opportunistic expansion of its carbon management business. The Board

has authorized a 23% increase to CRC's Share Repurchase Program to $1.35 billion and extended the program's authorization through year-end 2025. Post closing, and subject to Board approval, the Company expects to increase its fixed quarterly dividend.

- **Expands leading carbon management platform:** The combination will expand CRC's leading carbon management business through the addition of surface acreage and rights, and significant new carbon dioxide (CO_2) pore space to enable future carbon capture and sequestration (CCS) development. Through this combination, CRC will receive interests in approximately 220,000 net mineral acres with nearly 80% of the acreage within field boundaries held in mineral fee and 100,000 fee surface acres. Pro forma, CRC will have more than 1.9 million net mineral acres. CRC will also obtain 1 pending Environmental Protection Agency (EPA) Class VI permit application for 27 million metric tons (MMT) of storage capacity in the Belridge Field. CRC also expects to submit an additional Class VI permit for approximately 27MMT of storage at the Coles Levee Field. The Company will have the potential to nearly double its injection rate capacity near CTV I, creating a premier "decarbonization hub" for CO_2 storage.

- **Significant, identified synergies, with upside:** Identified synergies are expected to total $150 million annually and be realized within 15 months of closing. Cumulative synergies over the next decade have an estimated PV-10 value of nearly $1.0 billion. Synergies are expected to be realized primarily through lower operating costs, capital efficiencies, G&A reductions and optimization of shared field infrastructure.

- **Maintains strong balance sheet, enhances liquidity:** On a pro forma basis, CRC will maintain a strong balance sheet and estimates that its leverage ratio[2] will be below 0.5x within one year of closing. Pro forma, the Company expects to have more than $800 million of liquidity within one year of closing and enhanced access to capital.

- **Continued leadership across leading energy transition initiatives:** Combination of Carbon TerraVault platform and Aera's Low Carbon Solutions to enable further expansion to a variety of energy transition technologies in development including Direct Air Capture (DAC), geothermal, solar, and water treatment, and enable additional clean tech partnership opportunities with a goal to further decarbonize California

Transaction Details:

Under the terms of the merger agreement, CRC will issue 21.2 million shares of its common stock to the equity owners of Aera, and refinance Aera's outstanding debt. CRC has secured a firm commitment for a $500 million bridge loan facility to facilitate closing. At current valuations, the pro forma business would have an enterprise value of approximately $5.6 billion[1], with CRC shareholders owning approximately 77.1% of the combined company.

Aera is owned by entities managed by IKAV (51%), an international asset management group, and Canada Pension Plan Investment Board (CPP Investments) (49%). Post closing, IKAV-managed entities and CPP Investments will collectively hold 22.9% of CRC's common stock.

"*This transaction provides CPP Investments with an excellent opportunity to scale up our investment in California's energy transition, with Aera and CRC both aligned in their commitment to enabling new carbon management solutions and each bringing complementary strengths to the table*," said Bill Rogers, Managing Director, Global Head of Sustainable Energies, CPP Investments. CPP Investments' Sustainable Energies Group takes advantage of growing market opportunities as the energy sector evolves and global power demand grows, especially for low-carbon energy alternatives and carbon solutions. "*The combined company is set to play a leading role in California's energy transition, which we view as a promising source of long-term risk-adjusted returns for the CPP Fund*."

Constantin von Wasserschleben, Chairman of IKAV added: "*The combination of CRC and Aera has strong industrial logic and aligns with our philosophy to make investments that effect positive change in the world. The merger brings together the strengths of both companies, who will be better together to operate what will be the*

largest oil and gas company in California by production. We believe that the world needs access to affordable, reliable and lower carbon energy sources and we advocate a co-existence between renewable and conventional energy for decades to come. We look forward to partnering with the CRC team to shape the future path of the energy transition."

The CRC management team will run the combined company which will be headquartered in Long Beach, California, and at closing IKAV and CPP Investments will each nominate one representative to the CRC Board.

IKAV and CPP Investments will be subject to customary lock-up periods, which preclude the sale of any shares for six months after closing. At least 2/3 of issued shares will be subject to a 12 month lock up and at least 1/3 of the issued shares will be subject to an 18 month lock up period.

The merger agreement has been unanimously approved by CRC's Board of Directors and the shareholders of Aera. The transaction is subject to customary closing conditions, regulatory approvals and CRC shareholder approval. The transaction, which has an effective date of January 1, 2024, is expected to close in the second half of 2024.

Pro Forma Estimated 2024 Outlook[3]:

The transaction has an effective date of January 1, 2024 and on a combined basis CRC expects to produce between 145 and 150 MBoe/d (~76% oil) in 2024. CRC plans to run a one rig program in the first half of 2024 and will focus on workover and maintenance activity. Assuming resumption of a normalized level of new well permit approvals in the second half of 2024, CRC plans to run four to five operated rigs on a combined basis at that time. As CRC waits for the Kern County Environmental Impact Report (KCEIR) litigation ruling expected in the second quarter of 2024, management continues to seek previously started Conditional Use Permits (CUPs) for its core fields.

CRC expects to provide more complete guidance following closing of the transaction.

PRO FORMA CRC GUIDANCE	Total 2024E
Net Total Production (MBoe/d)	145 – 150
Oil Production (%)	76%
Adjusted EBITDAX[2] ($ millions)	$1,460 - $1,615
Capital ($ millions)	$420 - $470
Free Cash Flow[2] ($ millions)	$650 - $720

Note: Free cash flow is before synergies.

Shareholder Return Strategy

CRC is committed to returning significant cash to shareholders through dividends and repurchases of its common stock. On February 6, 2024, CRC's Board of Directors approved an increase of the Share Repurchase Program to $1.35 billion, an increase of $250 million, and extended the program through December 31, 2025. Adjusting for this increase, CRC has approximately $750 million of capacity remaining under the repurchase program as of December 31, 2023. Post closing, and subject to Board approval, the Company expects to increase its fixed quarterly dividend.

Conference Call Information

A conference call is scheduled for February 7, 2024, at 9:00 a.m. Eastern Time. To participate in the call, please dial (877) 328-5505 (International calls please dial +1 (412) 317-5421) or access via webcast at www.crc.com 15 minutes prior to the scheduled start time to register. Participants may also pre-register for the

conference call at https://dpregister.com/sreg/10186471/fb99757555. A digital replay of the conference call will be archived for approximately 90 days and supplemental slides for the conference call will be available online in the Investor Relations section of www.crc.com.

[1] Aera's enterprise value was calculated as 21.2 million of shares of CRC common stock based on a per share price of $46.81 as of February 2, 2024 plus $1.1B of assumed debt and other liabilities, which excludes a discounted hedge liability of ~$240MM, to be issued or assumed by CRC pursuant to the merger agreement. CRC's enterprise value was calculated as $3.5 billion assuming company's share price of $46.81 as of February 2, 2024, 71.4 million of fully diluted shares and $116MM of Net Debt[2] as of 3Q23.

[2] Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. CRC is unable to provide a reconciliation of non-GAAP financial measures contained in this release that are presented on a forward-looking basis for the described transaction because CRC is unable, without unreasonable efforts, to estimate and quantify the most directly comparable GAAP components, largely because predicting future operating results is subject to many factors outside of CRC's control and not readily predictable and that are not part of CRC's routine operating activities, including various economic, regulatory, political and legal factors.

[3] Unless otherwise noted, pro forma 2024 estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) estimated annualized synergies are excluded, and (iii) strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price, NGL realizations of 68% of crude price and Henry Hub gas price of $2.65 per MMBtu. Total pro forma capital includes combined Carbon Management Business and E&P, Corporate and Other business needs. CRC plans to run a one rig program in the first half of 2024 focusing on workover and maintenance activity. In the second half of 2024, and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals, CRC plans to run four to five rigs on a pro forma basis. Pro forma per share metrics are calculated using 92.6 million of fully diluted shares of CRC common stock post close, including 21.2 million shares of CRC common stock to be issued at closing of the transaction. All future quarterly dividends and share repurchases are subject to changes in commodity prices, restrictions under credit agreement covenants and the approval of CRC's Board. Pro forma 2024 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially. Pro forma 2024E free cash flow of $685MM represents a midpoint of a range between $650MM and $720MM.

[4] Reserves determined as of December 31, 2022 and use 2022 SEC Prices of $100.25 per barrel for oil and $6.36 per MMBtu for natural gas.

[5] The free cash flow amount shown is cumulative over the 2024-2028 period and includes impact of existing hedge settlements and excludes synergies. These estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price in 2024, $76.33 per barrel of oil in 2025 and $73.36 per barrel of oil 2026 - 2028, NGL realizations of 68% of crude price and Henry Hub gas price of $2.65 per MMBtu in 2024, $3.50 per MMBtu in 2025, $3.77 per MMBtu in 2026 and $3.78 per MMBtu 2027 - 2028, (iii) net total annual production between 145 – 150 mboepd (76% oil), (iv) decline rates between 10% to 15%, (v) G&A expenses of ~ $380MM through 2028, (vi) total pro forma capital needs of $420MM to $580MM inclusive of Carbon Management, and (vii) 4 to 5 rigs scenario starting from 2H24 and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals. Pro forma 2024 - 2028 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially.

About California Resources Corporation

CRC is an independent energy and carbon management company committed to energy transition. CRC produces some of the lowest carbon intensity oil in the US and is focused on maximizing the value of its land, mineral and technical resources for decarbonization efforts. For more information about CRC, please visit www.crc.com.

About Aera

Formed in 1997, Aera is based in Bakersfield, California, in the heart of Kern County – one of the largest oil-producing regions in the nation – with additional operations in Ventura, Monterey and Fresno counties. Aera is known for excellent safety and environmental performance. For more information about Aera, please visit www.aeraenergy.com.

About CPP Investments

Canada Pension Plan Investment Board (CPP Investments™) is a professional investment management organization that manages the Fund in the best interest of the more than 21 million contributors and beneficiaries of the Canada Pension Plan. In order to build diversified portfolios of assets, investments are made around the world in public equities, private equities, real estate, infrastructure and fixed income. Headquartered in Toronto, with offices in Hong Kong, London, Luxembourg, Mumbai, New York City, San Francisco, São Paulo and Sydney, CPP Investments is governed and managed independently of the Canada Pension Plan and at arm's length from governments. As of September 30, 2023, the Fund totaled C$576 billion. For more information, please visit www.cppinvestments.com.

About IKAV

IKAV is an international asset management group headquartered in Germany, with local offices in Luxembourg, Italy, Spain, Portugal, USA and France. The group was established in 2010. It provides institutional investors with investment solutions spanning a broad range of infrastructure energy assets, including solar, concentrated solar power, wind, energy efficiency, geothermal, thermal power plants and upstream. IKAV is a buy and hold investor with a vertically integrated business model to optimize its investment portfolio and to make its assets in line with the global net zero strategy over the upcoming decades. For more information, please visit ikav.com.

Advisors

Citi and Jefferies are serving as financial advisors and Sullivan & Cromwell LLP is serving as legal advisor to CRC. Wells Fargo acted as lead financial advisor alongside Truist and Latham & Watkins LLP is serving as legal advisor to CPP Investments & IKAV.

Additional Information and Where to Find It

This communication may be deemed to be solicitation material in respect of the transactions contemplated by the merger agreement pursuant to which California Resources Corporation (“CRC”) has agreed to combine with Aera Energy, LLC (“Aera”) (the “Merger Agreement”), including the proposed issuance of CRC’S common stock pursuant to the Merger Agreement. In connection with the transaction, CRC will file a proxy statement on Schedule 14A with the U.S. Securities and Exchange Commission (“SEC”), as well as other relevant materials. Following the filing of the definitive proxy statement, CRC will mail the definitive proxy statement and a proxy card to its stockholders. INVESTORS AND SECURITY HOLDERS OF CRC ARE URGED TO READ THE PROXY STATEMENT AND OTHER RELEVANT DOCUMENTS FILED OR TO BE FILED WITH THE SEC CAREFULLY WHEN THEY BECOME AVAILABLE BECAUSE THEY WILL CONTAIN IMPORTANT INFORMATION ABOUT CRC, Aera, THE TRANSACTION AND RELATED MATTERS. Investors and security holders will be able to obtain copies of the proxy statement (when available) as well as other filings containing information about CRC, Aera and the transaction, without charge, at the SEC’s website, www.sec.gov. Copies of documents filed with the SEC by CRC will be available, without charge, at CRC’s website, www.crc.com.

Participants in Solicitation

CRC and its directors and executive officers may be deemed to be participants in the solicitation of proxies in connection with the transaction. Information about the directors and executive officers of CRC is set forth in the proxy statement for CRC’s 2023 Annual Meeting of Stockholders, which was filed with the SEC on March 16, 2023. Investors may obtain additional information regarding the interest of such participants by reading the proxy statement regarding the transaction when it becomes available.

Cautionary Note Regarding Forward-Looking Statements

This communication contains statements that CRC believes to be “forward-looking statements” within the meaning of the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. All statements other than historical facts are forward-looking statements, and include statements regarding the benefits of the transaction, CRC's future financial position and operating results, business strategy, projected revenues, earnings, costs, capital expenditures and plans, objectives and intentions of management for the future. Words such as "expect," "could," "may," "anticipate," "intend," "plan," “ability,” "believe," "seek," "see," "will," "would," "estimate," "forecast," "target," "guidance," "outlook," "opportunity" or "strategy" or similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements are based upon the current beliefs and expectations of the management of CRC and are subject to risks and uncertainties that could cause actual results to differ materially from those expressed in, projected in, or implied by, such statements. Although CRC believes the expectations and forecasts reflected in its forward-looking statements are reasonable, they are inherently subject to numerous risks and uncertainties, most of which are difficult to predict and many of which are beyond CRC's control. No assurance can be given that such forward-looking statements will be

correct or achieved or that the assumptions are accurate or will not change over time. Particular uncertainties that could cause CRC's actual results to be materially different from those described in the forward-looking statements include:

(i) the timing, receipt and terms and conditions of any required governmental and regulatory approvals of the transaction that could reduce anticipated benefits or cause the parties to abandon the transaction,
(ii) the occurrence of any event, change or other circumstances that could give rise to the termination of the merger agreement,
(iii) the possibility that stockholders of CRC may not approve the issuance of new shares of common stock in the transaction,
(iv) the risk that any of the other closing conditions to the transaction may not be satisfied in a timely manner,
(v) transaction costs,
(vi) unknown liabilities,
(vii) the risk that any announcements relating to the transaction could have adverse effects on the market price of CRC's common stock,
(viii) the ability to successfully integrate the businesses,
(ix) the ability to achieve projected operational and capital synergies and the risk it may take longer than expected to achieve those synergies,
(x) the risk the pending transaction could distract management from ongoing operations,
(xi) the effects of disruption to CRC's or Aera's respective businesses and operations, including the ability of CRC and Aera to retain customers and retain and hire key personnel and maintain relationships with their suppliers and customers,
(xii) the ability of CRC to obtain the required debt financing pursuant to its commitment letters and, if obtained, the potential impact of additional debt on CRC's business and the financial impacts and restrictions due to the additional debt,
(xiii) risks related to potential litigation brought in connection with the transaction,
(xiv) risks related to financial community and rating agency perceptions of CRC or Aera or their respective businesses, operations, financial condition and the industry in which they operate,
(xv) risks related to the potential impact of general economic, political and market factors on CRC, Aera or the transaction, and
(xvi) those expressed in its forward-looking statements including those factors discussed in Part I, Item 1A – Risk Factors in CRC's Annual Report on Form 10-K and its other SEC filings available at www.crc.com.

CRC cautions you not to place undue reliance on forward-looking statements contained in this communication, which speak only as of the filing date, and CRC is under no obligation, and expressly disclaims any obligation to update, alter or otherwise revise any forward-looking statements, whether as a result of new information, future events or otherwise. This communication contains information from third party sources, including information from Aera regarding its assets, operations and results. This data may involve a number of assumptions and limitations. CRC has not independently verified such third-party information and does not warrant the accuracy or completeness of such information.

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EX-99.2 3 exhibit992202403078k.htm EX-99.2

Expanding Our Leading Energy Platform

Complementary Assets and Highly Accretive Transaction

CALIFORNIA RESOURCES CORPORATION | AERA Great Todays. Better Tomorrows.

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Forward-Looking / Cautionary Statements – Certain Terms

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Additional Information and Where to Find It

This communication may be deemed to be solicitation material in respect of the transactions contemplated by the merger agreement pursuant to which California Resources Corporation ("CRC") has agreed to combine with Aera Energy, LLC ("Aera") (the "Merger Agreement"), including the proposed issuance of CRC'S common stock pursuant to the Merger Agreement. In connection with the transaction, CRC will file a proxy statement on Schedule 14A with the U.S. Securities and Exchange Commission ("SEC"), as well as other relevant materials. Following the filing of the definitive proxy statement, CRC will mail the definitive proxy statement and a proxy card to its stockholders. INVESTORS AND SECURITY HOLDERS OF CRC ARE URGED TO READ THE PROXY STATEMENT AND OTHER RELEVANT DOCUMENTS FILED OR TO BE FILED WITH THE SEC CAREFULLY WHEN THEY BECOME AVAILABLE BECAUSE THEY WILL CONTAIN IMPORTANT INFORMATION ABOUT CRC, Aera, THE TRANSACTION AND RELATED MATTERS. Investors and security holders will be able to obtain copies of the proxy statement (when available) as well as other filings containing information about CRC, Aera and the transaction, without charge, at the SEC's website, www.sec.gov. Copies of documents filed with the SEC by CRC will be available, without charge, at CRC's website, www.crc.com.

Participants in Solicitation

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(ii) the occurrence of any event, change or other circumstances that could give rise to the termination of the merger agreement,
(iii) the possibility that stockholders of CRC may not approve the issuance of new shares of common stock in the transaction,
(iv) the risk that any of the other closing conditions to the transaction may not be satisfied in a timely manner,
(v) transaction costs,
(vi) unknown liabilities,
(vii) the risk that any announcements relating to the transaction could have adverse effects on the market price of CRC's common stock,
(viii) the ability to successfully integrate the businesses,
(ix) the ability to achieve projected operational and capital synergies and the risk it may take longer than expected to achieve those synergies,
(x) the risk the pending transaction could distract management from ongoing operations,
(xi) the effects of disruption to CRC's or Aera's respective businesses and operations, including the ability of CRC and Aera to retain customers and retain and hire key personnel and maintain relationships with their suppliers and customers,
(xii) the ability of CRC to obtain the required debt financing pursuant to its commitment letters and, if obtained, the potential impact of additional debt on CRC's business and the financial impacts and restrictions due to the additional debt,
(xiii) risks related to potential litigation brought in connection with the transaction,
(xiv) risks related to financial community and rating agency perceptions of CRC or Aera or their respective businesses, operations, financial condition and the industry in which they operate,
(xv) risks related to the potential impact of general economic, political and market factors on CRC, Aera or the transaction and
(xvi) those expressed in its forward-looking statements including those factors discussed in Part I, Item 1A – Risk Factors in CRC's Annual Report on Form 10-K and its other SEC filings available at www.crc.com.

CRC cautions you not to place undue reliance on forward-looking statements contained in this communication, which speak only as of the filing date, and CRC is under no obligation, and expressly disclaims any obligation to update, alter or otherwise revise any forward-looking statements, whether as a result of new information, future events or otherwise. This communication contains information from third party sources, including information from Aera regarding its assets, operations and results. This data may involve a number of assumptions and limitations. CRC has not independently verified such third-party information and does not warrant the accuracy or completeness of such information.

Non-GAAP Financial Measures:

This presentation contains certain financial measures that are not prepared in accordance with generally accepted accounting principles ("GAAP"). These measures are identified with an "*" and include Adjusted EBITDAX, PV-10, Leverage Ratio, Net Debt, Liquidity and Free Cash Flow. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. CRC is unable to provide a reconciliation of non-GAAP financial measures contained in this presentation that are presented on a forward-looking basis for the described transaction because CRC is unable, without unreasonable efforts, to estimate and quantify the most directly comparable GAAP components, largely because predicting future operating results is subject to many factors outside of CRC's control and not readily predictable and that are not part of CRC's routine operating activities, including various economic, regulatory, political and legal factors.

Complementary Combination, Higher Returns & Enhanced Platform

A DIFFERENT KIND OF ENERGY COMPANY

+ AERA

TRANSACTION SUMMARY

Transaction Value[1]

$2.1B

Pro Forma CRC Ownership

77%

CRC to Issue 21.2 Million Shares

$500MM Committed Bridge Financing

CRC to Lead Combined Business

CPP Investments and IKAV Will Appoint 2 New Directors to CRC's Board

ATTRACTIVELY PRICED AND ACCRETIVE TO KEY FINANCIAL METRICS

- Priced at 2.6x EV[1]/2024E Adj. EBITDAX*; Expected to more than double CRC's 2024E free cash flow*

CREATES SCALE, ENHANCES ASSET DURABILITY

- Expecting to more than double CRC's oil production; Oil % increases from 60% to 76%

EXPANDS CALIFORNIA'S LEADING ENERGY AND CARBON PLATFORM

- Doubles CTV's premium CO_2 pore space capacity and improves ability to service emissions in San Joaquin Basin

SIGNIFICANT SYNERGIES WITH UPSIDE

- Expect ~$150MM in ongoing synergies within 15 months post close *(assuming consistent activity set);* ~10% improvement in pro forma 2024E breakeven price[2]

MAINTAIN STRONG BALANCE SHEET & SHAREHOLDER RETURNS STRATEGY

- Expect leverage ratio* of <0.5x within 12 months post close; Increase SRP to $1.35B and expecting to raise quarterly dividend post close

See Slide 16 "Assumptions, Estimates and Endnotes" and for information regarding pro forma 2024 estimates.

Aera Assets Overview

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Combining With California's Second Largest Oil Producer[1]

HIGH QUALITY ASSETS

- Vast, conventional, low-decline, 95% oil-weighted
- Acreage position largely held in fee
- Long history of successful infill developments
- Owned in-field infrastructure

STRONG FREE CASH FLOW GENERATION

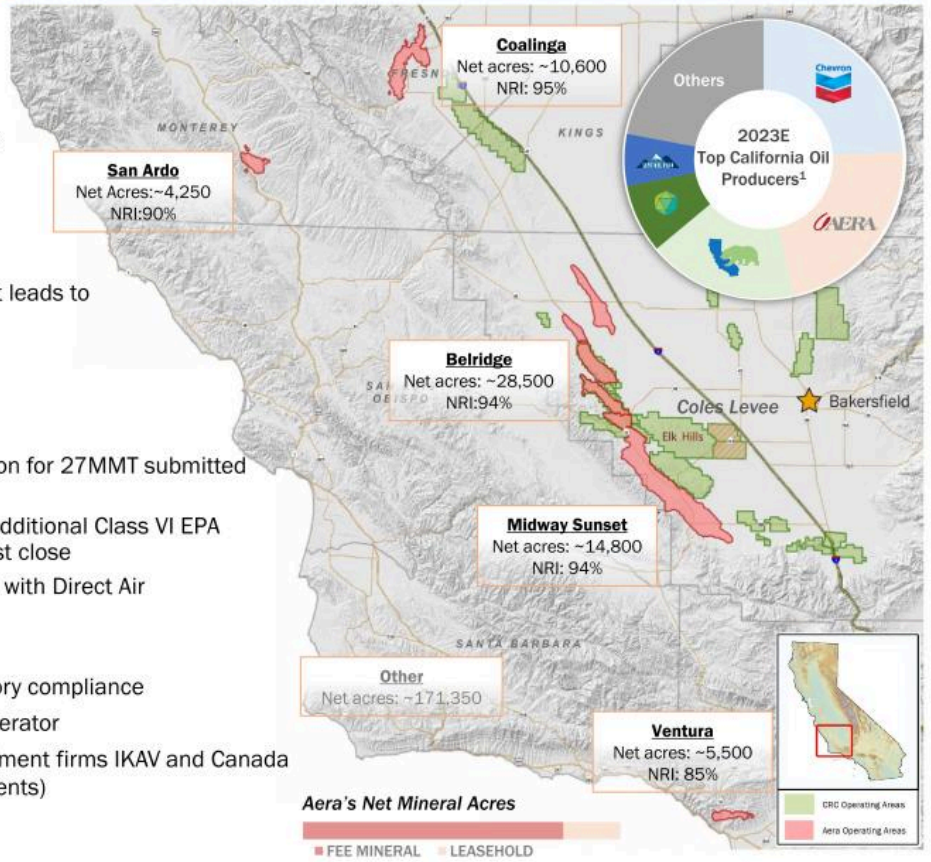
- Strong revenue based on Brent-index pricing
- Low royalty burden with 95% average NRI that leads to strong margins
- 25 years of profitable and safe operations[2]

SIGNIFICANT CARBON POTENTIAL

- CCS/CO_2 storage potential:
  - Belridge: Class VI EPA permit application for 27MMT submitted and on track for 2025 approval[2]
  - Coles Levee: CRC plans to submit an additional Class VI EPA permit for ~27MMT of CO_2 storage post close
- Additional carbon management opportunities with Direct Air Capture(DAC) and solar

TOP TIER, PROVEN OPERATOR

- Strong focus on the environment and regulatory compliance
- More than 25 years as a trusted California operator
- Legacy Exxon and Shell JV; acquired by investment firms IKAV and Canada Pension Plan Investment Board (CPP Investments)



See Slide 16 "Assumptions, Estimates and Endnotes".

California's Premier Energy Platform

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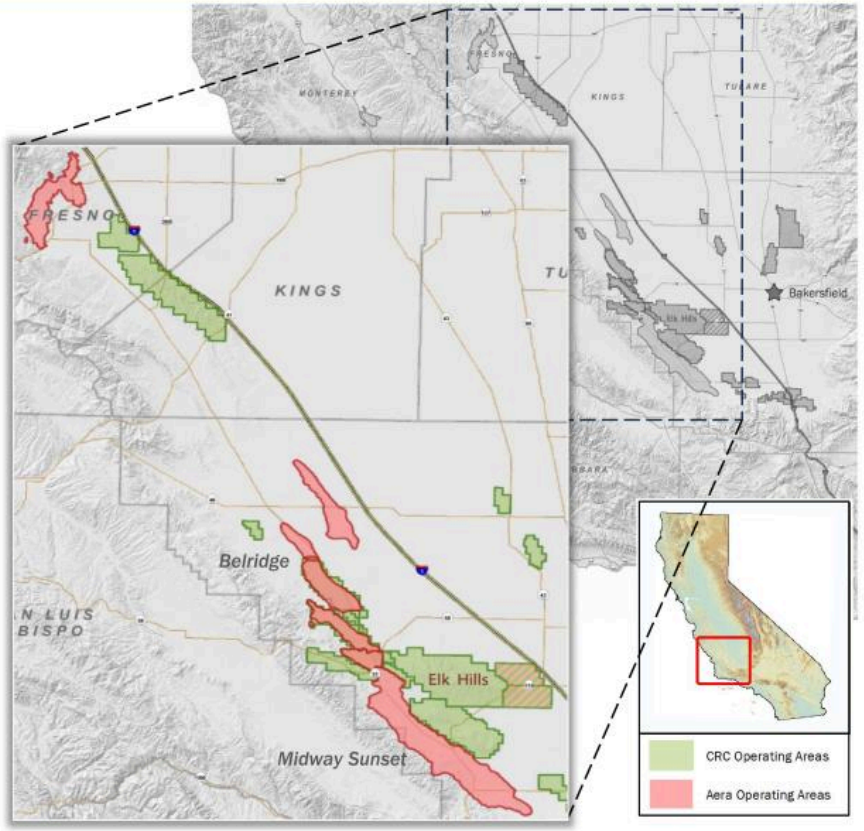
Operating and Financial Metrics

		AERA	Pro Forma
Operating Metrics			
3Q23 Net Total Production (MBOED)	85	76	**161**
3Q23 Oil (%)	60%	95%	**76%**
PDP Decline (%)	10% - 15%	10% - 15%	**10% - 15%**
NRI (%)	86%	95%	**91%**
Net Mineral Acres ('000s)	1,692	220	**1,912**
2022 Reserves[1] (MMBOE)	417	262	**679**
Financial Estimates *(to be updated post close)*			
'24E Adj. EBITDAX* ($MM)	$690 - $765	$770 - $850	**$1,460 - $1,615**
'24E Free Cash Flow* ($MM) *(before synergies)*	$270 - $300	$380 - $420	**$650 - $720**
'24E Leverage Ratio*	0.0x	0.7x	**<0.5x**
2024E CMB Metrics			
SJB Storage Capacity (MMT)	46	54[2]	**100**
Class VI Permits Filed with the EPA	6	2[2]	**8**
Surface Net Acres ('000s)	102	100	**202**
BTM Solar Projects Capacity (MW)	38MW	50MW	**88MW**

Higher Cashflow » Less Carbon » Better California

Complementary Assets



See Slide 16 "Assumptions, Estimates and Endnotes" and for information regarding pro forma 2024 estimates.

Strengthening Our Carbon TerraVault Story

Doubling Premium Pore Space in The San Joaquin Basin

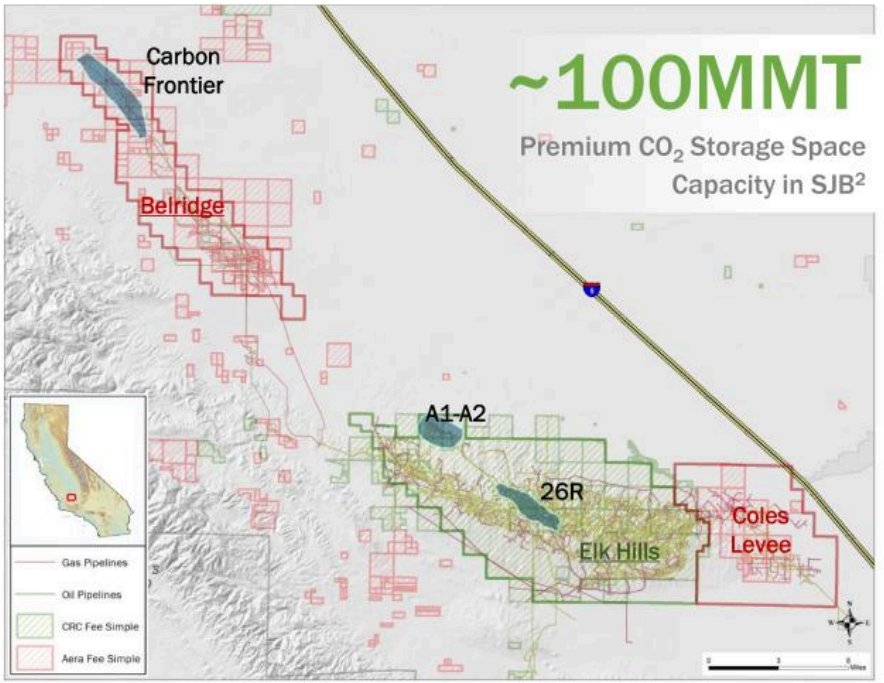
- Acquiring **large, fee simple[1] and bolt-on assets** helps streamline storage development
- **Up to 54MMT of additional CO_2 storage potential**
  - Class VI permit filed for 27MMT of CO_2 storage, on track for 2025 approval
  - CRC plans to submit an additional Class VI permit for ~27MMT of CO_2 storage[2]

Increasing Economic Potential

- New reservoirs would be eligible to be presented to CTV JV, potential for **Brookfield contributions[3]** *($10/MT buy-in for the estimated metric tons of storage capacity net to Brookfield's 49% percent ownership in the CTV JV)*
- **Incremental pore space has potential EBITDA*,[3] of $70MM to $180MM** *(CTV type curve "storage only" to "full service" business model over a standardized 40-year project life and fully subscribed)*

Aligning CRC with California's Decarbonization Goals

- New ownership of Aera's brownfield emissions and sequestration **reservoirs improves integrated project economics** and **unlocks a faster path to decarbonization**
- Able to provide carbon storage for 100MMT of emissions in the San Joaquin Basin
- **Adds additional emissions reducing opportunities with Solar and DAC**
- Positions **CRC** as **California's Decarbonization Operator of Choice**



See Slide 16 "Assumptions, Estimates and Endnotes".

Expanding Cash Flow and Free Cash Flow Generation

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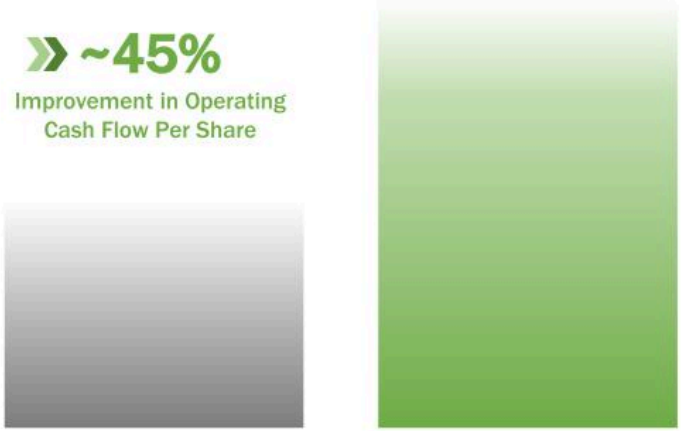
~80% of pro forma 2024E net oil production hedged, underpins cash flow

Pro forma 2024E ~90% uplift in cash flow from operations and >140% in free cash flow* further enhanced by synergies *(assuming consistent Brent prices)*

Robust free cash flow generation allows for acceleration of shareholder returns, rapid debt reduction and future growth opportunities

Accretive to Operating Cash Flow Per Share

~45%
Improvement in Operating Cash Flow Per Share



Resilient Free Cash Flow* Generation

See slide 16 for information regarding pro forma 2024 estimates.

Top-Tier Independent, Low Decline, Conventional Oil Producer

See Slide 16 "Assumptions, Estimates and Endnotes" and for information regarding pro forma 2024 estimates.

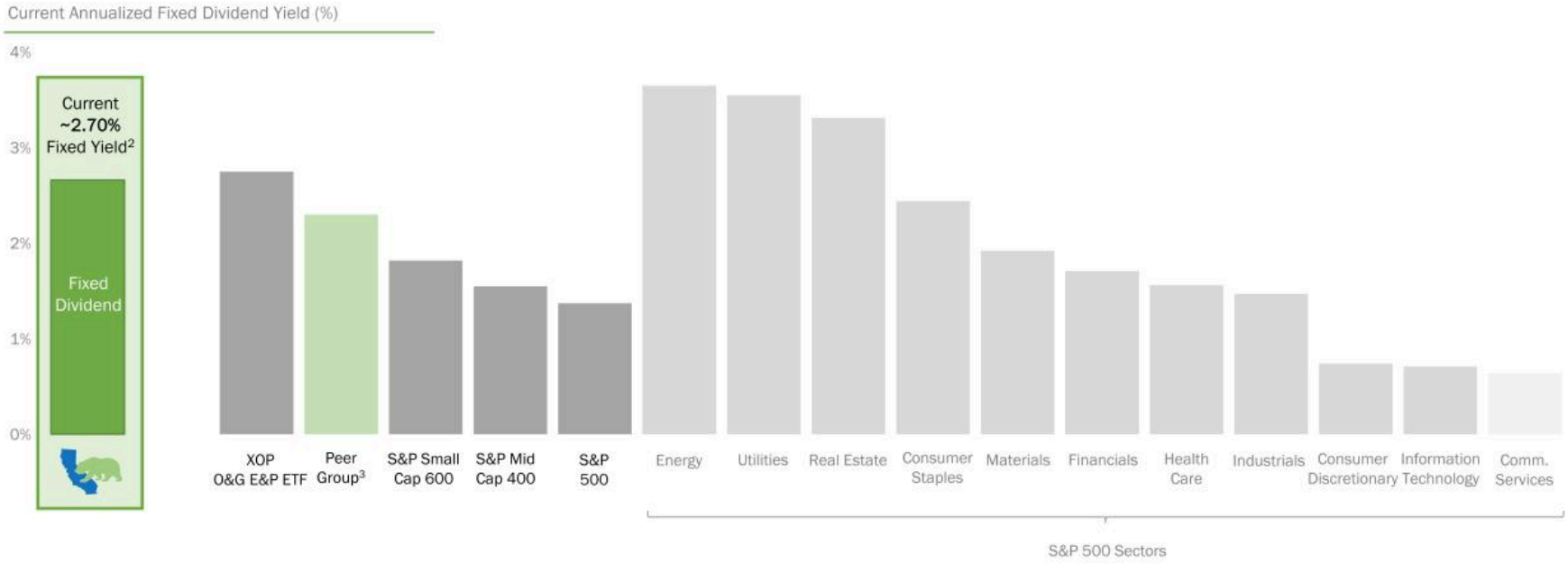
Synergies to Drive Significant Cost Savings

~$1.0B PV-10 of Est. Organic Synergies Over 10 Years

See Slide 16 "Assumptions, Estimates and Endnotes".

Compelling Shareholder Returns Program[1]

- Intend to raise quarterly fixed dividend post close
- Competitive current fixed dividend yield vs. market participants
- Expanding SRP[1] ~23% to $1.35B and extending through December 31, 2025 with $747MM remaining capacity



See Slide 17 "Assumptions, Estimates and Endnotes".

Significant FCF Drives Shareholder Returns, Balance Sheet Strength & Growth Opportunities

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Post Close:

- **Invest to Maintain Flat Production**
- **Free Cash Flow Deployment Priorities**

1. SHAREHOLDER RETURNS	**Return Significant Cash to Shareholders** ▪ Intends to increase fixed dividend ▪ Opportunistic buybacks with $747MM remaining authorization[2]
2. BALANCE SHEET STRENGTH	**Maintain Low Leverage Ratio*** ▪ Projecting pro forma leverage ratio of <0.5x within 12 months post close
3. GROWTH INVESTMENTS	**Invest for the Future** ▪ Advance and grow the Carbon Management Business

See slide 16 for information regarding pro forma 2024 estimates. See Slide 17 "Assumptions, Estimates and Endnotes".

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Accretive Across Key Financial Metrics

Creates Scale and Asset Durability

Enhances Cash Flow, Increases Free Cash Flow Available for Shareholder Returns, Maintains Strong Balance Sheet[1]

Expands Leading Carbon Management Platform and Continued Leadership Across Sustainability Initiatives

Appendix

Pro Forma 2024 Estimates *(complete guidance available at closing)*

A DIFFERENT KIND OF ENERGY COMPANY

Net Total Production
145 – 150MBOE/D
(76% oil)

Adj. EBITDAX*
$1,460 – $1,615MM
(before synergies)

Capital
$420 – $470MM
(before synergies)

Free Cash Flow*
$650 – $720MM
(before synergies)

Higher **Cashflow** » Less **Carbon** » Better **California**

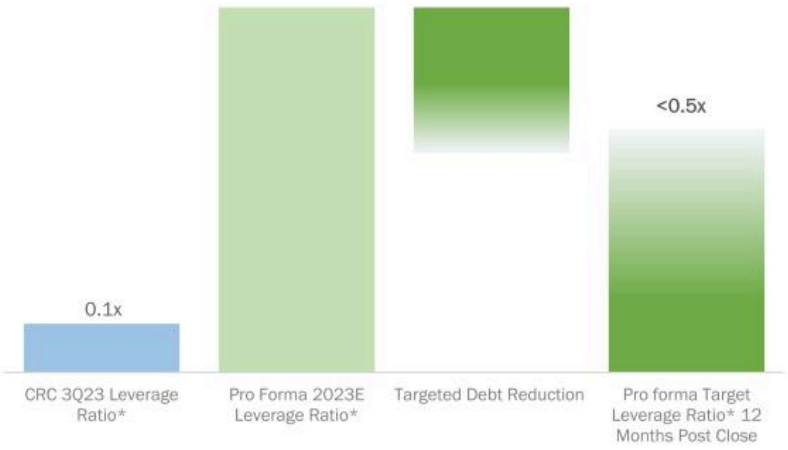
Low Carbon Intensity Production
Midstream Infrastructure
Carbon Capture & Storage
BTM Solar Opportunities
FTM/Grid Power Production
Geothermal Opportunities

See Slide 17 "Assumptions, Estimates and Endnotes".

Strong Capital Structure & Credit Profile

Transaction Value	$2.1B
Equity *(21.2 million shares at $46.81 per share as of February 2, 2024)*	~$1.0B
Assumed Debt and Other[1]	~$1.1B

Path to Target Leverage Ratio[2] ($MM)



Transaction Summary

- 21.2MM shares of CRC's common stock to be issued to Aera's owners, IKAV managed entities and CPP Investments, with CRC's pro forma share count of 92.6MM of fully diluted shares
- Expect to have more than $800 million of liquidity within one year post close[2] and enhanced access to capital
- Commitment to achieve a leverage ratio* <0.5x within one year post close[2]

Strong Balance Sheet Position, Ample Liquidity and Financial Flexibility

See slide 16 for information regarding pro forma 2024 estimates. See Slide 17 "Assumptions, Estimates and Endnotes". * Leverage and debt levels are net.

Assumptions, Estimates and Endnotes:

Pro forma 2024 estimates. This presentation includes certain forward-looking estimates of our pro forma combined operating and financial results for the year ended December 31, 2024. Unless otherwise noted, pro forma 2024 estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) estimated annualized synergies outlined on slide 9 are excluded, and (iii) strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price, NGL realizations of 68% of crude price and Henry Hub gas price of $2.65 per MMBtu. Total pro forma capital includes combined Carbon Management Business and E&P, Corporate and Other business needs. CRC plans to run a one rig program in the first half of 2024 focusing on workover and maintenance activity. In the second half of 2024, and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals, CRC plans to run four to five rigs on a pro forma basis. Pro forma per share metrics are calculated using 92.6 million of fully diluted shares of CRC common stock post close, including 21.2 million shares of CRC common stock to be issued at closing of the transaction. All future quarterly dividends and share repurchases are subject to changes in commodity prices, restrictions under credit agreement covenants and the approval of CRC's Board. Pro forma 2024 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially.

Endnotes:

Slide 3:

(1) Aera's enterprise value was calculated as 21.2 million of shares of CRC common stock based on a per share price of $46.81 as of February 2, 2024 plus $1.1B of assumed debt and other liabilities, which excludes a discounted hedge liability of ~$240MM, to be issued or assumed by CRC pursuant to the merger agreement. CRC's enterprise value was calculated as $3.5B assuming company's share price of $46.81 as of February 2, 2024, 71.4 million of fully diluted shares and $116MM of Net Debt* as of 3Q23. (2) Breakeven price represents the Brent price that CRC expects will generate sufficient revenue to allow CRC to cover its operating costs, taxes other than on income, capital expenditures and debt service. Breakeven price assumes pro forma 2024 estimates outlined on slide 14.

Slide 4:

(1) Source: Enverus 2023 data as of February 2, 2024. In 2023, California's oil producers accounted for approximatively 23% of oil consumed by local refiners in California, source: www.energy.ca.gov. (2) EPA.gov.

Slide 5:

(1) Reserves determined as of December 31, 2022 and use 2022 SEC Prices of $100.25 per barrel for oil and $6.36 per MMBtu for natural gas. (2) Includes 27MMT Carbon Frontier Class VI permit submitted to EPA and a 27MMT Class VI EPA permit at Coles Levee that CRC plans to file in a reasonable period of time after close.

Slide 6:

(1) Fee simple covers ~95% of storage plume as per CRC internal estimates. (2) Internal CRC estimates. Includes unsubmitted permit for 27MMT for Coles Levee. (3) See slides 42 to 45 in CRC's 2024 January deck for the details on the CTV JV and CTV JV project economic type curve assumptions. EBITDA estimates include 45Q tax credits. Results subject to effects of taxes, timing, pace of project development and Brookfield further approval to fund capital and participate in the CCS projects. (4) EPA.gov

Slide 8:

(1) Peer group's production data from FactSet as of February 1, 2024. (2) Reserves determined as of December 31, 2022 and use 2022 SEC Prices of $100.25 per barrel for oil and $6.36 per MMBtu for natural gas. (4) Peer group average PDP oil decline rate consists of public data from Enverus (January 2024) except for (a) CRGY PDP decline rate of 20% as per company's 3Q23 earnings presentation, and (b) BRY's PDP decline rate of 13% as per Jefferies initiation report from October 18, 2022.

Slide 9:

(1) Represents all operating expenses and capital expenditures. (2) Excludes costs to achieve savings and taxes.

Assumptions, Estimates and Endnotes (cont.):

Endnotes (cont.):

Slide 10:

(1) Future quarterly dividends and share repurchases are subject to changes in commodity prices, restrictions in our credit agreement covenants and approval of CRC's Board. (2) Represents annualized 2024E fixed dividend by CRC's market capitalization as of February 2, 2024. Sector yields sourced from FactSet as of February 2, 2024. (3) Peer dividend data from FactSet as of February 2, 2024. Peer group includes: BRY, CHRD, CIVI, CPE, CRGY, KOS, MGY, MTDR, MUR, PR, SM, TALO and VTLE.

Slide 11:

(1) The free cash flow amount shown is cumulative over the 2024-2028 period includes impact of existing hedge settlements and excludes synergies. These estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) $65, $75 and $85 per barrel of oil Brent price through 2024 - 2028, NGL realizations of 68% of crude price and SoCal Border gas price of $3.50, $4.00 and $4.50 per MMBtu through 2024 - 2028, respectively, (iii) net total annual production between 145 – 150 mboepd (76% oil), (iv) decline rates between 10% to 15%, (v) G&A expenses of ~ $380MM through 2028, (vi) total pro forma capital needs of $420MM to $580MM inclusive of Carbon Management, and (vii) 4 to 5 rigs scenario starting from 2H24 and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals. Pro forma 2024 - 2028 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially. (2) All CRC's future quarterly dividends and share repurchases are subject to commodity prices, credit agreement covenants and Board of Directors approval. These preliminary estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially. (3) 2024E leverage metrics data from FactSet as of February 1, 2024. Peer group includes: BRY, CHRD, CIVI, CPE, CRGY, KOS, MGY, MTDR, MUR, PR, SM, TALO and VTLE. (4) Targeted pro forma leverage ratio of ~0.5x within 12 months post close.

Slide 12:

(1) Assuming consistent Brent prices.

Slide 15:

(1) Debt and other includes long term debt, deferred consideration, make-whole obligations, and excludes the mark-to-market $240MM value of hedges among other items. (2) The liquidity range and target leverage ratio 12 months post close were calculated (i) use of strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price, NGL realizations of 68% of crude price and Henry Hub gas price of $2.65 per MMBtu, (ii) assuming transaction closed on January 1, 2024, subject to customary closing conditions, regulatory approvals and CRC shareholder approval, (iii) estimated liquidity at 12/31/24 calculated as unrestricted cash of $335MM and $630MM capacity on CRC's Revolving Credit Facility less $153MM in outstanding letters of credit, and (iii) partial realization of synergies due to a smaller period. These preliminary estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially.

Glossary

Term	Definition
Bcf	Billion Cubic Feet
BMT	Billion Metric Tons
CARB	California Air Resources Board
CCS	Carbon Capture and Storage
CCS+	Carbon Capture and Storage + EOR
CDMA	Carbon Dioxide Management Agreement
CEQA	California Environmental Quality Act
CGP	Cryogenic Gas Plant
CI	Carbon Intensity
CMB	Carbon Management Business
CO_2	Carbon Dioxide
CTV	Carbon TerraVault (a subsidiary of CRC)
DAC	Direct Air Capture
D&C	Drilling and Completions
E&P	Exploration and Production
EHPP	Elk Hills Power Plant
EIR	Environmental Impact Report
EOR	Enhanced Oil Recovery
EPA	Environmental Protection Agency
ESG	Environmental, Social and Governance
EV	Enterprise Value
FCF	Free Cash Flow
FEED	Front End Engineering and Design
FID	Final Investment Decision
GHG	Greenhouse Gas
IRR	Internal Rate of Return

Term	Definition
KMTPA	Thousand Metric Tons Per Annum
LCFS	Low Carbon Fuel Standard
MMT	Million Metric Tons
MMTPA	Million Metric Tons Per Annum
MRV	Monitoring, Reporting and Verification Plan
MT	Metric Tons
MTPA	Metric Tons Per Annum
ND	Net Debt
NRI	Net Revenue Interest
OCF	Operating Cash Flow
PD	Proved Developed
PDP	Proved Developed Producing
PF	Pro Forma
PUD	Proved Undeveloped
RSG	Responsibly Sourced Gas
ROFL	Right of First Look
R/P	Reserves to Production Ratio
RTC	Round-the-Clock
SFDR	Sustainable Finance Disclosure Regulation
SRP	Share Repurchase Program
SJB	San Joaquin Basin
SJV	San Joaquin Valley
TBA	To Be Announced
Tcf	Trillion Cubic Feet
WI	Working Interest

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California Resources Corporation to Combine with Aera Energy

07 Feb, 2024

Transaction highly accretive across key 2024E financial metrics

Complementary assets to significantly scale E&P business and expand leading carbon management platform

LONG BEACH, Calif.--(BUSINESS WIRE)-- California Resources Corporation (NYSE: CRC) today announced the signing of a definitive merger agreement to combine with Aera Energy, LLC (Aera) in an all-stock transaction. The transaction values Aera at approximately $2.1 billion, inclusive of Aera's net debt and certain other obligations[1], and is expected to be immediately accretive. At closing, Aera's owners will receive 21.2 million shares of CRC's common stock, equal to approximately 22.9% of CRC's fully diluted shares.

"This strategic transaction will create scale in our operations, generate significant free cash flow, accelerate cash returns to shareholders and expand our energy transition platform," said Francisco Leon, CRC's President and Chief Executive Officer. *"We remain committed to reducing emissions and this combination will advance our goal to permanently sequester 5 million metric tons per year of CO_2in our underground storage vaults.We are highly confident in our ability to drive sustainable savings that will enhance shareholder returns and deliver meaningful long-term value for our stakeholders. On behalf of CRC, we look forward to working with our new colleagues at Aera. Together, this combination will create an unquestioned leader in energy transition, producing low carbon intensity fuels that California needs while accelerating the decarbonization of the State's industrial and energy industries."*

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Erik Bartsch, Aera's President and Chief Executive Officer, added: "*Aera and CRC are two great companies with decades of experience and track records that will serve as a foundation for a strong combination. We are committed to continuing to deliver the energy Californians need today and working to deploy carbon capture at-scale.*"

Highlights:

- **Immediately accretive to key financial metrics:**Priced at approximately 2.6x enterprise value[1] / 2024E Adjusted EBITDAX[2,3], the transaction is expected to be immediately accretive to key 2024E financial metrics, and reflects approximately a 45% improvement to operating cash flow per share and 90% accretion to free cash flow per share[3].
- **Creates scale and enhances asset durability:** The transaction adds large, conventional, low decline, oil weighted, proved developed producing reserves and sustainable cash flow. Aera had average third quarter 2023 production of approximately 76 thousand barrels of oil equivalent per day (Boe/d) (95% oil) and estimated proved reserves of approximately 262 million Boe at year-end 2022[4]. On a pro forma 2024E basis, CRC will have estimated production of approximately 150 thousand Boe/d (76% oil) and proved reserves of approximately 680 million Boe[4] (90% proved developed). The combined company will own interests in five of the largest oil fields in California with opportunities to increase oil recovery.
- **Significantly increases free cash flow outlook and expands cash return to shareholders:**Pro forma 2024E free cash flow[2] is expected to more than double to approximately $685 million[3] at strip pricing as of January 25, 2024 of $79.81 Brent and $2.65 Henry Hub, and total nearly $3.0 billion[5] through 2028. Following the close of the transaction, CRC plans to allocate its free cash flow to enhance shareholder returns, reduce debt and fund opportunistic expansion of its carbon management business. The Board has authorized a 23% increase to CRC's Share Repurchase Program to $1.35 billion and extended the program's authorization through year-end 2025. Post closing, and subject to Board approval, the Company expects to increase its fixed quarterly dividend.
- **Expands leading carbon management platform:** The combination will expand CRC's leading carbon management business through the addition of surface acreage and rights, and significant new carbon dioxide (CO_2) pore space to enable future carbon capture and sequestration (CCS) development. Through this combination, CRC will receive interests in approximately 220,000 net mineral acres with nearly 80% of the

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acreage within field boundaries held in mineral fee and 100,000 fee surface acres. Pro forma, CRC will have more than 1.9 million net mineral acres. CRC will also obtain 1 pending Environmental Protection Agency (EPA) ClassVI permit application for 27 million metric tons (MMT) of storage capacity in the Belridge Field. CRC also expects to submit an additional Class VI permit for approximately 27MMT of storage at the Coles Levee Field. The Company will have the potential to nearly double its injection rate capacity near CTV I, creating a premier "decarbonization hub" for CO_2 storage.

- **Significant, identified synergies, with upside:** Identified synergies are expected to total $150 million annually and be realized within 15 months of closing. Cumulative synergies over the next decade have an estimated PV-10 value of nearly $1.0 billion. Synergies are expected to be realized primarily through lower operating costs, capital efficiencies, G&A reductions and optimization of shared field infrastructure.
- **Maintains strong balance sheet, enhances liquidity:** On a pro forma basis, CRC will maintain a strong balance sheet and estimates that its leverage ratio[2] will be below 0.5x within one year of closing. Pro forma, the Company expects to have more than $800 million of liquidity within one year of closing and enhanced access to capital.
- **Continued leadership across leading energy transition initiatives:** Combination of Carbon TerraVault platform and Aera's Low Carbon Solutions to enable further expansion to a variety of energy transition technologies in development including Direct Air Capture (DAC), geothermal, solar, and water treatment, and enable additional clean tech partnership opportunities with a goal to further decarbonize California

Transaction Details:

Under the terms of the merger agreement, CRC will issue 21.2 million shares of its common stock to the equity owners of Aera, and refinance Aera's outstanding debt. CRC has secured a firm commitment for a $500 million bridge loan facility to facilitate closing. At current valuations, the pro forma business would have an enterprise value of approximately $5.6 billion[1], with CRC shareholders owning approximately 77.1% of the combined company.

Aera is owned by entities managed by IKAV (51%), an international asset management group, and Canada Pension Plan Investment Board (CPP Investments) (49%). Post closing, IKAV-managed entities and CPP Investments will collectively hold 22.9% of CRC's common stock.

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"*This transaction provides CPP Investments with an excellent opportunity to scale up our investment in California's energy transition, with Aera and CRC both aligned in their commitment to enabling new carbon management solutions and each bringing complementary strengths to the table*," said Bill Rogers, Managing Director, Global Head of Sustainable Energies, CPP Investments. CPP Investments' Sustainable Energies Group takes advantage of growing market opportunities as the energy sector evolves and global power demand grows, especially for low-carbon energy alternatives and carbon solutions. "*The combined company is set to play a leading role in California's energy transition, which we view as a promising source of long-term risk-adjusted returns for the CPP Fund*."

Constantin von Wasserschleben, Chairman of IKAV, added: "*The combination of CRC and Aera has strong industrial logic and aligns with our philosophy to make investments that effect positive change in the world. The merger brings together the strengths of both companies, who will be better together to operate what will be the largest oil and gas company in California by production. We believe that the world needs access to affordable, reliable and lower carbon energy sources and we advocate a co-existence between renewable and conventional energy for decades to come. We look forward to partnering with the CRC team to shape the future path of the energy transition*."

The CRC management team will run the combined company which will be headquartered in Long Beach, California, and at closing IKAV and CPP Investments will each nominate one representative to the CRC Board.

IKAV and CPP Investments will be subject to customary lock-up periods, which preclude the sale of any shares for six months after closing. At least 2/3 of issued shares will be subject to a 12 month lock up and at least 1/3 of the issued shares will be subject to an 18 month lock up period.

The merger agreement has been unanimously approved by CRC's Board of Directors and the shareholders of Aera. The transaction is subject to customary closing conditions, regulatory approvals and CRC shareholder approval. The transaction, which has an effective date of January 1, 2024, is expected to close in the second half of 2024.

Pro Forma Estimated 2024 Outlook[3]:

The transaction has an effective date of January 1, 2024 and on a combined basis CRC expects to produce between 145 and 150 MBoe/d (~76% oil) in 2024. CRC plans to run a one rig program in the first half of 2024 and will focus on workover and maintenance activity. Assuming resumption of a normalized level of new well permit approvals in the

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second half of 2024, CRC plans to run four to five operated rigs on a combined basis at that time. As CRC waits for the Kern County Environmental Impact Report (KCEIR) litigation ruling expected in the second quarter of 2024, management continues to seek previously started Conditional Use Permits (CUPs) for its core fields.

CRC expects to provide more complete guidance following closing of the transaction.

PRO FORMA CRC GUIDANCE	Total 2024E
Net Total Production (MBoe/d)	145 – 150
Oil Production (%)	76%
Adjusted EBITDAX[2] ($ millions)	$1,460 - $1,615
Capital ($ millions)	$420 - $470
Free Cash Flow[2] ($ millions)	$650 - $720
Note: Free cash flow is before synergies.	

Shareholder Return Strategy

CRC is committed to returning significant cash to shareholders through dividends and repurchases of its common stock. On February 6, 2024, CRC's Board of Directors approved an increase of the Share Repurchase Program to $1.35 billion, an increase of $250 million, and extended the program through December 31, 2025. Adjusting for this increase, CRC has approximately $750 million of capacity remaining under the repurchase program as of December 31, 2023. Post closing, and subject to Board approval, the Company expects to increase its fixed quarterly dividend.

Conference Call Information

A conference call is scheduled for February 7, 2024, at 9:00 a.m. Eastern Time. To participate in the call, please dial (877) 328-5505 (International calls please dial +1 (412) 317-5421) or access via webcast at www.crc.com 15 minutes prior to the scheduled start time to register. Participants may also pre-register for the conference call at https://dpregister.com/sreg/10186471/fb99757555. A digital replay of the conference call will be archived for approximately 90 days and supplemental slides for the conference call will be available online in the Investor Relations section of www.crc.com.

[1]Aera's enterprise value was calculated as 21.2 million of shares of CRC common stock based on a per share price of $46.81 as of February 2, 2024 plus $1.1B of assumed debt and other liabilities, which excludes a discounted hedge liability of ~$240MM, to be

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issued or assumed by CRC pursuant to the merger agreement. CRC's enterprise value was calculated as $3.5 billion assuming company's share price of $46.81 as of February 2, 2024, 71.4 million of fully diluted shares and $116MM of Net Debt[2] as of 3Q23.

[2]Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. CRC is unable to provide a reconciliation of non-GAAP financial measures contained in this release that are presented on a forward-looking basis for the described transaction because CRC is unable, without unreasonable efforts, to estimate and quantify the most directly comparable GAAP components, largely because predicting future operating results is subject to many factors outside of CRC's control and not readily predictable and that are not part of CRC's routine operating activities, including various economic, regulatory, political and legal factors.

[3]Unless otherwise noted, pro forma 2024 estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) estimated annualized synergies are excluded, and (iii) strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price, NGL realizations of 68% of crude price and Henry Hub gas price of $2.65 per MMBtu. Total pro forma capital includes combined Carbon Management Business and E&P, Corporate and Other business needs. CRC plans to run a one rig program in the first half of 2024 focusing on workover and maintenance activity. In the second half of 2024, and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals, CRC plans to run four to five rigs on a pro forma basis. Pro forma per share metrics are calculated using 92.6 million of fully diluted shares of CRC common stock post close, including 21.2 million shares of CRC common stock to be issued at closing of the transaction. All future quarterly dividends and share repurchases are subject to changes in commodity prices, restrictions under credit agreement covenants and the approval of CRC's Board. Pro forma 2024 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially. Pro forma 2024E free cash flow of $685MM represents a midpoint of a range between $650MM and $720MM.

[4]Reserves determined as of December 31, 2022 and use 2022 SEC Prices of $100.25 per barrel for oil and $6.36 per MMBtu for natural gas.

[5]The free cash flow amount shown is cumulative over the 2024-2028 period and includes impact of existing hedge settlements and excludes synergies. These estimates are calculated assuming (i) the transaction closed on January 1, 2024, (ii) strip pricing as of January 25, 2024 of $79.81 per barrel of oil Brent price in 2024, $76.33 per barrel of oil in 2025 and $73.36 per barrel of oil 2026 - 2028, NGL realizations of 68% of crude price

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and Henry Hub gas price of $2.65 per MMBtu in 2024, $3.50 per MMBtu in 2025, $3.77 per MMBtu in 2026 and $3.78 per MMBtu 2027 - 2028, (iii) net total annual production between 145 – 150 mboepd (76% oil), (iv) decline rates between 10% to 15%, (v) G&A expenses of ~ $380MM through 2028, (vi) total pro forma capital needs of $420MM to $580MM inclusive of Carbon Management, and (vii) 4 to 5 rigs scenario starting from 2H24 and assuming a successful resolution to the Kern County EIR litigation and resumption of a normalized level of permit approvals. Pro forma 2024 - 2028 estimates are forward-looking statements and are based on management's expectations. Actual results could differ materially.

About California Resources Corporation

CRC is an independent energy and carbon management company committed to energy transition. CRC produces some of the lowest carbon intensity oil in the US and is focused on maximizing the value of its land, mineral and technical resources for decarbonization efforts. For more information about CRC, please visit www.crc.com.

About Aera

Formed in 1997, Aera is based in Bakersfield, California, in the heart of Kern County – one of the largest oil-producing regions in the nation – with additional operations in Ventura, Monterey and Fresno counties. Aera is known for excellent safety and environmental performance. For more information about Aera, please visit www.aeraenergy.com.

About CPP Investments

Canada Pension Plan Investment Board (CPP Investments™) is a professional investment management organization that manages the Fund in the best interest of the more than 21 million contributors and beneficiaries of the Canada Pension Plan. In order to build diversified portfolios of assets, investments are made around the world in public equities, private equities, real estate, infrastructure and fixed income. Headquartered in Toronto, with offices in Hong Kong, London, Luxembourg, Mumbai, New York City, San Francisco, São Paulo and Sydney, CPP Investments is governed and managed independently of the Canada Pension Plan and at arm's length from governments. As of September 30, 2023, the Fund totaled C$576 billion. For more information, please visit www.cppinvestments.com.

About IKAV

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IKAV is an international asset management group headquartered in Germany, with local offices in Luxembourg, Italy, Spain, Portugal, USA and France. The group was established

in 2010. It provides institutional investors with investment solutions spanning a broad range of infrastructure energy assets, including solar, concentrated solar power, wind, energy efficiency, geothermal, thermal power plants and upstream. IKAV is a buy and hold investor with a vertically integrated business model to optimize its investment portfolio and to make its assets in line with the global net zero strategy over the upcoming decades. For more information, please visit ikav.com.

Advisors

Citi and Jefferies are serving as financial advisors and Sullivan & Cromwell LLP is serving as legal advisor to CRC. Wells Fargo acted as lead financial advisor alongside Truist and Latham & Watkins LLP is serving as legal advisor to CPP Investments & IKAV.

Additional Information and Where to Find It

This communication may be deemed to be solicitation material in respect of the transactions contemplated by the merger agreement pursuant to which California Resources Corporation ("CRC") has agreed to combine with Aera Energy, LLC ("Aera") (the "Merger Agreement"), including the proposed issuance of CRC's common stock pursuant to the Merger Agreement. In connection with the transaction, CRC will file a proxy statement on Schedule 14A with the U.S. Securities and Exchange Commission ("SEC"), as well as other relevant materials. Following the filing of the definitive proxy statement, CRC will mail the definitive proxy statement and a proxy card to its stockholders. INVESTORS AND SECURITY HOLDERS OF CRC ARE URGED TO READ THE PROXY STATEMENT AND OTHER RELEVANT DOCUMENTS FILED OR TO BE FILED WITH THE SEC CAREFULLY WHEN THEY BECOME AVAILABLE BECAUSE THEY WILL CONTAIN IMPORTANT INFORMATION ABOUT CRC, Aera, THE TRANSACTION AND RELATED MATTERS. Investors and security holders will be able to obtain copies of the proxy statement (when available) as well as other filings containing information about CRC, Aera and the transaction, without charge, at the SEC's website, www.sec.gov. Copies of documents filed with the SEC by CRC will be available, without charge, at CRC's website, www.crc.com.

Participants in Solicitation

CRC and its directors and executive officers may be deemed to be participants in the solicitation of proxies in connection with the transaction. Information about the directors and executive officers of CRC is set forth in the proxy statement for CRC's 2023 Annual Meeting of Stockholders, which was filed with the SEC on March 16, 2023. Investors may

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obtain additional information regarding the interest of such participants by reading the proxy statement regarding the transaction when it becomes available.

Cautionary Note Regarding Forward-Looking Statements

This communication contains statements that CRC believes to be “forward-looking statements” within the meaning of the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. All statements other than historical facts are forward-looking statements, and include statements regarding the benefits of the transaction, CRC's future financial position and operating results, business strategy, projected revenues, earnings, costs, capital expenditures and plans, objectives and intentions of management for the future. Words such as "expect," "could," "may," "anticipate," "intend," "plan," “ability,” "believe," "seek," "see," "will," "would," "estimate," "forecast," "target," "guidance," "outlook," "opportunity" or "strategy" or similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements are based upon the current beliefs and expectations of the management of CRC and are subject to risks and uncertainties that could cause actual results to differ materially from those expressed in, projected in, or implied by, such statements. Although CRC believes the expectations and forecasts reflected in its forward-looking statements are reasonable, they are inherently subject to numerous risks and uncertainties, most of which are difficult to predict and many of which are beyond CRC's control. No assurance can be given that such forward-looking statements will be correct or achieved or that the assumptions are accurate or will not change over time. Particular uncertainties that could cause CRC's actual results to be materially different from those described in the forward-looking statements include:

(i) the timing, receipt and terms and conditions of any required governmental and regulatory approvals of the transaction that could reduce anticipated benefits or cause the parties to abandon the transaction,
(ii) the occurrence of any event, change or other circumstances that could give rise to the termination of the merger agreement,
(iii) the possibility that stockholders of CRC may not approve the issuance of new shares of common stock in the transaction,
(iv) the risk that any of the other closing conditions to the transaction may not be satisfied in a timely manner,
(v) transaction costs,
(vi) unknown liabilities,
(vii) the risk that any announcements relating to the transaction could have adverse effects on the market price of CRC’s common stock,
(viii) the ability to successfully integrate the businesses,

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(ix) the ability to achieve projected operational and capital synergies and the risk it may take longer than expected to achieve those synergies,
(x) the risk the pending transaction could distract management from ongoing operations,
(xi) the effects of disruption to CRC's or Aera's respective businesses and operations, including the ability of CRC and Aera to retain customers and retain and hire key personnel and maintain relationships with their suppliers and customers,
(xii) the ability of CRC to obtain the required debt financing pursuant to its commitment letters and, if obtained, the potential impact of additional debt on CRC's business and the financial impacts and restrictions due to the additional debt,
(xiii) risks related to potential litigation brought in connection with the transaction,
(xiv) risks related to financial community and rating agency perceptions of CRC or Aera or their respective businesses, operations, financial condition and the industry in which they operate,
(xv) risks related to the potential impact of general economic, political and market factors on CRC, Aera or the transaction, and
(xvi) those expressed in its forward-looking statements including those factors discussed in Part I, Item 1A – Risk Factors in CRC's Annual Report on Form 10-K and its other SEC filings available at www.crc.com.

CRC cautions you not to place undue reliance on forward-looking statements contained in this communication, which speak only as of the filing date, and CRC is under no obligation, and expressly disclaims any obligation to update, alter or otherwise revise any forward-looking statements, whether as a result of new information, future events or otherwise. This communication contains information from third party sources, including information from Aera regarding its assets, operations and results. This data may involve a number of assumptions and limitations. CRC has not independently verified such third-party information and does not warrant the accuracy or completeness of such information.

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ANALYSIS OF POTENTIAL FISCAL AND ECONOMIC BENEFITS OF KERN COUNTY CARBON MANAGEMENT INDUSTRY

Prepared for:

KERN COUNTY PLANNING AND NATURAL RESOURCES DEPARTMENT
AND
KERN COUNTY ADMINISTRATIVE OFFICE

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April 4, 2023

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1.0 INTRODUCTION

This report evaluates the potential fiscal and economic benefits that would be created by the development of a carbon management industry in Kern County. Specifically, the report quantifies the direct fiscal and economic impacts of the proposed Carbon Management Business Park (CMBP), and the indirect impacts that would be generated by related firms that the CMBP would support elsewhere in Kern County.

1.1. Categories of Benefits Evaluated

The study considers the following categories of fiscal and economic benefits:

Fiscal Benefits

- Property tax revenue accruing to the County of Kern General Fund and Fire Fund
- Sales tax revenue accruing to the County of Kern General Fund
- Property tax revenue accruing to city General Funds
- Sales tax revenue accruing to city General Funds

Broader Economic Benefits

- Jobs created
- Payroll created
- Total business activity (the dollar volume of "output") supported

Given the undefined nature of the indirect (offsite) benefits of the CMBP, the study does not attempt to quantify potential benefits to individual/specific cities (since the specific locations of supported businesses are unknown). Instead, potential city-level benefits are shown as aggregate numbers (i.e., for all cities combined).

1.2. Profile of Business Types in CMBP

As conceived by the Kern County Planning and Natural Resources Department, the proposed CMBP would encompass 4,200 acres in unincorporated Kern County. Although a specific site has not been identified yet, it is anticipated that the park would be developed on agricultural land that would be rezoned for industrial uses and the location would generally be west of Interstate 5.

The assumed mix of carbon management and related activities within the CMBP is as follows:

Business Type (Carbon Capture Technology)	Area
Liquid Direct Air Capture (L-DAC)	400 acres
Solid Direct Air Capture (S-DAC)	500 acres
Biomass Carbon Removal and Storage (BiCRS)	600 acres
Green Hydrogen (H2)	600 acres
Steel Micro Mill	600 acres
Research & Development Incubator Site	500 acres
Administrative Offices + Ancillary Clean Energy Industries	1,000 acres
Total (with 31 million square feet of industrial building space)	4,200 acres

1.3. Overview of Study Scope and Methodology

In completing this study, The Natelson Dale Group, Inc. (TNDG) has relied on industry profiles (for each of the above business types) prepared by Blue Engine for the CMBP project. In particular, the Blue Engine team has quantified the following economic variables for each CMBP component:

- Permanent (operational) jobs
- Operations and maintenance costs
- Capital costs

Blue Engine has also provided general descriptions of the types of carbon capture businesses that might be the "tenants" within each component of the park. From these descriptions, TNDG has selected specific industries (i.e., NAICS codes) representative of these business types for purposes of evaluating the projects fiscal and economic impacts.

The direct property tax impacts of the CMBP have been estimated by TNDG based on projected land re-assessment (from converting the underlying land from agricultural and industrial uses) plus anticipated improvement costs (based on the Blue Engine data). Indirect property taxes (i.e., from offsite businesses that would be developed as part of a countywide carbon management industry anchored by the CMBP) have been estimated using the IMPLAN model[1].

The IMPAN model has also been used to estimate direct and indirect sales tax revenue, as well as broader economic impacts such as job creation, payroll, and supported countywide business activity.

Due to the somewhat speculative nature of the CMBP (composed of industries that in many cases are still in early stages of development globally), the Blue Engine research is understood to provide general/

[1] This model was developed by researchers at the University of Minnesota and is widely used in economic impact analysis throughout the Country. This software is classified as an "Input-Output" (IO) model that computes all of the economic impacts of industries in a user-defined region (in this case, Kern County), including the estimated local expenditures of employees of both project-direct and supplier firms. The current version of the IMPLAN model divides the economy into 546 sectors that correspond to 4-digit and 5-digit NAICS codes.

approximate estimates of costs and employment. As such, the Blue Engine numbers are often expressed in broad ranges (e.g., the Liquid Direct Air Capture operation would support 75 to 270 permanent jobs per 1 million in CO2 captured annually). Since TNDG's analysis stems from the Blue Engine estimates, TNDG's numbers are expressed in terms of a "Low Scenario" and a "High Scenario" corresponding the Blue Engine's ranges.

2.0 EXECUTIVE SUMMARY

2.1. Fiscal Benefits of Carbon Management Industry

Table II-1, on the following page, summarizes the potential fiscal benefits of the proposed CMBP and the related countywide carbon management industry. All dollar amounts are expressed in 2023 dollars.

Fiscal Benefits to County of Kern. At full buildout, the CMBP and related offsite industries would generate total property tax income (General Fund plus Fire Fund) of $24.2 million (Low Scenario) to $56.2 million (High Scenario) per year.[2]

Total sales tax income to the County's General Fund is projected to range between $4.2 million and $7.9 million per year.[3]

Fiscal Benefits to Incorporated Cities. Whereas the direct impacts of the CMBP would occur in unincorporated Kern County (where the park would be located), the indirect impacts associated with the overall carbon management industry would potentially be spread throughout the county. Given the undefined nature of these indirect benefits, the study does not quantify potential benefits to individual/ specific cities (since the specific locations of supported businesses are unknown). Instead, potential city-level benefits are shown as aggregate numbers (i.e., for all cities combined).

The CMBP and related offsite industries would generate total property tax income to city General Funds of $4.5 million (Low Scenario) to $8.4 million (High Scenario) per year.

Total sales tax income (to city General Funds) is projected to range between $8.4 million and $15.6 million per year.[4]

[2] The projections of property tax generation are largely driven by the very substantial capital facility investments associated with carbon management projects. For purposes of this study, assessed valuation has been estimated based on total capital investments at the time facilities are completed and put into operation. To the extent these capital facility values are depreciated without offsetting capital reinvestments, property tax revenues from these facilities could decline over time.

[3] The sales tax projections are derived from the IMPLAN model; the IMPLAN estimates for Kern County have been adjusted by TNDG to reflect the recent passage of Measure K, which effectively doubles the County's local sales tax rate.

[4] A significant portion of the sales tax revenue projected in this analysis would be derived from indirect impacts (i.e., CMBP businesses making purchases at other Kern County firms) and induced impacts (i.e., CMBP employees spending their payroll incomes at local businesses). Since many of these indirect/induced expenditures would occur in incorporated cities, the CMBP would create larger sales tax impacts to city General Funds than to the County's General Fund.

Table II-1

POTENTIAL PROPERTHY TAX AND SALES TAX GENERATION
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)
INCLUDES DIRECT (ONSITE) + INDIRECT (OFFSITE) IMPACTS

LOW SCENARIO

	County		*Cities*	
Project Component	**Sales Tax**	**Property Tax**	**Sales Tax**	**Property Tax**
Liquid Direct Air Capture	$669,000	$3,163,700	$1,316,700	$709,500
Solid Direct Air Capture	$130,500	$4,326,800	$256,800	$138,400
Biomass Carbon Removal & Storage	$261,300	$1,836,800	$514,300	$277,200
Green Hydrogen	$84,600	$3,148,100	$166,400	$89,700
Steel Micro Mill	$111,800	$1,936,400	$220,000	$118,500
R&D Incubator Site	$581,400	$1,863,300	$1,144,200	$616,600
Ancillary Clean Energy Industries	$2,439,500	$7,895,100	$4,801,200	$2,587,200
Total CMBP and Offsite Support	$4,278,100	$24,170,200	$8,419,600	$4,537,100

HIGH SCENARIO

	County		*Cities*	
Project Component	**Sales Tax**	**Property Tax**	**Sales Tax**	**Property Tax**
Liquid Direct Air Capture	$1,226,500	$8,599,900	$2,413,900	$1,300,700
Solid Direct Air Capture	$344,000	$11,659,400	$677,000	$364,800
Biomass Carbon Removal & Storage	$1,835,900	$13,841,200	$3,613,300	$1,947,100
Green Hydrogen	$301,200	$4,124,200	$592,900	$319,500
Steel Micro Mill	$168,400	$4,406,800	$331,400	$178,600
R&D Incubator Site	$775,300	$2,681,300	$1,525,800	$822,200
Ancillary Clean Energy Industries	$3,252,600	$10,920,300	$6,401,400	$3,449,500
Total CMBP and Offsite Support	$7,903,900	$56,233,100	$15,555,700	$8,382,400

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: County Property Tax includes General Fund and County Fire Fund.

2.2. Broader Economic Benefits

Table II-2, on the following page, summarizes the broader economic benefits of the proposed CMBP and the related countywide carbon management industry. All dollar amounts are expressed in 2023 dollars.

Total business activity supported. The potential volume ("output") associated with the CMBP and related offsite activities is projected to range from $4.5 billion (Low Scenario) to $6.9 billion (High Scenario) per year.

Total jobs supported. At full buildout, the CMBP and related offsite activities would directly and indirectly support 13,500 to 22,000 permanent jobs.

Total payroll generated. The total direct and indirect payroll associated with these jobs is projected to range from $1.1 billion to $1.8 billion per year, representing an average annual wage of approximately $80,000.

Table II-2

POTENTIAL ECONOMIC IMPACTS
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)

LOW SCENARIO

Impact Measure	Employment	Employee Compensation	Value Added	Output
			$000s	
Liquid Direct Air Capture	197	$16,524	$117,945	$184,594
Solid Direct Air Capture	280	23,463	23,004	36,002
Biomass Carbon Removal & Storage	186	20,355	29,577	64,855
Green Hydrogen	368	43,675	32,989	74,886
Steel Micro Mill	500	36,999	30,400	119,439
R&D Incubator Site	325	30,073	47,059	85,755
Ancillary Clean Energy Industries	11,682	888,418	1,564,302	3,975,561
Total CMBP	13,540	$1,059,508	$1,845,277	$4,541,092

HIGH SCENARIO

Impact Measure	Employment	Employee Compensation	Value Added	Output
			$000s	
Liquid Direct Air Capture	711	$59,485	$184,714	$338,423
Solid Direct Air Capture	756	63,230	48,574	94,915
Biomass Carbon Removal & Storage	1,368	149,670	149,168	455,611
Green Hydrogen	1,228	145,583	88,822	266,780
Steel Micro Mill	1,501	110,998	37,973	179,934
R&D Incubator Site	876	81,043	99,760	231,094
Ancillary Clean Energy Industries	15,575	1,184,478	1,859,499	5,300,389
Total CMBP	22,014	$1,794,487	$2,468,510	$6,867,148

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: CMBP = Carbon Management Business Park

3.0 DETAILED SUMMARY OF FISCAL AND ECONOMIC IMPACTS

This section provides a detailed summary of the ongoing fiscal and economic impacts associated with the CMBP. For fiscal impacts, the analysis shows the ongoing property tax and sales tax revenues that would be generated for the County and incorporated cities in the County. For economic impacts, the analysis shows annually-recurring impacts related to employment, employee compensation, value added, and output (i.e., total dollar volume of business activity).

3.1. CMBP Sales Tax and Property Tax Impacts

Tables III-1 and III-2 (pages 9 and 10) show the direct and indirect sales tax and property tax impacts associated with each proposed CMBP component, along with the total for the entire proposed CMBP. Table III-1 shows the "low" scenario (reflecting more conservative direct employment and operating cost estimates), while Table III-2 shows the "high" scenario (reflecting higher direct employment and operating cost estimates).

3.2. CMBP Economic Impacts

Tables III-3 and III-4 (pages 11 and 12) show the direct and indirect/induced economic impacts associated with each proposed CMBP component, along with the total for the entire proposed CMBP. Table III-1 shows the "low" scenario (reflecting more conservative direct employment and operating cost estimates), while Table III-2 shows the "high" scenario (reflecting higher direct employment and operating cost estimates).

Table III-1

POTENTIAL PROPERTHY TAX AND SALES TAX GENERATION
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)
INCLUDES DIRECT (ONSITE) + INDIRECT (OFFSITE) IMPACTS

LOW SCENARIO

	County		*Cities*	
Impact Measure	**Sales Tax**	**Property Tax**	**Sales Tax**	**Property Tax**
Liquid Direct Air Capture				
Direct	$627,912	$3,014,656	$1,235,790	$665,920
Indirect	$41,089	$149,067	$80,867	$43,576
Total	$669,001	$3,163,723	$1,316,657	$709,496
Solid Direct Air Capture				
Direct	$122,465	$4,297,682	$241,023	$129,878
Indirect	$8,014	$29,073	$15,772	$8,499
Total	$130,479	$4,326,755	$256,795	$138,377
Biomass Carbon Removal & Storage				
Direct	$220,881	$1,689,984	$434,714	$234,251
Indirect	$40,461	$146,788	$79,631	$42,910
Total	$261,342	$1,836,772	$514,345	$277,161
Green Hydrogen				
Direct	$36,931	$2,975,317	$72,685	$39,167
Indirect	$47,626	$172,782	$93,732	$50,509
Total	$84,557	$3,148,099	$166,417	$89,676
Steel Micro Mill				
Direct	$58,109	$1,741,749	$114,364	$61,626
Indirect	$53,664	$194,688	$105,616	$56,912
Total	$111,773	$1,936,436	$219,980	$118,539
R&D Incubator Site				
Direct	$393,307	$1,180,952	$774,066	$417,115
Indirect	$188,070	$682,298	$370,140	$199,454
Total	$581,377	$1,863,251	$1,144,206	$616,569
Ancillary Clean Energy Industries				
Direct	$914,321	$2,361,905	$1,799,471	$969,666
Indirect	$1,525,172	$5,533,164	$3,001,683	$1,617,493
Total	$2,439,493	$7,895,069	$4,801,154	$2,587,159
Total Business Park Components				
Direct	$2,373,926	$17,262,245	$4,672,112	$2,517,624
Indirect	$1,904,095	$6,907,860	$3,747,441	$2,019,353
Total	$4,278,021	$24,170,105	$8,419,553	$4,536,977

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: County Direct Property Tax includes General Fund and County Fire Fund.

Table III-2

POTENTIAL PROPERTHY TAX AND SALES TAX GENERATION
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)
INCLUDES DIRECT (ONSITE) + INDIRECT (OFFSITE) IMPACTS

HIGH SCENARIO

	County		*Cities*	
Impact Measure	**Sales Tax**	**Property Tax**	**Sales Tax**	**Property Tax**
Liquid Direct Air Capture				
Direct	$1,151,171	$8,326,656	$2,265,614	$1,220,853
Indirect	$75,330	$273,290	$148,257	$79,890
Total	$1,226,501	$8,599,946	$2,413,871	$1,300,743
Solid Direct Air Capture				
Direct	$322,862	$11,582,788	$635,424	$342,406
Indirect	$21,127	$76,648	$41,581	$22,406
Total	$343,990	$11,659,436	$677,004	$364,812
Biomass Carbon Removal & Storage				
Direct	$1,551,707	$12,809,984	$3,053,907	$1,645,634
Indirect	$284,241	$1,031,197	$559,414	$301,447
Total	$1,835,948	$13,841,181	$3,613,320	$1,947,081
Green Hydrogen				
Direct	$131,568	$3,508,651	$258,939	$139,532
Indirect	$169,667	$615,535	$333,921	$179,937
Total	$301,236	$4,124,185	$592,860	$319,470
Steel Micro Mill				
Direct	$87,540	$4,113,513	$172,288	$92,839
Indirect	$80,845	$293,296	$159,110	$85,738
Total	$168,385	$4,406,809	$331,398	$178,578
R&D Incubator Site				
Direct	$524,473	$1,771,429	$1,032,214	$556,221
Indirect	$250,790	$909,841	$493,579	$265,971
Total	$775,264	$2,681,270	$1,525,793	$822,192
Ancillary Clean Energy Industries				
Direct	$1,219,061	$3,542,857	$2,399,229	$1,292,853
Indirect	$2,033,529	$7,377,432	$4,002,179	$2,156,622
Total	$3,252,590	$10,920,289	$6,401,407	$3,449,475
Total Business Park Components				
Direct	$4,988,384	$45,655,878	$9,817,614	$5,290,339
Indirect	$2,915,530	$10,577,239	$5,738,040	$3,092,012
Total	$7,903,914	$56,233,117	$15,555,654	$8,382,351

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: County Direct Property Tax includes General Fund and County Fire Fund.

Table III-3

POTENTIAL ECONOMIC IMPACTS
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)

LOW SCENARIO

Impact Measure	Employment	Employee Compensation	Value Added	Output
			$000s	
Liquid Direct Air Capture				
Direct	150	$12,163	$80,122	$120,000
Indirect/Induced	47	4,361	37,823	64,594
Total	197	$16,524	$117,945	$184,594
Solid Direct Air Capture				
Direct	213	$17,271	$15,627	$23,404
Indirect/Induced	67	6,192	7,377	12,598
Total	280	$23,463	$23,004	$36,002
Biomass Carbon Removal & Storage				
Direct	68	$10,986	$19,849	$46,500
Indirect/Induced	118	9,370	9,729	18,355
Total	186	$20,355	$29,577	$64,855
Green Hydrogen				
Direct	150	$25,978	$21,788	$53,333
Indirect/Induced	218	17,697	11,201	21,552
Total	368	$43,675	$32,989	$74,886
Steel Micro Mill				
Direct	235	$17,259	$14,950	$90,588
Indirect/Induced	265	19,741	15,450	28,851
Total	500	$36,999	$30,400	$119,439
R&D Incubator Site				
Direct	213	$21,587	$31,095	$57,322
Indirect/Induced	112	8,486	15,964	28,433
Total	325	$30,073	$47,059	$85,755
Ancillary Clean Energy Industries				
Direct	7,382	$563,778	$885,833	$2,727,538
Indirect/Induced	4,300	324,640	678,469	1,248,023
Total	11,682	$888,418	$1,564,302	$3,975,561
Total CMBP Components				
Direct	8,411	$669,022	$1,069,264	$3,118,686
Indirect/Induced	5,128	390,486	776,013	1,422,406
Total	13,540	$1,059,508	$1,845,277	$4,541,092

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: CMBP = Carbon Management Business Park

Table III-4

POTENTIAL ECONOMIC IMPACTS
KERN CARBON MANAGEMENT BUSINESS PARK (CMBP)

HIGH SCENARIO

Impact Measure	Employment	Employee Compensation	Value Added	Output
			$000s	
Liquid Direct Air Capture				
Direct	540	$43,786	$146,891	$220,000
Indirect/Induced	171	15,698	37,823	118,423
Total	711	$59,485	$184,714	$338,423
Solid Direct Air Capture				
Direct	574	$46,543	$41,198	$61,702
Indirect/Induced	182	16,687	7,377	33,213
Total	756	$63,230	$48,574	$94,915
Biomass Carbon Removal & Storage				
Direct	500	$80,777	$139,439	$326,667
Indirect/Induced	868	68,894	9,729	128,945
Total	1,368	$149,670	$149,168	$455,611
Green Hydrogen				
Direct	500	$86,594	$77,620	$190,000
Indirect/Induced	728	58,989	11,201	76,780
Total	1,228	$145,583	$88,822	$266,780
Steel Micro Mill				
Direct	706	$51,776	$22,523	$136,471
Indirect/Induced	795	59,222	15,450	43,464
Total	1,501	$110,998	$37,973	$179,934
R&D Incubator Site				
Direct	574	$58,174	$83,796	$154,472
Indirect/Induced	302	22,868	15,964	76,622
Total	876	$81,043	$99,760	$231,094
Ancillary Clean Energy Industries				
Direct	9,842	$751,653	$1,181,030	$3,636,471
Indirect/Induced	5,733	432,824	678,469	1,663,918
Total	15,575	$1,184,478	$1,859,499	$5,300,389
Total CMBP Components				
Direct	13,236	$1,119,305	$1,692,497	$4,725,783
Indirect/Induced	8,778	675,182	776,013	2,141,365
Total	22,014	$1,794,487	$2,468,510	$6,867,148

SOURCE: TNDG, based on Blue Engine research; IMPLAN.

Note: CMBP = Carbon Management Business Park

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 50, 53, and 58

[EPA–HQ–OAR–2015–0072; FRL–8635–02–OAR]

RIN 2060–AV52

Reconsideration of the National Ambient Air Quality Standards for Particulate Matter

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Based on the Environmental Protection Agency's (EPA's) reconsideration of the air quality criteria and the national ambient air quality standards (NAAQS) for particulate matter (PM), the EPA is revising the primary annual $PM_{2.5}$ standard by lowering the level from 12.0 μg/m^3 to 9.0 μg/m^3. The Agency is retaining the current primary 24-hour $PM_{2.5}$ standard and the primary 24-hour PM_{10} standard. The Agency also is not changing the secondary 24-hour $PM_{2.5}$ standard, secondary annual $PM_{2.5}$ standard, and secondary 24-hour PM_{10} standard at this time. The EPA is also finalizing revisions to other key aspects related to the PM NAAQS, including revisions to the Air Quality Index (AQI) and monitoring requirements for the PM NAAQS.

DATES: This final rule is effective May 6, 2024.

ADDRESSES: The EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2015–0072. All documents in the docket are listed on the *https://www.regulations.gov* website. Although listed in the index, some information is not publicly available, *e.g.,* CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the internet and will be publicly available only in hard copy form. Publicly available docket materials are available electronically through *https://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Dr. Lars Perlmutt, Health and Environmental Impacts Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Mail Code C539–04, Research Triangle Park, NC 27711; telephone: (919) 541–3037; fax: (919) 541–5315; email: *perlmutt.lars@epa.gov.*

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Executive Summary

This document presents the Administrator's final decisions for the reconsideration of the 2020 final decision on the primary (health-based) and secondary (welfare-based) National Ambient Air Quality Standards (NAAQS) for Particulate Matter (PM). More specifically, this document summarizes the background and rationale for the Administrator's final decisions to revise the primary annual $PM_{2.5}$ standard by lowering the level from 12.0 μg/m^3 to 9.0 μg/m^3; to retain the current primary 24-hour $PM_{2.5}$ standard (at a level of 35 μg/m^3); to retain the primary 24-hour PM_{10} standard; and, not to change the secondary PM standards at this time. In reaching his final decisions, the Administrator considered the currently available scientific evidence in the 2019 Integrated Science Assessment (2019 ISA) and the Supplement to the 2019 ISA (ISA Supplement), quantitative and policy analyses presented in the 2022 Policy Assessment (2022 PA), advice from the Clean Air Scientific Advisory Committee (CASAC), and public comments on the proposal. The EPA has established primary and secondary standards for $PM_{2.5}$, which includes particles with diameters generally less than or equal to 2.5 μm, and PM_{10}, which includes particles with diameters generally less than or equal to 10 μm. The standards include two primary $PM_{2.5}$ standards: an annual average standard, averaged over three years, with a level of 12.0 μg/m^3, and a 24-hour standard with a 98th percentile form, averaged over three years, and a level of 35 μg/m^3. It also includes a primary PM_{10} standard with a 24-hour averaging time, and a level of 150 μg/m^3, not to be exceeded more than once per year on average over three years. Secondary PM standards are set equal to the primary standards, except that the level of the secondary annual $PM_{2.5}$ standard is 15.0 μg/m^3.

The most recent of the PM NAAQS was completed in December 2020. In that review, the EPA retained the primary and secondary NAAQS, without revision (85 FR 82684, December 18, 2020). Following publication of the 2020 final action, several parties filed petitions for review and petitions for reconsideration of the EPA's final decision.

In June 2021, the Agency announced its decision to reconsider the 2020 PM NAAQS final action.[1] The EPA decided to reconsider the December 2020 decision because the available scientific evidence and technical information indicated that the current standards may not be adequate to protect public health and welfare, as required by the Clean Air Act. The EPA noted that the 2020 PA concluded that the scientific evidence and information called into question the adequacy of the primary $PM_{2.5}$ standards and supported consideration of revising the level of the primary annual $PM_{2.5}$ standard to below the current level of 12.0 μg/m^3 while retaining the primary 24-hour $PM_{2.5}$ standard (U.S. EPA, 2020b). The EPA also noted that the 2020 PA concluded that the available scientific evidence and information did not call into question the adequacy of the primary PM_{10} or secondary PM standards and supported consideration of retaining the primary PM_{10} standard and secondary PM standards without revision (U.S. EPA, 2020b).

The final decisions presented in this document on the primary $PM_{2.5}$ standards have been informed by key aspects of the available health effects evidence and conclusions contained in the 2019 ISA and ISA Supplement, quantitative exposure/risk analyses and policy evaluations presented in the 2022 PA, advice from the CASAC[2] and public comment received as part of this reconsideration.[3] The health effects evidence newly available in this reconsideration, in conjunction with the full body of evidence critically evaluated in the 2019 ISA, supports a causal relationship between long- and short-term exposures and mortality and cardiovascular effects, and the evidence supports a likely to be a causal relationship between long-term exposures and respiratory effects, nervous system effects, and cancer. The longstanding evidence base, including animal toxicological studies, controlled human exposure studies, and epidemiologic studies, reaffirms, and in some cases strengthens, the conclusions from past reviews regarding the health effects of $PM_{2.5}$ exposures. Epidemiologic studies available in this reconsideration demonstrate generally positive, and often statistically significant, $PM_{2.5}$ health effect associations. Such studies report associations between estimated $PM_{2.5}$ exposures and non-accidental, cardiovascular, or respiratory mortality; cardiovascular or respiratory hospitalizations or emergency room visits; and other mortality/morbidity outcomes (*e.g.,* lung cancer mortality or incidence, asthma development). The scientific evidence available in this reconsideration, as evaluated in the 2019 ISA and ISA Supplement, includes

[1] The press release for this announcement is available at: *https://www.epa.gov/newsreleases/epa-reexamine-health-standards-harmful-soot-previous-administration-left-unchanged.*

[2] In 2021, the Administrator announced his decision to reestablish the membership of the CASAC. The Administrator selected seven members to serve on the chartered CASAC, and appointed a PM CASAC panel to support the chartered CASAC's review of the draft ISA Supplement and the draft PA as a part of this reconsideration (see section I.C.6.b below for more information).

[3] More information regarding the CASAC review of the draft ISA Supplement and the draft PA, including opportunities for public comment, can be found in the following **Federal Register** notices: 86 FR 54186, September 30, 2021; 86 FR 52673, September 22, 2021; 86 FR 56263, October 8, 2021; 87 FR 958, January 7, 2022.

a number of epidemiologic studies that use various methods to characterize exposure to $PM_{2.5}$ (*e.g.,* ground-based monitors and hybrid modeling approaches) and to evaluate associations between health effects and lower ambient $PM_{2.5}$ concentrations. There are a number of recent epidemiologic studies that use varying study designs that reduce uncertainties related to confounding and exposure measurement error. The results of these analyses provide further support for the robustness of associations between $PM_{2.5}$ exposures and mortality and morbidity. Moreover, the Administrator notes that recent epidemiologic studies strengthen support for health effect associations at lower $PM_{2.5}$ concentrations, with these new studies finding positive and significant associations when assessing exposure in locations and time periods with lower annual mean and 25th percentile concentrations than those evaluated in epidemiologic studies available at the time of previous reviews. Additionally, the experimental evidence (*i.e.,* animal toxicological and controlled human exposure studies) strengthens the coherence of effects across scientific disciplines and provides additional support for potential biological pathways through which $PM_{2.5}$ exposures could lead to the overt population-level outcomes reported in epidemiologic studies for the health effect categories for which a causal relationship (*i.e.,* short- and long-term $PM_{2.5}$ exposure and mortality and cardiovascular effects) or likely to be causal relationship (*i.e.,* short- and long-term $PM_{2.5}$ exposure and respiratory effects; and long-term $PM_{2.5}$ exposure and nervous system effects and cancer) was concluded.

The available evidence in the 2019 ISA continues to provide support for factors that may contribute to increased risk of $PM_{2.5}$-related health effects including lifestage (children and older adults), pre-existing diseases (cardiovascular disease and respiratory disease), race/ethnicity, and socioeconomic status. For example, the 2019 ISA and ISA Supplement conclude that there is strong evidence that Black and Hispanic populations, on average, experience higher $PM_{2.5}$ exposures and $PM_{2.5}$-related health risks than non-Hispanic White populations. In addition, studies evaluated in the 2019 ISA and ISA Supplement also provide evidence indicating that communities with lower socioeconomic status (SES), as assessed in epidemiologic studies using indicators of SES including income and educational attainment are, on average, exposed to higher concentrations of $PM_{2.5}$ compared to higher SES communities.

The quantitative risk assessment, as well as policy considerations in the 2022 PA, also inform the final decisions on the primary $PM_{2.5}$ standards. The risk assessment in this reconsideration focuses on all-cause or nonaccidental mortality associated with long- and short-term $PM_{2.5}$ exposures. The primary analyses focus on exposure and risk associated with air quality that might occur in an area under air quality conditions that just meet the current and potential alternative standards. The risk assessment estimates that the current primary $PM_{2.5}$ standards could allow a substantial number of $PM_{2.5}$-associated premature deaths in the United States, and that public health improvements would be associated with just meeting all of the alternative (more stringent) annual and 24-hour standard levels modeled. Additionally, the results of the risk assessment suggest that for most of the U.S., the annual standard is the controlling standard and that revision to that standard has the most potential to reduce $PM_{2.5}$ exposure-related risk. The analyses are summarized in this document and in the proposal and are described in detail in the 2022 PA.

In its advice to the Administrator, in its review of the 2021 draft PA, the CASAC concurred that the currently available health effects evidence calls into question the adequacy of the primary annual $PM_{2.5}$ standard. With regard to the primary annual $PM_{2.5}$ standard, the majority of the CASAC concluded that the level of the standard should be revised within the range of 8.0 to 10.0 $\mu g/m^3$, while the minority of the CASAC concluded that the primary annual $PM_{2.5}$ standard should be revised to a level of 10.0 to 11.0 $\mu g/m^3$. With regard to the primary 24-hour $PM_{2.5}$ standard, the CASAC did not reach consensus on the adequacy of the current standard. The majority of the CASAC concluded that the primary 24-hour $PM_{2.5}$ was not adequate and that the level of the standard should be revised to within the range of 25 to 30 $\mu g/m^3$, while the minority of the CASAC concluded that the standard was adequate and should be retained, without revision. Additionally, in their review of the 2019 draft PA, the CASAC did not reach consensus on the adequacy of the primary annual $PM_{2.5}$ standard, with the minority recommending revision and the majority recommending the standard be retained. In their review of the 2019 draft PA, the CASAC reached consensus regarding the adequacy of the primary 24-hour $PM_{2.5}$ standard, concluding that the standard should be retained.

In considering how to revise the suite of primary $PM_{2.5}$ standards to provide the requisite degree of protection, the Administrator recognizes that the current annual standard and 24-hour standard, together, are intended to provide public health protection against the full distribution of short- and long-term $PM_{2.5}$ exposures. Further, he recognizes that changes in $PM_{2.5}$ air quality designed to meet either the annual or the 24-hour standard would likely result in changes to both long-term average and short-term peak $PM_{2.5}$ concentrations.

As in 2012, the Administrator concludes that the most effective way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures is to set a generally controlling annual standard, and to provide supplemental protection against the occurrence of peak 24-hour $PM_{2.5}$ concentrations by means of a 24-hour standard set at the appropriate level. Based on the current evidence and quantitative information, as well as consideration of CASAC advice and public comments, the Administrator concludes that the current primary annual $PM_{2.5}$ standard is not adequate to protect public health with an adequate margin of safety. The Administrator notes that the CASAC was unanimous in its advice on the 2021 draft PA regarding the need to revise the annual standard. In considering the appropriate level for a revised annual standard, the Administrator concludes that a standard set at a level of 9.0 $\mu g/m^3$ reflects his judgment about placing the most weight on the strongest available evidence while appropriately weighing the uncertainties.

With regard to the primary 24-hour $PM_{2.5}$ standard, the Administrator finds the available scientific evidence and quantitative information to be insufficient to call into question the adequacy of the public health protection afforded by the current 24-hour standard. He further notes that a more stringent annual standard set at a level of 9.0 $\mu g/m^3$ is expected to reduce both average (annual) concentrations and peak (daily) concentrations. The Administrator also notes that, in their review of the 2021 draft PA, the CASAC did not reach consensus on whether revisions to the primary 24-hour $PM_{2.5}$ standard are warranted at this time. He also notes that, in their review of the 2019 draft PA, the CASAC did reach consensus that the primary 24-hour $PM_{2.5}$ standard should be retained. The Administrator concludes that the 24-hour standard should be retained to

continue to provide requisite protection against short-term peak $PM_{2.5}$ concentrations, particularly when considered in conjunction with the protection provided by the suite of standards and the decision to revise the annual standard to a level of 9.0 μg/m³.

The primary PM_{10} standard is intended to provide public health protection against health effects related to exposures to $PM_{10–2.5}$, which are particles with a diameter between 10 μm and 2.5 μm. The final decision to retain the current 24-hour PM_{10} standard has been informed by key aspects of the available health effects evidence and conclusions contained in the 2019 ISA, the policy evaluations presented in the 2022 PA, advice from the CASAC and public comments. Specifically, the health effects evidence for $PM_{10–2.5}$ exposures is somewhat strengthened since past reviews, although the strongest evidence still only provides support for a suggestive of, but not sufficient to infer, causal relationship with long- and short-term exposures and mortality and cardiovascular effects, short-term exposures and respiratory effects, and long-term exposures and cancer, nervous system effects, and metabolic effects. In reaching his final decision on the primary PM_{10} standard, the Administrator recognizes that, while the available health effects evidence has expanded, recent studies are subject to the same types of uncertainties that were judged to be important in previous reviews. He also recognizes that, in their review of the 2019 draft PA and the 2021 draft PA, the CASAC generally agreed that it was reasonable to retain the primary 24-hour PM_{10} standard given the available scientific evidence, including retaining PM_{10} as the indicator. He concludes that the newly available evidence does not call into question the adequacy of the current primary PM_{10} standard, and retains that standard, without revision.

With respect to the secondary PM standards, this reconsideration focuses on visibility, climate, and materials effects.[4] The Administrator's final decision to not change the current secondary standards at this time has been informed by key aspects of the currently available welfare effects evidence as well as the conclusions contained in the 2019 ISA and ISA Supplement; quantitative analyses of visibility impairment; policy evaluations presented in the 2022 PA; advice from the CASAC; and public comments. Specifically, the welfare effects evidence available in this reconsideration is consistent with the evidence available in previous reviews and supports a causal relationship between PM and visibility, climate, and materials effects. With regard to visibility effects, the Administrator notes that he judges that the evidence supports a target level of protection of 27 dv. He further notes that the results of quantitative analyses of visibility impairment suggest that in areas that meet the current secondary 24-hour $PM_{2.5}$ standard that estimated light extinction in terms of a 3-year visibility metric would be at or well below the target level of protection. With regard to climate and materials effects, while the evidence has expanded since previous reviews, significant limitations and uncertainties remain in the evidence. While the evidence has expanded since previous reviews, the available scientific evidence remains insufficient to allow the Administrator to make a reasoned judgment about what specific standard(s) would be requisite to protect against known or anticipated adverse effects to public welfare from PM's effects on materials damage or climate.- In their review of the 2019 draft PA and the 2021 draft PA, the CASAC did not recommend revising the secondary PM standards. In considering the available evidence and quantitative information, with its inherent uncertainties and limitations, the Administrator judges that it is appropriate not to change the secondary PM standards at this time.

The final revisions to the primary annual $PM_{2.5}$ NAAQS trigger a process under which States (and Tribes, if they choose) make recommendations to the Administrator regarding designations, identifying areas of the country that either meet or do not meet the new or revised PM NAAQS. Those areas that do not meet the revised PM NAAQS will need to develop plans that demonstrate how they will meet the standards. As part of these plans, states have the opportunity to advance environmental justice, in this case for overburdened communities in areas with high PM concentrations above the NAAQS, by using the tools described in the current PM NAAQS implementation guidance (80 FR 58010, 58136, August 25, 2016). The EPA is not making changes to any of the current PM NAAQS implementation programs in this final rulemaking.

On other topics, the EPA is finalizing two sets of changes to the $PM_{2.5}$ sub-index of the Air Quality Index (AQI). First, the EPA is continuing to use the approach used in the revisions to the AQI in 2012 (77 FR 38890, June 29, 2012) of setting the lower breakpoints (50, 100 and 150) based on the levels of the primary annual and 24-hour $PM_{2.5}$ standards. In so doing, the EPA is revising the AQI value of 50 to 9.0 μg/m³ and is retaining the AQI values of 100 and 150 at 35.4 μg/m³ and 55.4 μg/m³, respectively. Second, the EPA is revising the upper AQI breakpoints (200 and above), and replacing the linear-relationship approach used in 1999 (64 FR 42530, August 4, 1999) to set these breakpoints, with an approach that more fully considers the $PM_{2.5}$ health effects evidence from controlled human exposure and epidemiologic studies that has become available in the last 20 years. The EPA is also revising the AQI values of 200, 300 and 500 to 125.4 μg/m³, 225.4 μg/m³, and 325.4 μg/m³, respectively. In addition, this final rule revises the daily reporting requirement from 5 days per week to 7 days per week, while also reformatting appendix G and providing clarifications.

With regard to monitoring-related activities, the EPA finalizes revisions to data calculations and ambient air monitoring requirements for PM to improve the usefulness and appropriateness of data used in regulatory decision making and to better characterize air quality in communities that are at increased risk of $PM_{2.5}$ exposure and health risk. These changes are found in 40 CFR part 50 (appendices K, L, and N), part 53, and part 58 with associated appendices (A, B, C, D, and E). These changes include addressing updates in data calculations, approval of reference and equivalent methods, updates in quality assurance statistical calculations to account for lower concentration measurements, updates to support improvements in PM methods, a revision to the $PM_{2.5}$ network design to account for at-risk populations, and updates to the Probe and Monitoring Path Siting Criteria for NAAQS pollutants.

In setting the NAAQS, the EPA may not consider the costs of implementing the standards. This was confirmed by the Supreme Court in *Whitman* v. *American Trucking Associations,* 531 U.S. 457, 465–472, 475–76 (2001), as discussed in section II.A of this document. As has traditionally been

[4] Consistent with the 2016 Integrated Review Plan (U.S. EPA, 2016), other welfare effects of PM, such as ecological effects, are being considered in the separate, on-going review of the secondary NAAQS for oxides of nitrogen, oxides of sulfur and PM. Accordingly, the public welfare protection provided by the secondary PM standards against ecological effects such as those related to deposition of nitrogen- and sulfur-containing compounds in vulnerable ecosystems is being considered in that separate review. Thus, the Administrator's conclusion in this reconsideration of the 2020 final decision is focused only and specifically on the adequacy of public welfare protection provided by the secondary PM standards from effects related to visibility, climate, and materials and hereafter ''welfare effects'' refers to those welfare effects.

done in NAAQS rulemaking, the EPA prepared a Regulatory Impact Analysis (RIA) to provide the public with information on the potential costs and benefits of attaining several alternative $PM_{2.5}$ standard levels. In NAAQS rulemaking, the RIA is done for informational purposes only, and the final decisions on the NAAQS in this rulemaking are not based on consideration of the information or analyses in the RIA. The RIA fulfills the requirements of Executive Orders 14094, 13563, and 12866. The RIA estimates the costs and monetized human health benefits of attaining the revised and two alternative annual $PM_{2.5}$ standard levels and one alternative 24-hour $PM_{2.5}$ standard level. Specifically, the RIA examines the revised annual standard level of 9.0 μg/m^3 in combination with the current 24-hour standard of 35 μg/m^3 (*i.e.,* 9.0/35 μg/m^3), as well as the following less and more stringent alternative standard levels: (1) An alternative annual standard level of 10.0 μg/m^3 in combination with the current 24-hour standard (*i.e.,* 10.0/35 μg/m^3), (2) an alternative annual standard level of 8.0 μg/m^3 in combination with the current 24-hour standard (*i.e.,* 8.0/35 μg/m^3), and (3) an alternative 24-hour standard level of 30 μg/m^3 in combination with an alternative annual standard level of 10 μg/m^3 (*i.e.,* 10.0/30 μg/m^3). The RIA presents estimates of the costs and benefits of applying illustrative national control strategies in 2032 after implementing existing and expected regulations and assessing emissions reductions to meet the current annual and 24-hour particulate matter NAAQS (12.0/35 μg/m^3).

I. Background

A. Legislative Requirements

Two sections of the Clean Air Act (CAA) govern the establishment and revision of the NAAQS. Section 108 (42 U.S.C. 7408) directs the Administrator to identify and list certain air pollutants and then to issue air quality criteria for those pollutants. The Administrator is to list those pollutants ''emissions of which, in his judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare''; ''the presence of which in the ambient air results from numerous or diverse mobile or stationary sources''; and for which he ''plans to issue air quality criteria. . . .'' (42 U.S.C. 7408(a)(1)). Air quality criteria are intended to ''accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of [a] pollutant in the ambient air. . . .'' (42 U.S.C. 7408(a)(2)).

Section 109 [42 U.S.C. 7409] directs the Administrator to propose and promulgate ''primary'' and ''secondary'' NAAQS for pollutants for which air quality criteria are issued [42 U.S.C. 7409(a)]. Section 109(b)(1) defines primary standards as ones ''the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health.'' [5] Under section 109(b)(2), a secondary standard must ''specify a level of air quality the attainment and maintenance of which, in the judgment of the Administrator, based on such criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of [the] pollutant in the ambient air.'' [6]

In setting primary and secondary standards that are ''requisite'' to protect public health and welfare, respectively, as provided in section 109(b), the EPA's task is to establish standards that are neither more nor less stringent than necessary. In so doing, the EPA may not consider the costs of implementing the standards. See generally *Whitman* v. *American Trucking Associations,* 531 U.S. 457, 465–472, 475–76 (2001). Likewise, ''[a]ttainability and technological feasibility are not relevant considerations in the promulgation of national ambient air quality standards.'' *American Petroleum Institute* v. *Costle,* 665 F.2d 1176, 1185 (D.C. Cir. 1981); *accord Murray Energy Corporation* v. *EPA,* 936 F.3d 597, 623–24 (D.C. Cir. 2019).

The requirement that primary standards provide an adequate margin of safety was intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It was also intended to provide a reasonable degree of protection against hazards that research has not yet identified. See *Lead Industries Association* v. *EPA,* 647 F.2d 1130, 1154 (D.C. Cir. 1980); *American Petroleum Institute* v. *Costle,* 665 F.2d at 1186; *Coalition of Battery Recyclers Ass'n* v. *EPA,* 604 F.3d 613, 617–18 (D.C. Cir. 2010); *Mississippi* v. *EPA,* 744 F.3d 1334, 1353 (D.C. Cir. 2013). Both kinds of uncertainties are components of the risk associated with pollution at levels below those at which human health effects can be said to occur with reasonable scientific certainty. Thus, in selecting primary standards that include an adequate margin of safety, the Administrator is seeking not only to prevent pollution levels that have been demonstrated to be harmful but also to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree. The CAA does not require the Administrator to establish a primary NAAQS at a zero-risk level or at background concentration levels, see *Lead Industries Ass'n* v. *EPA,* 647 F.2d at 1156 n.51, *Mississippi* v. *EPA,* 744 F.3d at 1351, but rather at a level that reduces risk sufficiently so as to protect public health with an adequate margin of safety.

In addressing the requirement for an adequate margin of safety, the EPA considers such factors as the nature and severity of the health effects involved, the size of the sensitive population(s), and the kind and degree of uncertainties. The selection of any particular approach to providing an adequate margin of safety is a policy choice left specifically to the Administrator's judgment. See *Lead Industries Ass'n* v. *EPA,* 647 F.2d at 1161–62; *Mississippi* v. *EPA,* 744 F.3d at 1353.

Section 109(d)(1) of the Act requires the review every five years of existing air quality criteria and, if appropriate, the revision of those criteria to reflect advances in scientific knowledge on the effects of the pollutant on public health and welfare. Under the same provision, the EPA is also to review every five years and, if appropriate, revise the NAAQS, based on the revised air quality criteria. Section 109(d)(1) also provides that the Administrator may review and revise criteria or promulgate new standards earlier or more frequently.

Section 109(d)(2) addresses the appointment and advisory functions of an independent scientific review committee. Section 109(d)(2)(A) requires the Administrator to appoint this committee, which is to be composed of ''seven members including at least one member of the National Academy of Sciences, one physician, and one person representing State air

[5] The legislative history of section 109 indicates that a primary standard is to be set at ''the maximum permissible ambient air level . . . which will protect the health of any [sensitive] group of the population,'' and that for this purpose ''reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group.'' S. Rep. No. 91–1196, 91st Cong., 2d Sess. 10 (1970).

[6] Under CAA section 302(h) (42 U.S.C. 7602(h)), effects on welfare include, but are not limited to, ''effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.''

pollution control agencies.'' Section 109(d)(2)(B) provides that the independent scientific review committee ''shall complete a review of the criteria . . . and the national primary and secondary ambient air quality standards . . . and shall recommend to the Administrator any new . . . standards and revisions of existing criteria and standards as may be appropriate. . . .'' Since the early 1980s, this independent review function has been performed by the Clean Air Scientific Advisory Committee (CASAC) of the EPA's Science Advisory Board.

As previously noted, the Supreme Court has held that section 109(b) ''unambiguously bars cost considerations from the NAAQS-setting process.'' *Whitman* v. *Am. Trucking Associations,* 531 U.S. 457, 471 (2001). Accordingly, while some of these issues regarding which Congress has directed the CASAC to advise the Administrator are ones that are relevant to the standard setting process, others are not. Issues that are not relevant to standard setting may be relevant to implementation of the NAAQS once they are established.

B. Related PM Control Programs

States are primarily responsible for ensuring attainment and maintenance of ambient air quality standards once the EPA has established them. Under section 110, Part C, and Part D, Subparts 1 and 4 of the CAA, and related provisions and regulations, States are to submit, for the EPA's approval, State implementation plans (SIPs) that provide for the attainment and maintenance of the NAAQS for PM through control programs directed to sources of the pollutants involved. The States, in conjunction with the EPA, also administer the prevention of significant deterioration of air quality program that covers these pollutants (see 42 U.S.C. 7470–7479). In addition, Federal programs provide for or result in nationwide reductions in emissions of PM and its precursors under Title II of the Act, 42 U.S.C. 7521–7574, which involves controls for motor vehicles and nonroad engines and equipment; the new source performance standards under section 111 of the Act, 42 U.S.C. 7411; and the national emissions standards for hazardous pollutants under section 112 of the Act, 42 U.S.C. 7412.

C. Review of the Air Quality Criteria and Standards for Particulate Matter

1. Reviews Completed in 1971 and 1987

The EPA first established NAAQS for PM in 1971 (36 FR 8186, April 30, 1971), based on the original Air Quality Criteria Document (AQCD) (DHEW, 1969).[7] The Federal reference method (FRM) specified for determining attainment of the original standards was the high-volume sampler, which collects PM up to a nominal size of 25 to 45 μm (referred to as total suspended particulates or TSP). The primary standards were set at 260 μg/m^3, 24-hour average, not to be exceeded more than once per year, and 75 μg/m^3, annual geometric mean. The secondary standards were set at 150 μg/m^3, 24-hour average, not to be exceeded more than once per year, and 60 μg/m^3, annual geometric mean.

In October 1979 (44 FR 56730, October 2, 1979), the EPA announced the first periodic review of the air quality criteria and NAAQS for PM. Revised primary and secondary standards were promulgated in 1987 (52 FR 24634, July 1, 1987). In the 1987 decision, the EPA changed the indicator for particles from TSP to PM_{10}, in order to focus on the subset of inhalable particles small enough to penetrate to the thoracic region of the respiratory tract (including the tracheobronchial and alveolar regions), referred to as thoracic particles.[8] The level of the 24-hour standards (primary and secondary) was set at 150 μg/m^3, and the form was one expected exceedance per year, on average over three years. The level of the annual standards (primary and secondary) was set at 50 μg/m^3, and the form was the annual arithmetic mean, averaged over three years.

2. Review Completed in 1997

In April 1994, the EPA announced its plans for the second periodic review of the air quality criteria and NAAQS for PM, and in 1997 the EPA promulgated revisions to the NAAQS (62 FR 38652, July 18, 1997). In the 1997 decision, the EPA determined that the fine and coarse fractions of PM_{10} should be considered separately. This determination was based on evidence that serious health effects were associated with short- and long-term exposures to fine particles in areas that met the existing PM_{10} standards. The EPA added new standards, using $PM_{2.5}$ as the indicator for fine particles (with $PM_{2.5}$ referring to particles with a nominal mean aerodynamic diameter less than or equal to 2.5 μm). The new primary standards were as follows: (1) An annual standard with a level of 15.0 μg/m^3, based on the 3-year average of annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors;[9] and (2) a 24-hour standard with a level of 65 μg/m^3, based on the 3-year average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations at each monitor within an area. Also, the EPA established a new reference method for the measurement of $PM_{2.5}$ in the ambient air and adopted rules for determining attainment of the new standards. To continue to address the health effects of the coarse fraction of PM_{10} (referred to as thoracic coarse particles or $PM_{10–2.5}$, generally including particles with a nominal mean aerodynamic diameter greater than 2.5 μm and less than or equal to 10 μm), the EPA retained the primary annual PM_{10} standard and revised the form of the primary 24-hour PM_{10} standard to be based on the 99th percentile of 24-hour PM_{10} concentrations at each monitor in an area. The EPA revised the secondary standards by setting them equal in all respects to the primary standards.

Following promulgation of the 1997 PM NAAQS, petitions for review were filed by several parties, addressing a broad range of issues. In May 1999, the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit) upheld the EPA's decision to establish fine particle standards and to regulate coarse particle pollution, but vacated the 1997 PM_{10} standards, concluding that the EPA had not provided a reasonable explanation justifying use of PM_{10} as an indicator for coarse particles. *American Trucking Associations, Inc.* v. *EPA,* 175 F. 3d 1027 (D.C. Cir. 1999). Pursuant to the D.C. Circuit's decision, the EPA removed the vacated 1997 PM_{10} standards, and the pre-existing 1987 PM_{10} standards remained in place (65 FR 80776, December 22, 2000). The D.C. Circuit also upheld the EPA's determination not to establish more stringent secondary standards for fine particles to address effects on visibility. *American Trucking Associations* v. *EPA,* 175 F. 3d at 1027.

[7] Prior to the review initiated in 2007 (see below), the AQCD provided the scientific foundation (*i.e.,* the air quality criteria) for the NAAQS. Beginning in that review, the Integrated Science Assessment (ISA) has replaced the AQCD.

[8] PM_{10} refers to particles with a nominal mean aerodynamic diameter less than or equal to 10 μm. More specifically, 10 μm is the aerodynamic diameter for which the efficiency of particle collection is 50 percent.

[9] The 1997 annual $PM_{2.5}$ standard was compared with measurements made at the community-oriented monitoring site recording the highest concentration or, if specific constraints were met, measurements from multiple community-oriented monitoring sites could be averaged (*i.e.,* ''spatial averaging''). In the last review (completed in 2012) the EPA replaced the term ''community-oriented'' monitor with the term ''area-wide'' monitor. Area-wide monitors are those sited at the neighborhood scale or larger, as well as those monitors sited at micro- or middle-scales that are representative of many such locations in the same core-based statistical area (CBSA) (78 FR 3236, January 15, 2013).

The D.C. Circuit also addressed more general issues related to the NAAQS, including issues related to the consideration of costs in setting NAAQS and the EPA's approach to establishing the levels of NAAQS. Regarding the cost issue, the court reaffirmed prior rulings holding that in setting NAAQS the EPA is ''not permitted to consider the cost of implementing those standards.'' *American Trucking Associations* v. *EPA,* 175 F. 3d at 1040–41. Regarding the levels of NAAQS, the court held that the EPA's approach to establishing the level of the standards in 1997 (*i.e.,* both for PM and for the ozone NAAQS promulgated on the same day) effected ''an unconstitutional delegation of legislative authority.'' *American Trucking Associations* v. *EPA,* 175 F. 3d at 1034–40. Although the court stated that ''the factors EPA uses in determining the degree of public health concern associated with different levels of ozone and PM are reasonable,'' it remanded the rule to the EPA, stating that when the EPA considers these factors for potential non-threshold pollutants ''what EPA lacks is any determinate criterion for drawing lines'' to determine where the standards should be set.

The D.C. Circuit's holding on the cost and constitutional issues were appealed to the United States Supreme Court. In February 2001, the Supreme Court issued a unanimous decision upholding the EPA's position on both the cost and constitutional issues. *Whitman* v. *American Trucking Associations,* 531 U.S. 457, 464, 475–76. On the constitutional issue, the Court held that the statutory requirement that NAAQS be ''requisite'' to protect public health with an adequate margin of safety sufficiently guided the EPA's discretion, affirming the EPA's approach of setting standards that are neither more nor less stringent than necessary.

The Supreme Court remanded the case to the D.C. Circuit for resolution of any remaining issues that had not been addressed in that court's earlier rulings. Id. at 475–76. In a March 2002 decision, the D.C. Circuit rejected all remaining challenges to the standards, holding that the EPA's $PM_{2.5}$ standards were reasonably supported by the administrative record and were not ''arbitrary and capricious.'' *American Trucking Associations* v. *EPA,* 283 F. 3d 355, 369–72 (D.C. Cir. 2002).

3. Review Completed in 2006

In October 1997, the EPA published its plans for the third periodic review of the air quality criteria and NAAQS for PM (62 FR 55201, October 23, 1997). After the CASAC and public review of several drafts, the EPA's National Center for Environmental Assessment (NCEA) finalized the AQCD in October 2004 (U.S. EPA, 2004a). The EPA's Office of Air Quality Planning and Standards (OAQPS) finalized a Risk Assessment and Staff Paper in December 2005 (Abt Associates, 2005; U.S. EPA, 2005).[10] On December 20, 2005, the EPA announced its proposed decision to revise the NAAQS for PM and solicited public comment on a broad range of options (71 FR 2620, January 17, 2006). On September 21, 2006, the EPA announced its final decisions to revise the primary and secondary NAAQS for PM to provide increased protection of public health and welfare, respectively (71 FR 61144, October 17, 2006). With regard to the primary and secondary standards for fine particles, the EPA revised the level of the 24-hour $PM_{2.5}$ standards to 35 $\mu g/m^3$, retained the level of the annual $PM_{2.5}$ standards at 15.0 $\mu g/m^3$, and revised the form of the annual $PM_{2.5}$ standards by narrowing the constraints on the optional use of spatial averaging. With regard to the primary and secondary standards for PM_{10}, the EPA retained the 24-hour standards, with levels at 150 $\mu g/m^3$, and revoked the annual standards. The then-Administrator judged that the available evidence generally did not suggest a link between long-term exposure to existing ambient levels of coarse particles and health or welfare effects. In addition, a new reference method was added for the measurement of $PM_{10-2.5}$ in the ambient air in order to provide a basis for approving Federal Equivalent Methods (FEMs) and to promote the gathering of scientific data to support future reviews of the PM NAAQS.

Several parties filed petitions for review following promulgation of the revised PM NAAQS in 2006. On February 24, 2009, the D.C. Circuit issued its opinion in the case *American Farm Bureau Federation* v. *EPA,* 559 F. 3d 512 (D.C. Cir. 2009). The court remanded the primary annual $PM_{2.5}$ NAAQS to the EPA because the Agency had failed to adequately explain why the standards provided the requisite protection from both short- and long-term exposures to fine particles, including protection for at-risk populations. *Id. at* 520–27. With regard to the standards for $PM_{10,}$ the court upheld the EPA's decisions to retain the 24-hour PM_{10} standard to provide protection from thoracic coarse particle exposures and to revoke the annual PM_{10} standard. *Id.* at 533–38. With regard to the secondary $PM_{2.5}$ standards, the court remanded the standards to the EPA because the Agency failed to adequately explain why setting the secondary PM standards identical to the primary standards provided the required protection for public welfare, including protection from visibility impairment. *Id.* at 528–32. The EPA responded to the court's remands as part of the next review of the PM NAAQS, which was initiated in 2007 (discussed below).

4. Review Completed in 2012

In June 2007, the EPA initiated the fourth periodic review of the air quality criteria and the PM NAAQS by issuing a call for information (72 FR 35462, June 28, 2007). Based on the NAAQS review process, as revised in 2008 and again in 2009,[11] the EPA held science/policy issue workshops on the primary and secondary PM NAAQS (72 FR 34003, June 20, 2007; 72 FR 34005, June 20, 2007), and prepared and released the planning and assessment documents that comprise the review process (*i.e.,* Integrated Review Plan, (IRP; U.S. EPA, 2008), Integrated Science Assessment (ISA; U.S. EPA, 2009a), Risk and Exposure Assessment (REA) planning documents for health and welfare (U.S. EPA, 2009b, U.S. EPA, 2009c), a quantitative health risk assessment (U.S. EPA, 2010a) and an urban-focused visibility assessment (U.S. EPA, 2010b), and a Policy Assessment (PA; U.S. EPA, 2011). In June 2012, the EPA announced its proposed decision to revise the NAAQS for PM (77 FR 38890, June 29, 2012).

In December 2012, the EPA announced its final decisions to revise the primary NAAQS for PM to provide increased protection of public health (78 FR 3086, January 15, 2013). With regard to primary standards for $PM_{2.5}$, the EPA revised the level of the annual $PM_{2.5}$ standard [12] to 12.0 $\mu g/m^3$ and retained the 24-hour $PM_{2.5}$ standard, with its level of 35 $\mu g/m^3$. For the primary PM_{10} standard, the EPA retained the 24-hour standard to continue to provide protection against effects associated with short-term exposure to thoracic coarse particles (*i.e.,* $PM_{10-2.5}$). With regard to the secondary PM standards, the EPA generally retained the 24-hour

[10] Prior to the review initiated in 2007, the Staff Paper presented the EPA staff's considerations and conclusions regarding the adequacy of existing NAAQS and, when appropriate, the potential alternative standards that could be supported by the evidence and information. More recent reviews present this information in the Policy Assessment.

[11] The history of the NAAQS review process, including revisions to the process, is discussed at *https://www.epa.gov/naaqs/historical-information-naaqs-review-process.*

[12] The EPA also eliminated the option for spatial averaging.

and annual $PM_{2.5}$ standards [13] and the 24-hour PM_{10} standard to address visibility and non-visibility welfare effects.

As with previous reviews, petitioners challenged the EPA's final rule. Petitioners argued that the EPA acted unreasonably in revising the level and form of the annual standard and in amending the monitoring network provisions. On judicial review, the revised standards and monitoring requirements were upheld in all respects. *NAM* v. *EPA,* 750 F.3d 921 (D.C. Cir. 2014).

5. Review Initiated in 2014

In December 2014, the EPA announced the initiation of the current periodic review of the air quality criteria for PM and of the $PM_{2.5}$ and PM_{10} NAAQS and issued a call for information (79 FR 71764, December 3, 2014). On February 9 to 11, 2015, the EPA's NCEA and OAQPS held a public workshop to inform the planning for the review of the PM NAAQS (announced in 79 FR 71764, December 3, 2014). Workshop participants, including a wide range of external experts as well as the EPA staff representing a variety of areas of expertise (*e.g.,* epidemiology, human and animal toxicology, risk/exposure analysis, atmospheric science, visibility impairment, climate effects), were asked to highlight significant new and emerging PM research, and to make recommendations to the Agency regarding the design and scope of the review. This workshop provided for a public discussion of the key science and policy-relevant issues around which the EPA structured the review of the PM NAAQS and of the most meaningful new scientific information that would be available in the review to inform understanding of these issues.

The input received at the workshop guided the EPA staff in developing a draft IRP, which was reviewed by the CASAC Particulate Matter Panel and discussed on public teleconferences held in May 2016 (81 FR 13362, March 14, 2016) and August 2016 (81 FR 39043, June 15, 2016). Advice from the CASAC, supplemented by the Particulate Matter Panel, and input from the public were considered in developing the final IRP (U.S. EPA, 2016). The final IRP discusses the approaches to be taken in developing key scientific, technical, and policy documents in the review and the key policy-relevant issues that frame the EPA's consideration of whether the primary and/or secondary NAAQS for PM should be retained or revised.

In May 2018, the then-Administrator issued a memorandum announcing the Agency's intention to conduct the review of the PM NAAQS in such a manner as to ensure that any necessary revisions were finalized by December 2020 (Pruitt, 2018). Following this memo, on October 10, 2018, the then-Administrator additionally announced that the role of reviewing the key assessments developed as part of the ongoing review of the PM NAAQS (*i.e.,* drafts of the ISA and PA) would be performed by the seven-member chartered CASAC (*i.e.,* rather than the CASAC Particulate Matter Panel that reviewed the draft IRP).[14]

The EPA released the draft ISA in October 2018 (83 FR 53471, October 23, 2018). The draft ISA was reviewed by the chartered CASAC at a public meeting held in Arlington, VA in December 2018 (83 FR 55529, November 6, 2018) and was discussed on a public teleconference in March 2019 (84 FR 8523, March 8, 2019). The CASAC provided its advice on the draft ISA in a letter to the then-Administrator dated April 11, 2019 (Cox, 2019a). The EPA addressed these comments in the final ISA, which was released in December 2019 (U.S. EPA, 2019a).

The EPA released the draft PA in September 2019 (84 FR 47944, September 11, 2019). The draft PA was reviewed by the chartered CASAC and discussed in October 2019 at a public meeting held in Cary, NC. Public comments were received via a separate public teleconference (84 FR 51555, September 30, 2019). A public meeting to discuss the chartered CASAC letter and response to charge questions on the draft PA was held in Cary, NC, in October 2019 (84 FR 51555, September 30, 2019), and the CASAC provided its advice on the draft PA, including its advice on the current primary and secondary PM standards, in a letter to the then-Administrator dated December 16, 2019 (Cox, 2019b). With regard to the primary standards, the CASAC recommended retaining the current 24-hour $PM_{2.5}$ and PM_{10} standards but did not reach consensus on the adequacy of the current annual $PM_{2.5}$ standard. Some CASAC members expressed support for retaining the current primary annual $PM_{2.5}$ standard while other members expressed support for revising that standard in order to increase public health protection (Cox, 2019b, p. 1 of letter). These views are described in greater detail in the letter to the then-Administrator (Cox, 2019b) and in the notice of final rulemaking (85 FR 82706–82707, December 18, 2020), as well as below. With regard to the secondary standards, the CASAC recommended retaining the current standards. In response to the CASAC's comments, the 2020 final PA incorporated a number of changes (Cox, 2019b, U.S. EPA, 2020b), as described in detail in section I.C.5 of the 2020 proposal document (85 FR 24100, April 30, 2020).

a. 2020 Proposed and Final Actions

On April 14, 2020, the EPA proposed to retain all of the primary and secondary PM standards, without revision. These proposed decisions were published in the **Federal Register** on April 30, 2020 (85 FR 24094, April 30, 2020). The EPA's final decision on the PM NAAQS was published in the **Federal Register** on December 18, 2020 (85 FR 82684, December 18, 2020). In the 2020 rulemaking, the EPA retained the primary and secondary $PM_{2.5}$ and PM_{10} standards, without revision. The then-Administrator's rationale for his decisions is described in more detail in section II, III, and V below, and is briefly summarized here.

In reaching his final decision to retain the primary annual and 24-hour $PM_{2.5}$ standards, the then-Administrator considered the available scientific evidence, quantitative information, CASAC advice, and public comments in his supporting rationale in the 2020 final action (85 FR 82714, December 18, 2020). In so doing, he concluded that the available controlled human exposure studies did not provide support for additional public health protection against exposures to peak $PM_{2.5}$ concentrations, beyond the protection provided by the combination of the current primary annual and 24-hour $PM_{2.5}$ standards. He also noted that the available epidemiologic studies did not indicate that associations in those studies are strongly influenced by exposures to peak concentrations in the air quality distribution and thus did not indicate the need for additional protection against short-term exposures to peak $PM_{2.5}$ concentrations. Accordingly, and taking into account consensus CASAC advice to retain the current primary 24-hour $PM_{2.5}$ standard, the then-Administrator concluded the primary 24-hour $PM_{2.5}$ standard should be retained.

With respect to the annual $PM_{2.5}$ standard, the then-Administrator recognized that important uncertainties and limitations that were present in epidemiologic studies in previous

[13] Consistent with the primary standard, the EPA eliminated the option for spatial averaging with the annual standard.

[14] Announcement available at: *https://www.regulations.gov/document/EPA-HQ-OAR-2015-0072-0223.*

reviews remained in the evidence assessed in the 2019 ISA. In considering the epidemiologic evidence, the then-Administrator noted that: (1) The reported mean concentration in the majority of the key U.S. epidemiologic studies using ground-based monitoring data are above the level of the current annual standard; (2) the mean of the reported study means (or medians) (*i.e.,* 13.5 $\mu g/m^3$) is above the level of the current primary annual $PM_{2.5}$ standard of 12 $\mu g/m^3$; (3) air quality analyses show the study means to be lower than their corresponding design by 10–20%; and (4) that these analyses must be considered in light of uncertainties inherent in the epidemiologic evidence. The then-Administrator further considered other available information, including the risk assessment, accountability studies, and controlled human exposure studies, and found that, in considering all of the evidence together along with advice from the CASAC, the suite of primary $PM_{2.5}$ standards were requisite to protect public health with an adequate margin of safety, and should be retained, without revision.

With regard to the primary PM_{10} standard, the then-Administrator noted that the expanded body of evidence has broadened the range of effects that have been linked with $PM_{10–2.5}$ exposures. In light of that information, as well as continued uncertainties in the evidence and advice from the CASAC to retain the standard, the then-Administrator judged it appropriate to retain the primary PM_{10} standard to provide the requisite degree of public health protection against $PM_{10–2.5}$ exposures, regardless of location, source of origin, or particle composition (85 FR 82725, December 18, 2020).

With regard to the secondary PM standards, the then-Administrator concluded that there was insufficient information available to establish any distinct secondary PM standards to address climate and materials effects of PM. For visibility effects, he found that in the absence of a monitoring network for direct measurement of light extinction, a calculated light extinction indicator that utilizes the IMPROVE algorithms continued to provide a reasonable basis for defining a target level of protection against PM-related visibility impairment. He further found that a visibility index with a 24-hour averaging time was reasonable based on its stability and suitability for representing subdaily periods, and a form based on the 3-year average of annual 90th percentile values was reasonable based on its stability and that it represents the median of the 20 percent worst visibility days which are targeted under the Regional Haze program. With regard to the level of a visibility index, the then-Administrator judged it appropriate to establish a target level of protection of 30 dv, reflecting the upper end of the range of visibility impairment judged to be acceptable by at least 50% of study participants in the available public preference studies, taking into consideration the variability, limitations and uncertainties of the public preference studies. The then-Administrator judged that the secondary 24-hour $PM_{2.5}$ standard with its level of 35 $\mu g/m^3$ would provide at least the target level of protection for visual air quality of 30 dv which he judged appropriate. Accordingly, taking into consideration the advice of the CASAC to retain the current secondary PM standards, the then-Administrator found the current secondary standards provide the requisite degree of protection and that they should be retained (85 FR 82742, December 18, 2020).

Following publication of the 2020 final action, several parties filed petitions for review and petitions for reconsideration of the EPA's final decision. The petitions for review were filed in the D.C. Circuit and the Court consolidated the cases.[15] Following EPA's decision to reconsider the 2020 final decision, the Court ordered the consolidated cases to be held in abeyance.

b. Reconsideration of the 2020 PM NAAQS Final Action

Executive Order 13990 directed review of certain agency actions (86 FR 7037, January 25, 2021).[16] An accompanying fact sheet provided a non-exclusive list of agency actions that agency heads should review in accordance with that order, including the 2020 Particulate Matter NAAQS Decision.[17]

On June 10, 2021, the Agency announced its decision to reconsider the 2020 PM NAAQS final action because the available scientific evidence and technical information indicate that the current standards may not be adequate to protect public health and welfare, as required by the Clean Air Act.[18] The Administrator reached this decision in part based on the fact that the EPA noted that the 2020 PA concluded that the scientific evidence and information called into question the adequacy of the primary annual $PM_{2.5}$ standard and supported revising the level to below the current level of 12.0 $\mu g/m^3$ while retaining the primary 24-hour $PM_{2.5}$ standard (U.S. EPA, 2020b). The EPA also noted that the 2020 PA concluded that the available scientific evidence and information supported retaining the primary PM_{10} standard and secondary PM standards without revision (U.S. EPA, 2020b).

The EPA staff conclusions detailed in the 2020 PA in combination with the CASAC advice that informed the Administrator's decisions regarding the 2020 final action, studies highlighted by public comments on the 2020 proposal, and the numerous studies published since the literature cutoff date of the 2019 ISA all informed the scope of the reconsideration.

In its review of the 2019 draft PA, some members of the CASAC had recommended that greater attention should be given to accountability studies and epidemiologic studies that employ alternative methods for confounder control (also referred to as causal inference or causal modeling studies) in order to ''more fully account for effects of confounding, measurement and estimation errors, model uncertainty, and heterogeneity'' in epidemiologic studies (Cox, 2019b, p. 8 of consensus responses). In addition, public commenters submitted a number of recent studies published after the literature cutoff date for the 2019 ISA that would have been considered within the scope of the 2019 ISA. While the EPA provisionally considered these studies in responding to public comments,[19] it was determined that, at the time of the 2020 final action, these studies were generally consistent with the evidence assessed in the 2019 ISA (85 FR 82690, December 18, 2020; U.S. EPA, 2020a). As such, and consistent with previous NAAQS reviews, the EPA concluded that the new studies did not materially change any of the broad scientific conclusions regarding the health and welfare effects of PM in ambient air made in the air quality criteria, and therefore, reopening of the air quality criteria was not warranted (85 FR 82691, December 18, 2020). However, at that time, the EPA

[15] See *California* v. *EPA,* (D.C. Cir., No. 21–2014 consolidated with Nos. 21–1027, 21–1054).

[16] See *https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/.*

[17] See *https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/20/fact-sheet-list-of-agency-actions-for-review/.*

[18] The press release for this announcement is available at: *https://www.epa.gov/newsreleases/epa-reexamine-health-standards-harmful-soot-previous-administration-left-unchanged.*

[19] The list of provisionally considered studies is included in Appendix A to the 2020 Response to Comments document (U.S. EPA, 2020a).

recognized that its ''provisional consideration of these studies did not and could not provide the kind of in-depth critical review'' (85 FR 82690, December 18, 2020) that studies undergo in the development of an ISA.

In preparing to reconsider the 2020 final decision for the PM NAAQS, the Agency revisited the need to reopen the air quality criteria, given the amount of time that had passed since the literature cutoff date of the 2019 ISA (*i.e.,* approximately January 2018) and the volume of literature that had become available, including those studies provisionally considered in responding to comments in 2020. In so doing, the EPA preliminarily concluded that at least some of these studies were likely to be relevant to its reconsideration of the air quality criteria and the PM NAAQS and that, in considering public comments on any proposed decisions for the reconsideration, these studies were likely to be raised by public commenters and would potentially warrant a reopening of the air quality criteria. For example, on February 16, 2021, the EPA received two petitions to reconsider the PM NAAQS. One petition objected to the EPA's provisional consideration of studies submitted in public comments on the 2020 proposal and suggested that the provisional consideration was inadequate because the studies could be important in determining whether the existing standards are adequately protective. See, Petition for Reconsideration of National Ambient Air Quality Standards for Particulate Matter, submitted by American Lung Association, et al, dated Feb. 16, 2020. The other petition identified a number of new studies, including one epidemiologic study that was published after the provisional consideration was completed that could further inform the concern expressed by the CASAC that associations reported in epidemiologic studies do not adequately account for ''uncontrolled confounding and other potential sources of error and bias.'' See Petition for Reconsideration of ''Review of the National Ambient Air Quality Standards for Particulate Matter,'' submitted by the State of California, dated Feb. 16, 2020. This was also an uncertainty noted by the then-Administrator in the 2020 decision, who also recognized ''that methodological study designs to address confounding, such as causal inference methods, are an emerging field of study.'' Thus, the Agency concluded it was appropriate to reconsider not only the standards but also the air quality criteria, in light of public comments during the 2020 PM NAAQS proposal and recent studies published since the cutoff date of the 2019 ISA, as reflected in petitions. In deciding to reopen the air quality criteria, the Agency concluded it was reasonable to focus on studies that were most likely to inform decisions on the appropriate standard, but not to reassess areas which, based on the assessment of available science published since the cutoff date of the 2019 ISA and through 2021, were judged unlikely to have new information that would be useful for the Administrator's decision making. The Agency accordingly announced that, in support of the reconsideration, it would develop a supplement to the 2019 ISA and a revised PA.

The EPA also explained that the draft ISA Supplement and draft PA would be reviewed at a public meeting by the CASAC, and the public would have opportunities to comment on these documents during the CASAC review process, as well as to provide input during the rulemaking through the public comment process and public hearings on the proposed rulemaking.

On March 31, 2021, the Administrator announced his decision to reestablish the membership of the CASAC to ''ensure the agency received the best possible scientific insight to support our work to protect human health and the environment.'' [20] Consistent with this memorandum, a call for nominations of candidates to the EPA's chartered CASAC was published in the **Federal Register** (86 FR 17146, April 1, 2021). On June 17, 2021, the Administrator announced his selection of the seven members to serve on the chartered CASAC.[21] [22] Additionally, a call for nominations of candidates to a PM-specific panel was published in the **Federal Register** (86 FR 33703, June 25, 2021). The members of the PM CASAC panel were announced on August 30, 2021.[23]

The draft ISA Supplement was released in September 2021 (U.S. EPA, 2021a; 86 FR 54186, September 30, 2021), and included a discussion of the rationale and scope of the Supplement. As explained therein, the ISA Supplement focuses on a thorough evaluation of some studies that became available after the literature cutoff date of the 2019 ISA that could either further inform the adequacy of the current PM NAAQS or address key scientific topics that have evolved since the literature cutoff date for the 2019 ISA. In selecting the health effects to evaluate within the ISA Supplement, the EPA focused on health effects for which the evidence supported a ''causal relationship'' because those were the health effects that were most useful in informing conclusions in the 2020 PA (U.S. EPA, 2022a, section 1.2.1).[24] Consistent with the rationale for the focus on certain health effects, in selecting the non-ecological welfare effects to evaluate within the ISA Supplement, the EPA focused on the non-ecological welfare effects for which the evidence supported a ''causal relationship'' and for which quantitative analyses could be supported by the evidence because those were the welfare effects that were most useful in informing conclusions in the 2020 PA.[25] Specifically, for non-ecological welfare effects, the focus within the ISA Supplement is on visibility effects. The ISA Supplement also considers recent health effects evidence that addresses key scientific topics where the literature has evolved since the 2020 review was completed,

[20] The press release for this announcement is available at: *https://www.epa.gov/newsreleases/administrator-regan-directs-epa-reset-critical-science-focused-federal-advisory.*

[21] The press release for this announcement is available at: *https://www.epa.gov/newsreleases/epa-announces-selections-charter-members-clean-air-scientific-advisory-committee.*

[22] The list of members of the chartered CASAC and their biosketches are available at: *https://casac.epa.gov/ords/sab/r/sab_apex/casac/mems?p14_committeeon=2021%20CASAC%20PM%20Panel&session=17433386035954.*

[23] The list of members of the PM CASAC panel and their biosketches are available at: *https://casac.epa.gov/ords/sab/f?p=105:14:9979229564047:::14:P14_COMMITTEEON:2021%20CASAC%20PM%20Panel.*

[24] As described in section 1.2.1 of the ISA Supplement: ''In considering the public health protection provided by the current primary $PM_{2.5}$ standards, and the protection that could be provided by alternatives, [the U.S. EPA, within the 2020 PM PA] emphasized health outcomes for which the ISA determined that the evidence supports either a '*causal*' or a '*likely to be causal*' relationship with $PM_{2.5}$ exposures'' (U.S. EPA, 2020b). Although the 2020 PA initially focused on this broader set of evidence, the basis of the discussion on potential alternative standards primarily focused on health effect categories where the 2019 PM ISA concluded a '*causal relationship*' (*i.e.,* short- and long-term $PM_{2.5}$ exposure and cardiovascular effects and mortality) as reflected in Figures 3–7 and 3–8 of the 2020 PA (U.S. EPA, 2020b).''

[25] As described in section 1.2.1 of the ISA Supplement: ''The 2019 PM ISA concluded a '*causal relationship*' for each of the welfare effects categories evaluated (*i.e.,* visibility, climate effects and materials effects). While the 2020 PA considered the broader set of evidence for these effects, for climate effects and material effects, it concluded that there remained 'substantial uncertainties with regard to the quantitative relationships with PM concentrations and concentration patterns that limit[ed] [the] ability to quantitatively assess the public welfare protection provided by the standards from these effects' (U.S. EPA, 2020b).''

specifically since the literature cutoff date for the 2019 ISA.[26]

Building on the rationale presented in section 1.2.1, the ISA Supplement considers peer-reviewed studies published from approximately January 2018 through March 2021 that meet the following criteria:

- Health Effects
  - U.S. and Canadian epidemiologic studies for health effect categories where the 2019 ISA concluded a ''*causal relationship*'' (*i.e.,* short- and long-term $PM_{2.5}$ exposure and cardiovascular effects and mortality).
  - U.S. and Canadian epidemiologic studies that employed alternative methods for confounder control or conducted accountability analyses (*i.e.,* examined the effect of a policy on reducing $PM_{2.5}$ concentrations).
- Welfare Effects
  - U.S. and Canadian studies that provide new information on public preferences for visibility impairment and/or developed methodologies or conducted quantitative analyses of light extinction.
- Key Scientific Topics
  - Experimental studies (*i.e.,* controlled human exposure and animal toxicological) conducted at near-ambient $PM_{2.5}$ concentrations experienced in the U.S.
  - U.S.- and Canadian-based epidemiologic studies that examined the relationship between $PM_{2.5}$ exposures and severe acute respiratory syndrome coronavirus 2 (SARS–CoV–2) infection and coronavirus disease 2019 (COVID–19) death.
  - At-Risk Populations.
  - U.S.- and Canadian-based epidemiologic or exposure studies examining potential disparities in either $PM_{2.5}$ exposures or the risk of health effects by race/ethnicity or socioeconomic status (SES).

Given the narrow scope of the ISA Supplement, it is important to recognize that the evaluation does not encompass the full multidisciplinary evaluation presented within the 2019 ISA that would result in weight-of-evidence conclusions on causality (*i.e.,* causality determinations). The ISA Supplement critically evaluates and provides key study-specific information for those recent studies deemed to be of greatest significance for informing preliminary conclusions on the PM NAAQS in the context of the body of evidence and scientific conclusions presented in the 2019 ISA.

In developing a revised PA to support the reconsideration, the EPA considered the available scientific evidence, including the evidence presented in the 2019 ISA and ISA Supplement. The 2022 PA considered the quantitative and technical information presented in the 2020 PA, in addition to new and updated analyses conducted since the 2020 final decision. For those health and welfare effects for which the ISA Supplement evaluated recently available studies (*i.e.,* $PM_{2.5}$-related health effects and visibility effects), new updated quantitative analyses were conducted as a part of the development of the 2022 PA. The newly available scientific and technical information presented in the 2022 PA were considered in reaching conclusions regarding the adequacy of the current standards and any potential alternative standards. For those health and welfare effects for which newly available scientific and technical information were not evaluated (*i.e.,* $PM_{10–2.5}$-related health effects and non-visibility welfare effects), the conclusions presented in the 2022 PA rely heavily on the information that supported the conclusions in the 2020 PA.

The CASAC PM panel met at a virtual public meeting in November 2021 to review the draft ISA Supplement (86 FR 52673, September 22, 2021). A virtual public meeting was then held in February 2022, and during this meeting the chartered CASAC considered the CASAC PM panel's draft letter to the Administrator on the draft ISA Supplement (87 FR 958, January 7, 2022).

The chartered CASAC provided its advice on the draft ISA Supplement in a letter to the EPA Administrator dated March 18, 2022 (Sheppard, 2022b). In its review of the draft ISA Supplement, the CASAC noted that they found ''the Draft ISA Supplement to be a well-written, comprehensive evaluation of the new scientific information published since the 2019 PM ISA'' (Sheppard, 2022b, p. 2 of letter). Furthermore, the CASAC stated that ''the final Integrated Science Assessment (ISA) Supplement . . . deserve[s] the Administrator's full consideration and [is] adequate for rulemaking'' (Sheppard, 2022b, p. 2 of letter). The CASAC generally endorsed EPA's decisions regarding the limited scope of the draft ISA Supplement, stating that ''this limitation [on scope] is appropriate for the targeted purpose of the Draft ISA Supplement'' although the CASAC noted it would not be appropriate for ISAs generally, and recommended that the EPA provide additional acknowledgment and explanation for the limited scope (Sheppard, 2022b, p. 2 of letter; see also pp. 2–3 of consensus responses). The EPA specifically noted in the final ISA Supplement, which was released in May 2022 (U.S. EPA, 2022a; hereafter referred to as the ISA Supplement throughout this document) that the ''targeted approach to developing the Supplement to the 2019 PM ISA for the purpose of reconsidering the 2020 PM NAAQS decision does not reflect a change to EPA's approach for developing ISAs for NAAQS reviews.'' Thus, the evidence presented within the 2019 ISA, along with the targeted identification and evaluation of new scientific information in the ISA Supplement, provides the scientific basis for the reconsideration of the 2020 PM NAAQS final decision.

The draft PA was released in October 2021 (86 FR 56263, October 8, 2021). The CASAC PM panel met at a virtual public meeting in December 2021 to review the draft PA (86 FR 52673, September 22, 2021). A virtual public meeting was then held in February 2022 and March 2022, and during this meeting the chartered CASAC considered the CASAC PM panel's draft letter to the Administrator on the draft PA (87 FR 958, January 7, 2022). The chartered CASAC provided its advice on the draft PA in a letter to the EPA Administrator dated March 18, 2022 (Sheppard, 2022a). The EPA took steps to address these comments in revising and finalizing the PA. The 2022 PA considers the scientific evidence presented in the 2019 ISA and ISA Supplement and considers the quantitative and technical information presented in the 2020 PA, along with updated and newly available analyses since the completion of the 2020 review. For those health and welfare effects for which the ISA Supplement evaluated recently available evidence and for which updated quantitative analyses were supported (*i.e.,* $PM_{2.5}$-related health effects and visibility effects), the 2022 PA includes consideration of this newly available scientific and technical information in reaching preliminary conclusions. For those health and welfare effects for which newly available scientific and technical

[26] These key scientific topics include experimental studies conducted at near-ambient concentrations, epidemiologic studies that employed alternative methods for confounder control or conducted accountability analyses, studies that assess the relationship between $PM_{2.5}$ exposure and severe acute respiratory syndrome coronavirus 2 (SARS–CoV–2) infection and coronavirus disease 2019 (COVID–19) death; and in accordance with recent EPA goals on addressing environmental justice, studies that examine disparities in $PM_{2.5}$ exposure and the risk of health effects by race/ethnicity or socioeconomic status (SES) (U.S. EPA, 2022a, section 1.2.1).

information were not evaluated (*i.e.,* $PM_{10–2.5}$-related health effects and non-visibility effects), the conclusions presented in the 2022 PA rely heavily on the information that supported the conclusions in the 2020 PA. The final PA was released in May 2022 (U.S. EPA, 2022b; hereafter referred to as the 2022 PA throughout this document).

Drawing from his consideration of the scientific evidence assessed in the 2019 ISA and ISA Supplement and the analyses in the 2022 PA, including the uncertainties in the evidence and analyses, and from his consideration of advice from the CASAC, on January 5, 2023, the Administrator proposed to revise the level of the primary annual $PM_{2.5}$ standard and to retain the primary 24-hour $PM_{2.5}$ standard, the primary 24-hour PM_{10} standard, and the secondary PM standards. These proposed decisions were published in the **Federal Register** on January 27, 2023 (88 FR 5558, January 27, 2023). The EPA held a multi-day virtual public hearing on February 21–23, 2023 (88 FR 6215, January 31, 2023). In total, the EPA received nearly 700,000 comments on the proposal from members of the public by the close of the public comment period on March 28, 2023. Major issues raised in the public comments are discussed throughout the preamble of this final action. A more detailed summary of all significant comments, along with the EPA's responses (henceforth ''Response to Comments'' document), can be found in the docket for this rulemaking (Docket No. EPA–HQ–OAR–2015–0072).

As in prior reviews, the EPA is basing its decision in this reconsideration on studies and related information in the air quality criteria, which have undergone CASAC and public review. These studies assessed in the 2019 ISA [27] and ISA Supplement [28] and the 2022 PA, and the integration of the scientific evidence presented in them, have undergone extensive critical review by the EPA, the CASAC, and the public. Decisions on the NAAQS should be based on studies that have been rigorously assessed in an integrative manner not only by the EPA but also by the statutorily mandated independent scientific advisory committee, as well as the public review that accompanies this process. It is for this reason that the EPA preliminarily concluded that the scientific evidence available since the completion of the 2019 ISA, including those raised in public comments on the proposal in 2020, warranted a partial reopening of the air quality criteria and prepared an ISA Supplement to enable the EPA, the CASAC, and the public to consider them further. Some commenters have referred to and discussed additional individual scientific studies on the health effects of PM that were not included in the 2019 ISA or ISA Supplement (''new studies'') and that have not gone through this comprehensive review process. In considering and responding to comments for which such ''new'' studies were cited in support, the EPA has provisionally considered the cited studies in the context of the findings of the 2019 ISA and ISA Supplement. The EPA's provisional consideration of these studies did not and could not provide the kind of in-depth critical review described above, but rather was focused on determining whether they warranted further reopening the review of the air quality criteria to enable the EPA, the CASAC, and the public to consider them further.

This approach, and the decision to rely on the studies and related information in the air quality criteria, which have undergone CASAC and public review, is consistent with the EPA's practice in prior NAAQS reviews and its interpretation of the requirements of the CAA. Since the 1970 amendments, the EPA has taken the view that NAAQS decisions are to be based on scientific studies and related information that have been assessed as a part of the pertinent air quality criteria, and the EPA has consistently followed this approach. This longstanding interpretation was strengthened by new legislative requirements enacted in 1977, which added section 109(d)(2) of the Act concerning CASAC review of air quality criteria. See 71 FR 6114, 61148 (October 17, 2006, final decision on review of NAAQS for particulate matter) for a detailed discussion of this issue and the EPA's past practice.

As discussed in the EPA's 1993 decision not to review the O_3 NAAQS, ''new'' studies may sometimes be of such significance that it is appropriate to delay a decision in a NAAQS review and to supplement the pertinent air quality criteria so the studies can be taken into account (58 FR 13013–13014, March 9, 1993). In the present case, the EPA decided to partially reopen the air quality criteria and prepared an ISA Supplement as a part of the reconsideration to facilitate evaluation of these studies by the EPA, the CASAC, and the public. The narrow scope of the ISA Supplement is supported by EPA's provisional consideration of ''new'' studies submitted in response to public comments on the 2020 proposal which concluded that, taken in context, the ''new'' information and findings do not materially change any of the broad scientific conclusions regarding the health and welfare effects of PM in ambient air made in the air quality criteria. Therefore, a full reopening of the air quality criteria was not warranted to assess the health and welfare effects of PM for purposes of the review.

Accordingly, the EPA is basing the final decisions in this reconsideration on the studies and related information included in the PM air quality criteria (including the 2019 PM ISA and ISA Supplement) that have undergone rigorous review by the EPA, the CASAC, and the public. The EPA will consider these ''new'' studies for inclusion in the air quality criteria for the next PM NAAQS review, which the EPA expects to begin soon after the conclusion of this reconsideration and which will provide the opportunity to fully assess these studies through a more rigorous review process involving the EPA, the CASAC, and the public.

D. Air Quality Information

This section provides a summary of basic information related to PM ambient air quality. It summarizes information on the distribution of particle size in ambient air (section I.D.1), sources and emissions contributing to PM in the ambient air (section I.D.2), monitoring ambient PM in the U.S. (section I.D.3), ambient PM concentrations and trends in the U.S. (I.D.4), characterizing ambient $PM_{2.5}$ concentrations for exposure (section I.D.5), and background PM (section I.D.6). Additional detail on PM air quality can be found in Chapter 2 of the 2022 PA (U.S. EPA, 2022b).

1. Distribution of Particle Size in Ambient Air

In ambient air, PM is a mixture of substances suspended as small liquid and/or solid particles (U.S. EPA, 2019a, section 2.2) and distinct health and welfare effects have been linked with exposures to particles of different sizes. Particles in the atmosphere range in size from less than 0.01 to more than 10 μm

[27] In addition to the 2020 review's opening ''call for information'' (79 FR 71764, December 3, 2014), the 2019 ISA identified and evaluated studies and reports that have undergone scientific peer review and were published or accepted for publication between January 1, 2009, through approximately January 2018 (U.S. EPA, 2019a, p. ES–2). References that are cited in the 2019 ISA, the references that were considered for inclusion but not cited, and electronic links to bibliographic information and abstracts can be found at: *https://hero.epa.gov/hero/particulate-matter.*

[28] As described above, the ISA Supplement represents an evaluation of recent studies that are of greatest policy relevance and utility to the reconsideration of the 2020 final decision on the PM NAAQS (U.S. EPA, 2022a).

in diameter (U.S. EPA, 2019a, section 2.2). The EPA defines $PM_{2.5}$, also referred to as fine particles, as particles with aerodynamic diameters generally less than or equal to 2.5 μm. The size range for $PM_{10–2.5}$, also called coarse or thoracic coarse particles, includes those particles with aerodynamic diameters generally greater than 2.5 μm and less than or equal to 10 μm. PM_{10}, which is comprised of both fine and coarse fractions, includes those particles with aerodynamic diameters generally less than or equal to 10 μm. In addition, ultrafine particles (UFP) are often defined as particles with a diameter of less than 0.1 μm based on physical size, thermal diffusivity or electrical mobility (U.S. EPA, 2019a, section 2.2). Atmospheric lifetimes are generally longest for $PM_{2.5}$, which often remains in the atmosphere for days to weeks (U.S. EPA, 2019a, Table 2–1) before being removed by wet or dry deposition, while atmospheric lifetimes for UFP and $PM_{10–2.5}$ are shorter and are generally removed from the atmosphere within hours, through wet or dry deposition (U.S. EPA, 2019a, Table 2–1; U.S. EPA, 2022b, section 2.1).

2. Sources and Emissions Contributing to PM in the Ambient Air

PM is composed of both primary (directly emitted particles) and secondary particles. Primary PM is derived from direct particle emissions from specific PM sources while secondary PM originates from gas-phase precursor chemical compounds present in the atmosphere that have participated in new particle formation or condensed onto existing particles (U.S. EPA, 2019a, section 2.3). As discussed further in the 2019 ISA (U.S. EPA, 2019a, section 2.3.2.1), secondary PM is formed in the atmosphere by photochemical oxidation reactions of both inorganic and organic gas-phase precursors. Precursor gases include sulfur dioxide (SO_2), nitrogen oxides (NO_X), and volatile organic compounds (VOC) (U.S. EPA, 2019a, section 2.3.2.1). Ammonia also plays an important role in the formation of nitrate PM by neutralizing sulfuric acid and nitric acid. Sources and emissions of PM are discussed in more detail the 2022 PA (U.S. EPA, 2022b, section 2.1.1). Briefly, anthropogenic sources of PM include both stationary (*e.g.,* fuel combustion for electricity production and other purposes, industrial processes, agricultural activities) and mobile (*e.g.,* diesel- and gasoline-powered highway vehicles and other engine-driven sources). Natural sources of PM include dust from the wind erosion of natural surfaces, sea salt, wildfires, primary biological aerosol particles (PBAP) such as bacteria and pollen, oxidation of biogenic hydrocarbons, such as isoprene and terpenes to produce secondary organic aerosol (SOA), and geogenic sources, such as sulfate formed from volcanic production of SO_2. Wildland fire, which encompass both wildfire and prescribed fire, accounts for 44% of emissions of primary $PM_{2.5}$ emissions (U.S. EPA, 2021b). Emissions from wildfire comprises 29% of primary $PM_{2.5}$ emissions.

In recent years, the frequency and magnitude of wildfires have increased (U.S. EPA, 2019a). The magnitude of the public health impact of wildfires is substantial both because of the increase in $PM_{2.5}$ concentrations as well as the duration of the wildfire smoke season, which is considered to range from May to November. Wildfire can make a large contribution to air pollution (including $PM_{2.5}$), and wildfire events can threaten public safety and life. The impacts of wildfire events can be mitigated through management of wildland vegetation, including through prescribed fire. Prescribed fire (and some wildfires) can mimic the natural processes necessary to maintain fire-dependent ecosystems, minimizing catastrophic wildfires and the risks they pose to safety, property and air quality (see, *e.g.,* 81 FR 58010, 58038, August 24, 2016). The EPA views the strategic use of prescribed fire as an important tool for reducing wildfire risk and the severity of wildfires and wildfire smoke (88 FR, 54118, 54126, August 9, 2023).[29] As noted in the PM NAAQS proposal, agencies have efforts in place to reduce the frequency and severity of human-caused wildfires (88 FR 5570, January 27, 2023).

Wildfire events produce high PM emissions that may impact the PM concentrations in ambient air to the extent that the concentrations result in an exceedance or violation which may affect the design value in a given area. The EPA's Exceptional Events Rule (81 FR 68216, October 3, 2016) describes the process by which air agencies may request to exclude 'event-influenced' data caused by exceptional events, which can include wildfires and prescribed fires on wildland. The EPA has issued guidance specifically addressing exceptional events demonstrations for both wildfires and prescribed fires on wildland. These documents are available on EPA's Exceptional Events Program website.[30] The EPA will develop fire-related exceptional events implementation tools, including updates as needed to existing guidance to facilitate more efficient processing of $PM_{2.5}$-related exceptional events demonstrations for both the 24-hour and annual standards.

3. Monitoring of Ambient PM

To promote uniform application of the air quality standards set forth under the CAA and to achieve the degree of public health and welfare protection intended for the NAAQS, the EPA establishes PM Federal Reference Methods (FRMs) for both PM_{10} and $PM_{2.5}$ in appendices J and L to 40 CFR part 50, both of which were amended following the 2006 and 2012 PM NAAQS reviews. The current PM monitoring network relies on FRMs and automated continuous Federal Equivalent Methods (FEMs) approved pursuant to 40 CFR part 53, in part to support changes necessary for implementation of the revised PM standards. Additionally, 40 CFR part 58, appendices A through E, detail the requirements to measure ambient air quality and report ambient air quality data and related information. More information on PM ambient monitoring networks is available in section 2.2 of the 2022 PA (U.S. EPA, 2022b).

The $PM_{2.5}$ monitoring program is one of the major ambient air monitoring programs with a robust, nationally consistent network of ambient air monitoring sites providing mass and/or chemical speciation measurements. 40 CFR part 58, appendix D, section 4.7 provides the applicable $PM_{2.5}$ network design criteria. For most urban locations, $PM_{2.5}$ monitors are sited at the neighborhood scale,[31] where $PM_{2.5}$ concentrations are reasonably homogeneous throughout an entire urban sub-region. In each CBSA with a monitoring requirement, at least one $PM_{2.5}$ monitoring station representing

[29] See also: *https://www.usda.gov/sites/default/files/documents/usda-epa-doi-cdc-mou.pdf.*

[30] See: *https://www.epa.gov/air-quality-analysis/final-2016-exceptional-events-rule-supporting-guidance-documents-updated-faqs.*

[31] For $PM_{2.5}$, neighborhood scale is defined at 40 CFR part 58, appendix D, 4.7.1(c)(3) as follows: Measurements in this category would represent conditions throughout some reasonably homogeneous urban sub-region with dimensions of a few kilometers and of generally more regular shape than the middle scale. Homogeneity refers to the particulate matter concentrations, as well as the land use and land surface characteristics. Much of the $PM_{2.5}$ exposures are expected to be associated with this scale of measurement. In some cases, a location carefully chosen to provide neighborhood scale data would represent the immediate neighborhood as well as neighborhoods of the same type in other parts of the city. $PM_{2.5}$ sites of this kind provide good information about trends and compliance with standards because they often represent conditions in areas where people commonly live and work for periods comparable to those specified in the NAAQS. In general, most $PM_{2.5}$ monitoring in urban areas should have this scale.

area-wide air quality is sited in an area of expected maximum concentration.[32] By ensuring the area of expected maximum concentration in a CBSA has a site compared to both the annual and 24-hour NAAQS, all other similar locations are thus protected. Sites that represent relatively unique microscale, localized hot-spot, or unique middle scale impact sites are only eligible for comparison to the 24-hour $PM_{2.5}$ NAAQS.

Under 40 CFR part 50, appendix L, and 40 CFR part 53, and 40 CFR part 58 appendix D there are three main methods components of the $PM_{2.5}$ monitoring program: filter-based FRMs measuring $PM_{2.5}$ mass, FEMs measuring $PM_{2.5}$ mass, and other samplers used to collect the aerosol used in subsequent laboratory analysis for measuring $PM_{2.5}$ chemical speciation. The FRMs are primarily used for comparison to the NAAQS, but also serve other important purposes, such as developing trends and evaluating the performance of FEMs. $PM_{2.5}$ FEMs are typically continuous methods used to support forecasting and reporting of the Air Quality Index (AQI) but are also used for comparison to the NAAQS. Samplers that are part of the Chemical Speciation Network (CSN) and Interagency Monitoring of Protected Visual Environments (IMPROVE) network are used to provide chemical composition of the aerosol and serve a variety of objectives. More detail on of each of these components of the $PM_{2.5}$ monitoring program and of recent changes to $PM_{2.5}$ monitoring requirements are described in detail in the 2022 PA (U.S. EPA, 2022b, section 2.2.3).

4. Ambient Concentrations and Trends

This section summarizes available information on recent ambient PM concentrations in the U.S. and on trends in PM air quality. Sections I.D.4.a and I.D.4.b summarize information on $PM_{2.5}$ mass and components, respectively. Section I.D.4.c summarizes information on PM_{10}. Sections I.D.4.d and I.D.4.e summarize the more limited information on $PM_{10-2.5}$ and UFP, respectively. Additional detail on PM air quality and trends can be found in the 2022 PA (U.S. EPA, 2022b, section 2.3).

a. $PM_{2.5}$ mass

At monitoring sites in the U.S., annual $PM_{2.5}$ concentrations from 2017 to 2019 averaged 8.0 μg/m³ (with the 10th and 90th percentiles at 5.9 and 10.0 μg/m³, respectively) and the 98th percentiles of 24-hour concentrations averaged 21.3 μg/m³ (with the 10th and 90th percentiles at 14.0 and 29.7 μg/m³, respectively) (U.S. EPA, 2022b, section 2.3.2.1). The highest ambient $PM_{2.5}$ concentrations occur in the western U.S., particularly in California and the Pacific Northwest (U.S. EPA, 2022b, Figure 2–15). Much of the eastern U.S. has lower ambient concentrations, with annual average concentrations generally at or below 12.0 μg/m³ and 98th percentiles of 24-hour concentrations generally at or below 30 μg/m³ (U.S. EPA, 2022b, section 2.3.2.1).

Recent ambient $PM_{2.5}$ concentrations reflect the substantial reductions that have occurred across much of the U.S. (U.S. EPA, 2022b, section 2.3.2.1). From 2000 to 2019, national annual average $PM_{2.5}$ concentrations declined from 13.5 μg/m³ to 7.6 μg/m³, a 43% decrease (U.S. EPA, 2022b, section 2.3.2.1).[33] These declines have occurred at urban and rural monitoring sites, although urban $PM_{2.5}$ concentrations remain consistently higher than those in rural areas (Chan et al., 2018) due to the impact of local sources in urban areas. Analyses at individual monitoring sites indicate that declines in ambient $PM_{2.5}$ concentrations have been most consistent across the eastern U.S. and in parts of coastal California, where both annual average and 98th percentiles of 24-hour concentrations declined significantly (U.S. EPA, 2022b, section 2.3.2.1). In contrast, trends in ambient $PM_{2.5}$ concentrations have been less consistent over much of the western U.S., with no significant changes since 2000 observed at some sites in the Pacific Northwest, the northern Rockies and plains, and the Southwest, particularly for 98th percentiles of 24-hour concentrations (U.S. EPA, 2022b, section 2.3.2.1). As noted below, some sites in the northwestern U.S. and California, where wildfire have been relatively common in recent years, have experienced high concentrations over shorter periods (*i.e.,* 2-hour averages).

The recent deployment of $PM_{2.5}$ monitors near major roads in large urban areas provides information on $PM_{2.5}$ concentrations near an important emissions source. For 2016–2018, Gantt et al. (2021) reported that 52% and 24% of the time near-road sites reported the highest annual and 24-hour $PM_{2.5}$ design value [34] in the CBSA, respectively. Of the CBSAs with the highest annual design values at near-road sites reported by Gantt et al. (2021), those design values were, on average, 0.8 μg/m³ higher than at the highest measuring non-near-road sites (range is 0.1 to 2.1 μg/m³ higher at near-road sites). Although most near-road monitoring sites do not have sufficient data to evaluate long-term trends in near-road $PM_{2.5}$ concentrations, analyses of the data at one near-road-like site in Elizabeth, NJ, [35] show that the annual average near-road increment has generally decreased between 1999 and 2017 from about 2.0 μg/m³ to about 1.3 μg/m³ (U.S. EPA, 2022b, section 2.3.2.1).

Ambient $PM_{2.5}$ concentrations can exhibit a diurnal cycle that varies due to impacts from intermittent emission sources, meteorology, and atmospheric chemistry. The $PM_{2.5}$ monitoring network in the U.S. has an increasing number of continuous FEM monitors reporting hourly $PM_{2.5}$ mass concentrations that reflect this diurnal variation. The 2019 ISA describes a two-peaked diurnal pattern in urban areas, with morning peaks attributed to rush-hour traffic and afternoon peaks attributed to a combination of rush hour traffic, decreasing atmospheric dilution, and nucleation (U.S. EPA, 2019a, section 2.5.2.3, Figure 2–32). Because a focus on annual average and 24-hour average $PM_{2.5}$ concentrations could mask subdaily patterns, and because some health studies examine PM exposure durations shorter than 24-hours, it is useful to understand the broader distribution of subdaily $PM_{2.5}$ concentrations across the U.S. The 2022 PA presents information on the frequency distribution of 2-hour average $PM_{2.5}$ mass concentrations from all FEM $PM_{2.5}$ monitors in the U.S. for 2017–2019. At sites meeting the current primary $PM_{2.5}$ standards, these 2-hour concentrations generally remain below 10 μg/m³, and rarely exceed 30 μg/m³. Two-hour concentrations are higher at sites violating the current standards, generally remaining below 16 μg/m³ and rarely exceeding 80 μg/m³ (U.S. EPA, 2022b, section 2.3.2.2.3). The extreme upper end of the distribution of 2-hour $PM_{2.5}$ concentrations is shifted higher during the warmer months, generally corresponding to the period of peak wildfire frequency (April to September) in the U.S. At sites meeting the current primary standards, the highest 2-hour concentrations measured rarely occur outside of the period of peak wildfire frequency. Most of the sites measuring

[32] 40 CFR part 58, app. D, 4.7.1(b)(2).

[33] See *https://www.epa.gov/air-trends/particulate-matter-pm25-trends* for up-to-date $PM_{2.5}$ trends information.

[34] A design value is considered valid if it meets the data handling requirements given in appendix N to 40 CFR part 50.

[35] The Elizabeth Lab site in Elizabeth, NJ, is situated approximately 30 meters from travel lanes of the Interchange 13 toll plaza of the New Jersey Turnpike and within 200 meters of travel lanes for Interstate 278 and the New Jersey Turnpike.

these very high concentrations are in the northwestern U.S. and California, where wildfires have been relatively common in recent years (see U.S. EPA, 2022b, Appendix A, Figure A–1). When the period of peak wildfire frequency is excluded from the analysis, the extreme upper end of the distribution is reduced (U.S. EPA, 2022b, section 2.3.2.2.3).

b. $PM_{2.5}$ Components

Based on recent air quality data, the major chemical components of $PM_{2.5}$ have distinct spatial distributions. Sulfate concentrations tend to be highest in the eastern U.S., while in the Ohio Valley, Salt Lake Valley, and California nitrate concentrations are highest, and relatively high concentrations of organic carbon are widespread across most of the continental U.S. (U.S. EPA, 2022b, section 2.3.2.3). Elemental carbon, crustal material, and sea salt are found to have the highest concentrations in the northeast U.S., southwest U.S., and coastal areas, respectively.

An examination of $PM_{2.5}$ composition trends can provide insight into the factors contributing to overall reductions in ambient $PM_{2.5}$ concentrations. The biggest change in $PM_{2.5}$ composition that has occurred in recent years is the reduction in sulfate concentrations due to reductions in SO_2 emissions. Between 2000 and 2015, the nationwide annual average sulfate concentration decreased by 17% at urban sites and 20% at rural sites. This change in sulfate concentrations is most evident in the eastern U.S. and has resulted in organic matter or nitrate now being the greatest contributor to $PM_{2.5}$ mass in many locations (U.S. EPA, 2019a, Figure 2–19). The overall reduction in sulfate concentrations has contributed substantially to the decrease in national average $PM_{2.5}$ concentrations as well as the decline in the fraction of PM_{10} mass accounted for by $PM_{2.5}$ (U.S. EPA, 2019a, section 2.5.1.1.6; U.S. EPA, 2022b, section 2.3.1).

c. PM_{10}

At long-term monitoring sites in the U.S., the 2017–2019 average of 2nd highest 24-hour PM_{10} concentration was 68 μg/m^3 (with 10th and 90th percentiles at 28 and 124 μg/m^3, respectively) (U.S. EPA, 2022b, section 2.3.2.4).[36] The highest PM_{10} concentrations tend to occur in the western U.S. Seasonal analyses indicate that ambient PM_{10} concentrations are generally higher in the summer months than at other times of year, though the most extreme high concentration events are more likely in the spring (U.S. EPA, 2019a, Table 2–5). This is due to fact that the major PM_{10} emission sources, dust and agriculture, are more active during the warmer and drier periods of the year.

Recent ambient PM_{10} concentrations reflect reductions that have occurred across much of the U.S. (U.S. EPA, 2022b, section 2.3.2.4). From 2000 to 2019, 2nd highest 24-hour PM_{10} concentrations have declined by about 46% (U.S. EPA, 2022b, section 2.3.2.4).[37] Analyses at individual monitoring sites indicate that annual average PM_{10} concentrations have generally declined at most sites across the U.S., with much of the decrease in the eastern U.S. associated with reductions in $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 2.3.2.4). Annual 2nd highest 24-hour PM_{10} concentrations have generally declined in the eastern U.S., while concentrations in much of the midwest and western U.S. have remained unchanged or increased since 2000 (U.S. EPA, 2022b, section 2.3.2.4).

Compared to previous reviews, data available from the NCore monitoring network in the current reconsideration allows a more comprehensive analysis of the relative contributions of $PM_{2.5}$ and $PM_{10–2.5}$ to PM_{10} mass. $PM_{2.5}$ generally contributes more to annual average PM_{10} mass in the eastern U.S. than the western U.S. (U.S. EPA, 2022b, Figure 2–23). At most sites in the eastern U.S., the majority of PM_{10} mass is comprised of $PM_{2.5}$. As ambient $PM_{2.5}$ concentrations have declined in the eastern U.S. (U.S. EPA, 2022b, section 2.3.2.2), the ratios of $PM_{2.5}$ to PM_{10} have also declined. For sites with days having concurrently very high $PM_{2.5}$ and PM_{10} concentrations (U.S. EPA, 2022b, Figure 2–24), the $PM_{2.5}/PM_{10}$ ratios are typically higher than the annual average ratios. This is particularly true in the northwestern U.S. where the high PM_{10} concentrations can occur during wildfires with high $PM_{2.5}$ (U.S. EPA, 2022b, section 2.3.2.4).

d. $PM_{10–2.5}$

Since the 2012 review, the availability of $PM_{10–2.5}$ ambient concentration data has greatly increased because of additions to the $PM_{10–2.5}$ monitoring capabilities to the national monitoring network. As illustrated in the 2022 PA (U.S. EPA, 2022b, section 2.3.2.5), annual average and 98th percentile $PM_{10–2.5}$ concentrations exhibit less distinct differences between the eastern and western U.S. than for either $PM_{2.5}$ or PM_{10}.

Due to the short atmospheric lifetime of $PM_{10–2.5}$ relative to $PM_{2.5}$, many of the high concentration sites are isolated and likely near emission sources associated with wind-blown and fugitive dust. The spatial distributions of annual average and 98th percentile concentrations of $PM_{10–2.5}$ are more similar than that of $PM_{2.5}$, suggesting that the same dust-related emission sources are affecting both long-term and episodic concentrations (U.S. EPA, 2022b, Figure 2–25). The highest concentrations of $PM_{10–2.5}$ are in the southwest U.S. where widespread dry and windy conditions contribute to wind-blown dust emissions. Additionally, compared to $PM_{2.5}$ and PM_{10}, changes in $PM_{10–2.5}$ concentrations have been small in magnitude and inconsistent in direction (U.S. EPA, 2022b, Figure 2–25). The majority of $PM_{10–2.5}$ sites in the U.S. do not have a concentration trend from 2000–2019, reflecting the relatively consistent level of dust emissions across the U.S. during the same time period (U.S. EPA, 2022b, section 2.3.2.5).[38]

e. UFP

Compared to $PM_{2.5}$ mass, there is relatively little data on U.S. particle number concentrations, which are dominated by UFP. In the published literature, annual average particle number concentrations reaching about 20,000 to 30,000 cm^3 have been reported in U.S. cities (U.S. EPA, 2019a). In addition, based on UFP measurements in two urban areas (New York City, Buffalo) and at a background site (Steuben County) in New York, there is a pronounced difference in particle number concentration between different types of locations (U.S. EPA, 2022b, Figure 2–26; U.S. EPA, 2019a, Figure 2–18). Urban particle number counts were several times higher than at the background site, and the highest particle number counts in an urban area with multiple sites (Buffalo) were observed at a near-road location (U.S. EPA, 2022b, section 2.3.2.6).

Long-term trends in UFP are not routinely available at U.S. monitoring

[36] The form of the current 24-hour PM_{10} standard is one-expected-exceedance, averaged over three years.

[37] For more information, see *https://www.epa.gov/air-trends/particulate-matter-pm10-trends#pmnat.*

[38] PM from dust emissions in the National Emissions Inventory (NEI) remain fairly consistent from year-to-year, except when there are severe weather incursions or there is a dust event that transports or causes major local dust storms to occur (particularly in the western U.S.). These dust events and weather incursions needed to effect dust emissions on a national level are not common and only seldomly occur. In the emissions trends analysis presented in the 2022 PA (U.S. EPA, 2022b, section 2.1.1), dust is included in the NEI sector labeled ''miscellaneous.''

sites. At one background site in Illinois with long-term data available, the annual average particle number concentration declined between 2000 and 2019, closely matching the reductions in annual $PM_{2.5}$ mass over that same period (U.S. EPA, 2022b, section 2.3.2.6). In addition, a small number of published studies have examined UFP trends over time. While limited, these studies also suggest that UFP number concentrations have declined over time along with decreases in $PM_{2.5}$ (U.S. EPA, 2022b, section 2.3.2.6). However, the relationship between changes in ambient $PM_{2.5}$ and UFPs cannot be comprehensively characterized due to the high variability and limited monitoring of UFPs (U.S. EPA, 2022b, section 2.3.2.6).

5. Characterizing Ambient $PM_{2.5}$ Concentrations for Exposure

Epidemiologic studies use various methods to characterize exposure to ambient $PM_{2.5}$. The methods used to estimate $PM_{2.5}$ concentrations can vary from traditional methods using monitoring data from ground-based monitors to newer methods using more complex hybrid modeling approaches. Studies using hybrid modeling approaches aim to broaden the spatial coverage, as well as estimate more spatially-resolved ambient $PM_{2.5}$ concentrations, by expanding beyond just those areas with monitors and providing estimates in areas that do not have ground-based monitors (*i.e.,* areas that are generally less densely populated and tend to have lower $PM_{2.5}$ concentrations) and at finer spatial resolutions (*e.g.,* 1 km x 1 km grid cells). Ground-based $PM_{2.5}$ monitors are generally sited in areas of expected maximum concentration. As such, the hybrid modeling approaches tend to broaden the areas captured in the exposure assessment, and in doing so, the studies that utilize these methods tend to report lower mean $PM_{2.5}$ concentrations than monitor-based approaches. Further, other aspects of the approaches applied in the various epidemiologic studies to estimate $PM_{2.5}$ exposure and/or to calculate the related study-reported mean concentration (*i.e.,* population weighting, trim mean approaches) can affect those data values. More detail related to hybrid modeling methods, performance of the methods, and how the reported mean concentrations compare across approaches is provided in section 2.3.3.2 of the 2022 PA (U.S. EPA, 2022b). The subsections below discuss the characterization of $PM_{2.5}$ concentrations based on monitoring data (I.D.5.a) and using hybrid modeling approaches (I.D.5.b).

a. Predicted Ambient $PM_{2.5}$ and Exposure Based on Monitored Data

Ambient concentrations of $PM_{2.5}$ are often characterized using measurements from national monitoring networks due to the accuracy and precision of the measurements and the public availability of data. For applications requiring $PM_{2.5}$ characterizations across large areas or provide complete coverage from the site measurements, data interpolation and averaging techniques (such as Average Nearest Neighbor tools, and area-wide or population-weighted averaging of monitors) are sometimes used (U.S. EPA, 2019a, chapter 3).

For an area to meet the NAAQS, all valid design values [39] in that area, including the highest annual and 24-hour design values, must be at or below the levels of the standards. Because the monitoring network siting requirements are specified to capture the high $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 2.2.3), areas meeting an annual $PM_{2.5}$ standard with a particular level would be expected to have long-term average monitored $PM_{2.5}$ concentrations (*i.e.,* averaged across space and over time in the area) somewhat below that standard level. This means that the $PM_{2.5}$ design value in an area is associated with a distribution of $PM_{2.5}$ concentrations in that area, and, based on monitoring siting requirements, should represent the highest concentration location applicable to be monitored under the $PM_{2.5}$ NAAQS. Analyses in the 2022 PA indicate that, based on recent air quality in U.S. CBSAs, maximum annual $PM_{2.5}$ design values are often 10% to 20% higher than annual average concentrations (*i.e.,* averaged across multiple monitors in the same CBSA) (U.S. EPA, 2022b, section 2.3.3.1, Figures 2–28 and 2–29). This difference between the maximum annual design value and the average concentration in an area can vary, depending on factors such as the number of monitors, monitor siting characteristics, and the distribution of ambient $PM_{2.5}$ concentrations. Given that higher $PM_{2.5}$ concentrations have been reported at some near-road monitoring sites relative to the surrounding area (U.S. EPA, 2022b, section 2.3.2.2.2), recent requirements for $PM_{2.5}$ monitoring at near-road locations in large urban areas (U.S. EPA, 2022b, section 2.2.3.3) may increase the ratios of maximum design values to average annual design values in some areas. Such ratios may also depend on how the averages are calculated (*i.e.,* averaged across monitors versus across modeled grid cells, as described below in section I.5.b). Compared to annual design values, the analysis in the 2022 PA indicates a more variable relationship between maximum 24-hour $PM_{2.5}$ design values and annual average concentrations (U.S. EPA, 2022b, section 2.3.3.1, Figure 2–29).

b. Comparison of $PM_{2.5}$ Hybrid Modeling Approaches in Estimating Exposure and Relative to Design Values

Two types of hybrid approaches that have been utilized in several key $PM_{2.5}$ epidemiologic studies in the 2019 ISA and ISA Supplement include neural network approaches and a satellite-based method with regression of residual $PM_{2.5}$ with land-use and other variables to improve estimates of $PM_{2.5}$ concentration in the U.S. As such, the 2022 PA further compares these two types of approaches across various scales (*e.g.,* CBSA versus nationwide), taking into account population weighting approaches utilized in epidemiologic studies when estimating $PM_{2.5}$ exposure (U.S. EPA, 2022b, section 2.3.3.2.4). Additionally, the 2022 PA assesses how average $PM_{2.5}$ concentrations computed in epidemiologic studies using these hybrid surfaces compare to the maximum design values measured at ground-based monitors. For this assessment, the 2022 PA evaluates the DI2019 [40] and HA2020 [41] hybrid surfaces, surfaces that are used in several of the key epidemiologic studies in the 2022 PA. This analysis is intended to help inform how the magnitude of the overall study-reported mean $PM_{2.5}$ concentrations in epidemiologic studies may be

[39] For the annual $PM_{2.5}$ standard, design values are calculated as the annual arithmetic mean $PM_{2.5}$ concentration, averaged over 3 years. For the 24-hour standard, design values are calculated as the 98th percentile of the annual distribution of 24-hour $PM_{2.5}$ concentrations, averaged over three years (appendix N of 40 CFR part 50).

[40] This analysis includes an updated version of the surface used in Di et al. (2016). Predictions in Di et al. (2016) were for 2000 to 2012 using a neural network model. The Di et al. (2019) study improved on that effort in several ways. First, a generalized additive model was used that accounted for geographic variations in performance to combine predictions from three models (neural network, random forest, and gradient boosting) to make the final optimal $PM_{2.5}$ predictions. Second, the datasets were updated that were used in model training and included additional variables such as 12-km CMAQ modeling as predictors. Finally, more recent years were included in the Di et al. (2019) study.

[41] The HA2020 field is based on the V4.NA.03 product available at: *https://sites.wustl.edu/acag/datasets/surface-pm2-5/.* The name ''HA2020'' comes from the references for this product (Hammer et al., 2020; van Donkelaar et al., 2019).

influenced by the approach used to compute that mean and how that value might compare to monitor reported concentrations. The $PM_{2.5}$ standards are expected to achieve a pattern of air quality through the attainment of a specific design value at each monitor in the monitoring network. As a result, it is important to be able to assess the relationship between monitor concentrations and patterns of air quality evaluated in the epidemiologic studies.

In estimating exposure, some studies focus on estimating concentrations in urban areas, while others examine the entire U.S. or large portions of the country. In general, the areas that are not included in the CBSA-only analysis tend to be more rural or less densely populated areas, tend to have lower $PM_{2.5}$ concentrations, and likely correspond to those locations where monitoring data availability is limited or nonexistent (U.S. EPA, 2022b, section 2.3.3.2.4, Figure 2–37). To evaluate the differences in mean $PM_{2.5}$ concentrations across different spatial scales, the 2022 PA analysis compares the DI2019 and HA2020 surfaces. At the national scale, the two surfaces generally produce similar average annual $PM_{2.5}$ concentrations, with the DI2019 surface being slightly higher compared to the HA2020 surface. The average annual $PM_{2.5}$ concentrations are also slightly higher using the DI2019 surface compared to the HA2020 surface when the analyses are conducted for CBSAs. Also, regardless of which surface is used, the average annual and 3-year average of the average annual $PM_{2.5}$ concentrations for the CBSA-only analyses are somewhat higher than for the nationwide analyses (4–8% higher) (U.S. EPA, 2022b, section 2.3.3.2.4, Table 2–5).[42] Overall, these analyses suggest that there are only slight differences in the average $PM_{2.5}$ concentrations depending on the hybrid modeling method employed, though including other hybrid modeling methods in this comparison could result in larger differences.

The 2022 PA next evaluates how the averages of the hybrid model surfaces compare to regulatory design values using both the DI2019 and HA2020 surfaces and how population weighting influences the mean $PM_{2.5}$ concentration.[43] As presented in the 2022 PA, the results using the DI2019 and HA2020 surfaces are similar for the average annual $PM_{2.5}$ concentrations, for each 3-year period. When population weighting is not applied, the average annual $PM_{2.5}$ concentrations generally range from 7.0 to 8.6 $\mu g/m^3$. When population weighting is applied, the average annual $PM_{2.5}$ concentrations are slightly higher, ranging from 8.2 to 10.2 $\mu g/m^3$. As with CBSAs versus the national comparison above, population weighting results in a higher average $PM_{2.5}$ concentration than when population weighting is not applied (U.S. EPA, 2022b, section 2.3.3.2.4, Table 2–7). For the CBSAs included in the population weighted analyses, the average maximum annual design values generally range from 9.5 to 11.7 $\mu g/m^3$. The results are similar for both the DI2019 and HA2020 surfaces and the maximum annual $PM_{2.5}$ design values measured at the monitors are often 40% to 50% higher than average annual $PM_{2.5}$ concentrations predicted by hybrid modeling methods when population weighting is not applied. However, when population weighting is applied, the ratio of the maximum annual $PM_{2.5}$ design values to the predicted average annual $PM_{2.5}$ concentrations are lower than when population weighting is not applied, with monitored design values generally 15% to 18% higher than population-weighted hybrid modeling average annual $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 2.3.3.2.4, Table 2–7).

6. Background PM

In this reconsideration, background PM is defined as all particles that are formed by sources or processes that cannot be influenced by actions within the jurisdiction of concern. U.S. background PM is defined as any PM formed from emissions other than U.S. anthropogenic (*i.e.,* manmade) emissions. Potential sources of U.S. background PM include both natural sources (*i.e.,* PM that would exist in the absence of any anthropogenic emissions of PM or PM precursors) and transboundary sources originating outside U.S. borders. Background PM is discussed in more detail in the 2022 PA (U.S. EPA, 2022b, section 2.4). At annual and national scales, estimated background PM concentrations in the U.S. are small compared to contributions from domestic anthropogenic sources.[44] For example, based on zero-out modeling in the last review of the PM NAAQS, annual background $PM_{2.5}$ concentrations were estimated to range from 0.5–3 $\mu g/m^3$ across the sites examined. In addition, speciated monitoring data from IMPROVE sites can provide some insights into how contributions from different sources, including sources of background PM, may have changed over time. Such data suggests the estimates of background concentrations using speciated monitoring data from IMPROVE monitors are around 1–3 $\mu g/m^3$ and have not changed significantly since the 2012 review. Contributions to background PM in the U.S. result mainly from sources within North America. Contributions from intercontinental events have also been documented (*e.g.,* transport from dust storms occurring in deserts in North Africa and Asia), but these events are less frequent and represent a relatively small fraction of background PM in most of the U.S. (U.S. EPA, 2022b, section 2.4).

II. Rationale for Decisions on the Primary $PM_{2.5}$ Standards

This section presents the rationale for the Administrator's decision to revise the primary annual $PM_{2.5}$ standard down to a level of 9 $\mu g/m^3$ and retain the primary 24-hour $PM_{2.5}$ standard. This rationale is based on a thorough review of the scientific evidence generally published through January 2018,[45] as evaluated in the 2019 ISA (U.S. EPA, 2019a), on the human health effects of $PM_{2.5}$ associated with long- and short-term exposures[46] to $PM_{2.5}$ in

[42] For the national scale, 3-year averages of the average annual $PM_{2.5}$ concentrations generally range from about 5.3 $\mu g/m^3$ to 8.1 $\mu g/m^3$, compared to the CBSA scale, which ranges from 5.7 $\mu g/m^3$ to 8.7 $\mu g/m^3$. (U.S. EPA, 2022b, section 2.3.3.2.4, Table 2–6).

[43] For this analysis, the 2022 PA includes CBSAs with three or more valid design values for the 3-year period. The regulatory design values for the CBSAs were calculated for each 3-year period for the CBSAs with 3 or more design values in each of the 3-year periods. Using the maximum design value for each CBSA and by each 3-year period, the ratio of maximum design values to modeled average annual $PM_{2.5}$ concentrations were calculated, for each 3-year period. More details about the analytical methods used for this analysis are described in section A.6 of Appendix A in the 2022 PA (U.S. EPA, 2022b).

[44] Sources that contribute to natural background PM include dust from the wind erosion of natural surfaces, sea salt, wildland fires, primary biological aerosol particles such as bacteria and pollen, oxidation of biogenic hydrocarbons such as isoprene and terpenes to produce secondary organic aerosols (SOA), and geogenic sources such as sulfate formed from volcanic production of SO_2 and oceanic production of dimethyl-sulfide (U.S. EPA, 2022b, section 2.4). While most of these sources release or contribute predominantly to fine aerosol, some sources including windblown dust, and sea salt also produce particles in the coarse size range (U.S. EPA, 2019a, section 2.3.3).

[45] In addition to the 2020 review's opening ''call for information'' (79 FR 71764, December 3, 2014), the 2019 ISA identified and evaluated studies and reports that have undergone scientific peer review and were published or accepted for publication between January 1, 2009, through approximately January 2018 (U.S. EPA, 2019a, p. ES–2). References that are cited in the 2019 ISA, the references that were considered for inclusion but not cited, and electronic links to bibliographic information and abstracts can be found at: *https://hero.epa.gov/hero/particulate-matter.*

[46] Short-term exposures are defined as those exposures occurring over hours up to 1 month,

the ambient air. Additionally, this rationale is based on a thorough evaluation of some studies that became available after the literature cutoff date of the 2019 ISA, as evaluated in the ISA Supplement, that could either further inform the adequacy of the current PM NAAQS or address key scientific topics that have evolved since the literature cutoff date for the 2019 ISA, generally through March 2021 (U.S. EPA, 2022a).[47] The Administrator's rationale also takes into account: (1) The 2022 PA evaluation of the policy-relevant information in the 2019 ISA and ISA Supplement and presentation of quantitative analyses of air quality and health risks; (2) CASAC advice and recommendations; and (3) public comments received during the development of these documents.

In presenting the rationale for the Administrator's decisions and its foundations, section II.A provides background on the general approach for this reconsideration and the basis for the existing standard, and also presents brief summaries of key aspects of the currently available health effects and risk information. Section II.B summarizes the CASAC advice and the basis for the proposed conclusions, addresses public comments received on the proposal and presents the Administrator's conclusions on the adequacy of the current standards, drawing on consideration of the scientific evidence and quantitative risk information, advice from the CASAC, and comments from the public. Section II.C summarizes the Administrator's decision on the primary $PM_{2.5}$ standards.

A. Introduction

The general approach for this reconsideration of the 2020 final decision on the primary $PM_{2.5}$ standards is fundamentally based on using the EPA's assessment of the current scientific evidence and associated quantitative analyses to inform the Administrator's judgment regarding primary $PM_{2.5}$ standards that protect public health with an adequate margin of safety. The EPA's assessments are primarily documented in the 2019 ISA, ISA Supplement, and 2022 PA, all of which have received CASAC review and public comment (83 FR 53471, October 23, 2018; 83 FR 55529, November 6, 2018; 85 FR 4655, January 27, 2020; 86 FR 52673, September 22, 2021; 86 FR 54186, September 30, 2021; 86 FR 56263, October 8, 2021; 87 FR 958, January 7, 2022; 87 FR 22207, April 14, 2022; 87 FR 31965, May 26, 2022). In bridging the gap between the scientific assessments of the 2019 ISA and ISA Supplement and the judgments required of the Administrator in determining whether the current standards provide the requisite public health protection, the 2022 PA evaluates policy implications of the evaluation of the current evidence in the 2019 ISA and ISA Supplement, and the risk information documented in the 2022 PA. In evaluating the public health protection afforded by the current standards, the four basic elements of the NAAQS (*i.e.,* indicator, averaging time, level, and form) are considered collectively.

The final decision on the adequacy of the current primary $PM_{2.5}$ standards is a public health policy judgment to be made by the Administrator. In reaching conclusions with regard to the standards, the decision will draw on the scientific information and analyses about health effects and population risks, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the scientific evidence and analyses. This approach is based on the recognition that the available health effects evidence generally reflects a continuum, consisting of levels at which scientists generally agree that health effects are likely to occur, through lower levels at which the likelihood and magnitude of the response become increasingly uncertain. This approach is consistent with the requirements of the NAAQS provisions of the Clean Air Act and with how the EPA and the courts have historically interpreted the Act (summarized in section I.A above). These provisions require the Administrator to establish primary standards that, in the judgment of the Administrator, are requisite to protect public health with an adequate margin of safety. In so doing, the Administrator seeks to establish standards that are neither more nor less stringent than necessary for this purpose. The Act does not require that primary standards be set at a zero-risk level, but rather at a level that avoids unacceptable risks to public health, including the health of sensitive (also referred to as ''at-risk'') groups.[48]

1. Background on the Current Standards

The current primary $PM_{2.5}$ standards were retained in 2020 based on the scientific evidence and quantitative risk information available at that time, as well as the then-Administrator's judgments regarding the available health effects evidence and the appropriate degree of public health protection afforded by the existing standards (85 FR 82718, December 18, 2020). With the 2020 decision, the then-Administrator retained the primary annual $PM_{2.5}$ standard with its level of 12.0 $\mu g/m^3$ and retained the primary 24-hour $PM_{2.5}$ standard with its level of 35 $\mu g/m^3$. The key considerations and the then-Administrator's conclusions regarding the primary $PM_{2.5}$ standards in the 2020 review are summarized below.

The health effects evidence base available in the 2020 review included extensive evidence from previous reviews as well as the evidence that had emerged since the prior review had been completed in 2012. This evidence base, spanning several decades, documents the relationship between short- and long-term $PM_{2.5}$ exposure and mortality or serious morbidity effects. The evidence available in the 2019 ISA reaffirmed, and in some cases strengthened, the conclusions from the 2009 ISA regarding the health effects of $PM_{2.5}$ exposures (U.S. EPA, 2019a). Much of the evidence came from epidemiologic studies conducted in North America, Europe, or Asia examining short-term and long-term exposures that demonstrated generally positive, and often statistically significant, $PM_{2.5}$ health effect associations with a range of outcomes including non- accidental, cardiovascular, or respiratory mortality; cardiovascular- or respiratory-related hospitalizations or emergency department visits; and other mortality/morbidity outcomes (*e.g.,* lung cancer mortality or incidence, asthma development). Experimental evidence, as well as evidence from panel studies, strengthened support for potential biological pathways through which $PM_{2.5}$ exposures could lead to health effects reported in many population-based epidemiologic studies, including support for pathways that could lead to cardiovascular, respiratory, nervous system, and cancer-related effects.

whereas long-term exposures are defined as those exposures occurring over 1 month to years (U.S. EPA, 2019a, section P.3.1).

[47] The ISA Supplement represents an evaluation of recent studies that are of greatest policy relevance to the reconsideration of the 2020 final decision on the PM NAAQS. Specifically, the ISA Supplement focuses on studies of health effects for which the evidence in the 2019 ISA supported a ''causal relationship'' (*i.e.,* short- and long-term $PM_{2.5}$ exposure and mortality and cardiovascular effects) because those were the health effects that were most useful in informing conclusions in the 2020 PA. The ISA Supplement does not include an evaluation of studies for other $PM_{2.5}$-related health effects (U.S. EPA, 2022a).

[48] As noted in section I.A above, the legislative history describes such protection for the sensitive group of individuals and not for a single person in the sensitive group (see S. Rep. No. 91–1196, 91st Cong, 2d Sess. 10 [1970]); see also *Am. Lung Ass'n* v. *EPA,* 134 F.3d 388, 389 (D.C. Cir. 1998).

Based on this evidence, the 2019 ISA concluded there to be a causal relationship between long- and short-term $PM_{2.5}$ exposure and mortality and cardiovascular effects, as well as likely to be causal relationships between long- and short-term $PM_{2.5}$ exposure and respiratory effects, and between long-term $PM_{2.5}$ exposure and cancer and nervous system effects (U.S. EPA, 2019a, section 1.7).

Epidemiologic studies reported $PM_{2.5}$ health effect associations with mortality and/or morbidity across multiple U.S. cities and in diverse populations, including in studies examining populations and lifestages that may be at increased risk of experiencing a $PM_{2.5}$-related health effect (*e.g.,* older adults, children). The 2019 ISA cited extensive evidence indicating that ''both the general population as well as specific populations and lifestages are at risk for $PM_{2.5}$-related health effects'' (U.S. EPA, 2019a, p. 12–1), including children and older adults, people with pre-existing respiratory or cardiovascular disease, minority populations, and low socioeconomic status (SES) populations.

The risk information available in the 2020 review included risk estimates for air quality conditions just meeting the existing primary $PM_{2.5}$ standards, and also for air quality conditions just meeting potential alternative standards. The general approach to estimating $PM_{2.5}$-associated health risks combined concentration-response (C–R) functions from epidemiologic studies with model-based $PM_{2.5}$ air quality surfaces, baseline health incidence data, and population demographics for 47 urban areas (U.S. EPA, 2020b, section 3.3, Figure 3–10, Appendix C). The risk assessment estimated that the existing primary $PM_{2.5}$ standards could allow a substantial number of $PM_{2.5}$-associated deaths in the U.S. Uncertainty in risk estimates (*e.g.,* in the size of risk estimates) can result from a number of factors, including assumptions about the shape of the C–R relationship with mortality at low ambient $PM_{2.5}$ concentrations, the potential for confounding and/or exposure measurement error, and the methods used to adjust $PM_{2.5}$ air quality.

Consistent with the general approach routinely employed in NAAQS reviews, the initial consideration in the 2020 review of the primary $PM_{2.5}$ standards was with regard to the adequacy of the protection provided by the existing standards.

As an initial matter, the then-Administrator considered the range of scientific evidence evaluating these effects, including studies of at-risk populations, to inform his review of the primary $PM_{2.5}$ standards, placing the greatest weight on evidence of effects for which the 2019 ISA determined there to be a causal or likely to be causal relationship with long- and short-term $PM_{2.5}$ exposures (85 FR 82714–82715, December 18, 2020).

With regard to indicator, the then-Administrator recognized that, consistent with the evidence available in prior reviews, the scientific evidence continued to provide strong support for health effects following short- and long-term $PM_{2.5}$ exposures. He noted the 2020 PA conclusions that the information continued to support the $PM_{2.5}$ mass-based indicator and remained too limited to support a distinct standard for any specific $PM_{2.5}$ component or group of components, and too limited to support a distinct standard for the ultrafine fraction. Thus, the then-Administrator concluded that it was appropriate to retain $PM_{2.5}$ as the indicator for the primary standards for fine particles (85 FR 82715, December 18, 2020).

With respect to averaging time and form, the then-Administrator noted that the scientific evidence continued to provide strong support for health effects associations with both long-term (*e.g.,* annual or multi-year) and short-term (*e.g.,* mostly 24-hour) exposures to $PM_{2.5}$, consistent with the conclusions in the 2020 PA. In the 2019 ISA, epidemiologic and controlled human exposure studies examined a variety of $PM_{2.5}$ exposure durations. Epidemiologic studies continued to provide strong support for health effects associated with short-term $PM_{2.5}$ exposures based on 24-hour $PM_{2.5}$ averaging periods, and the EPA noted that associations with subdaily estimates are less consistent and, in some cases, smaller in magnitude (U.S. EPA, 2019a, section 1.5.2.1; U.S. EPA, 2020b, section 3.5.2.2). In addition, controlled human exposure and panel-based studies of subdaily exposures typically examined subclinical effects, rather than the more serious population-level effects that have been reported to be associated with 24-hour exposures (*e.g.,* mortality, hospitalizations). Taken together, the 2019 ISA concluded that epidemiologic studies did not indicate that subdaily averaging periods were more closely associated with health effects than the 24-hour average exposure metric (U.S. EPA, 2019a, section 1.5.2.1). Additionally, while controlled human exposure studies provided consistent evidence for cardiovascular effects following $PM_{2.5}$ exposures for less than 24 hours (*i.e.,* <30 minutes to 5 hours), exposure concentrations in the studies were well-above the ambient concentrations typically measured in locations meeting the existing standards (U.S. EPA, 2020b, section 3.2.3.1). Thus, these studies also did not suggest the need for additional protection against subdaily $PM_{2.5}$ exposures (U.S. EPA, 2020b, section 3.5.2.2). Therefore, the then-Administrator judged that the 24-hour averaging time remained appropriate (85 FR 82715, December 18, 2020).

With regard to the form of the 24-hour standard (98th percentile, averaged over three years), the then-Administrator noted that epidemiologic studies continued to provide strong support for health effect associations with short-term (*e.g.,* mostly 24-hour) $PM_{2.5}$ exposures (U.S. EPA, 2020b, section 3.5.2.3) and that controlled human exposure studies provided evidence for health effects following single short-term ''peak'' $PM_{2.5}$ exposures. Thus, the evidence supported retaining a standard focused on providing supplemental protection against short-term peak exposures and supported a 98th percentile form for a 24-hour standard. The then-Administrator further noted that this form also provided an appropriate balance between limiting the occurrence of peak 24-hour $PM_{2.5}$ concentrations and identifying a stable target for risk management programs (U.S. EPA, 2020b, section 3.5.2.3). As such, the then-Administrator concluded that the available information supported retaining the form and averaging time of the current 24-hour standard (98th percentile, averaged over three years) and annual standard (annual average, averaged over three years) (85 FR 82715, December 18, 2020).

With regard to the level of the standards, in reaching his final decision, the then-Administrator considered the large body of evidence presented and assessed in the 2019 ISA (U.S. EPA, 2019a), the policy-relevant and risk-based conclusions and rationales as presented in the 2020 PA (U.S. EPA, 2020b), advice from the CASAC, and public comments. In particular, in considering the 2019 ISA and 2020 PA, he considered key epidemiologic studies that evaluated associations between $PM_{2.5}$ air quality distributions and mortality and morbidity, including key accountability studies; the availability of experimental studies to support biological plausibility; controlled human exposure studies examining effects following short-term $PM_{2.5}$ exposures; air quality analyses; and the important uncertainties and limitations associated with the information (85 FR 82715, December 18, 2020).

As an initial matter, the then-Administrator considered the protection afforded by both the annual and 24-hour standards together against long- and short-term $PM_{2.5}$ exposures and health effects. The Administrator recognized that the annual standard was most effective in controlling ''typical'' $PM_{2.5}$ concentrations near the middle of the air quality distribution (*i.e.,* around the mean of the distribution), but also provided some control over short-term peak $PM_{2.5}$ concentrations. On the other hand, the 24-hour standard, with its 98th percentile form, was most effective at limiting peak 24-hour $PM_{2.5}$ concentrations, but in doing so also had an effect on annual average $PM_{2.5}$ concentrations. Thus, while either standard could be viewed as providing some measure of protection against both average exposures and peak exposures, the 24-hour and annual standards were not expected to be equally effective at limiting both types of exposures. Thus, consistent with previous reviews, the then-Administrator's consideration of the public health protection provided by the existing primary $PM_{2.5}$ standards was based on his consideration of the combination of the annual and 24-hour standards. Specifically, he recognized that the annual standard was more likely to appropriately limit the ''typical'' daily and annual exposures that are most strongly associated with the health effects observed in epidemiologic studies. The then-Administrator concluded that an annual standard (as the arithmetic mean, averaged over three years) remained appropriate for targeting protection against the annual and daily $PM_{2.5}$ exposures around the middle portion of the $PM_{2.5}$ air quality distribution. Further, recognizing that the 24-hour standard (with its 98th percentile form) was more directly tied to short-term peak $PM_{2.5}$ concentrations, and more likely to appropriately limit exposures to such concentrations, the then-Administrator concluded that the current 24-hour standard (with its 98th percentile form, averaged over three years) remained appropriate to provide a balance between limiting the occurrence of peak 24-hour $PM_{2.5}$ concentrations and identifying a stable target for risk management programs. However, the then-Administrator recognized that changes in $PM_{2.5}$ air quality to meet an annual standard would likely result not only in lower short- and long-term $PM_{2.5}$ concentrations near the middle of the air quality distribution, but also in fewer and lower short-term peak $PM_{2.5}$ concentrations. The then-Administrator further recognized that changes in air quality to meet a 24-hour standard, with a 98th percentile form, would result not only in fewer and lower peak 24-hour $PM_{2.5}$ concentrations, but also in lower annual average $PM_{2.5}$ concentrations (85 FR 82715–82716, December 18, 2020).

Thus, in considering the adequacy of the 24-hour standard, the then-Administrator noted the importance of considering whether additional protection was needed against short-term exposures to peak $PM_{2.5}$ concentrations. In examining the scientific evidence, he noted the limited utility of the animal toxicological studies in directly informing conclusions on the appropriate level of the standard given the uncertainty in extrapolating from effects in animals to those in human populations. The then-Administrator noted that controlled human exposure studies provided evidence for health effects following single, short-term $PM_{2.5}$ exposures that corresponded best to exposures that might be experienced in the upper end of the $PM_{2.5}$ air quality distribution in the U.S. (*i.e.,* ''peak'' concentrations). However, most of these studies examined exposure concentrations considerably higher than are typically measured in areas meeting the standards (U.S. EPA, 2020b, section 3.2.3.1). In particular, controlled human exposure studies often reported statistically significant effects on one or more indicators of cardiovascular function following 2-hour exposures to $PM_{2.5}$ concentrations at and above 120 $\mu g/m^3$ (at and above 149 $\mu g/m^3$ for vascular impairment, the effect shown to be most consistent across studies). To provide insight into what these studies may indicate regarding the primary $PM_{2.5}$ standards, the 2020 PA (U.S. EPA, 2020b, p. 3–49) noted that 2-hour ambient concentrations of $PM_{2.5}$ at monitoring sites meeting the current standards almost never exceeded 32 $\mu g/m^3$. In fact, even the extreme upper end of the distribution of 2-hour $PM_{2.5}$ concentrations at sites meeting the primary $PM_{2.5}$ standards remained well-below the $PM_{2.5}$ exposure concentrations consistently shown in controlled human exposure studies to elicit effects (*i.e.,* 99.9th percentile of 2-hour concentrations at these sites is 68 $\mu g/m^3$ during the warm season). Thus, the experimental evidence did not indicate the need for additional protection against exposures to peak $PM_{2.5}$ concentrations, beyond the protection provided by the combination of the 24-hour and the annual standards (U.S. EPA, 2020b, section 3.2.3.1; 85 FR 82716, December 18, 2020).

With respect to the epidemiologic evidence, the then-Administrator noted that the studies did not indicate that associations in those studies were strongly influenced by exposures to peak concentrations in the air quality distribution and thus did not indicate the need for additional protection against short-term exposures to peak $PM_{2.5}$ concentrations (U.S. EPA, 2020b, section 3.5.1). The then-Administrator noted that this was consistent with CASAC consensus support for retaining the current 24-hour standard. Thus, the then-Administrator concluded that the 24-hour standard with its level of 35 $\mu g/m^3$ was adequate to provide supplemental protection (*i.e.,* beyond that provided by the annual standard alone) against short-term exposures to peak $PM_{2.5}$ concentrations (85 FR 82716, December 18, 2020).

With regard to the level of the annual standard, the then-Administrator recognized that the annual standard, with its form based on the arithmetic mean concentration, was most appropriately meant to limit the ''typical'' daily and annual exposures that were most strongly associated with the health effects observed in epidemiologic studies. However, the then-Administrator also noted that while epidemiologic studies examined associations between distributions of $PM_{2.5}$ air quality and health outcomes, they did not identify particular $PM_{2.5}$ exposures that cause effects and thus, they could not alone identify a specific level at which the standard should be set, as such a determination necessarily required the then-Administrator's judgment. Thus, consistent with the approaches in previous NAAQS reviews, the then-Administrator recognized that any approach that used epidemiologic information in reaching decisions on what standards are appropriate necessarily required judgments about how to translate the information from the epidemiologic studies into a basis for appropriate standards. This approach included consideration of the uncertainties in the reported associations between daily or annual average $PM_{2.5}$ exposures and mortality or morbidity in the epidemiologic studies. Such an approach is consistent with setting standards that are neither more nor less stringent than necessary, recognizing that a zero-risk standard is not required by the Clean Air Act (CAA) (85 FR 82716, December 18, 2020).

The then-Administrator emphasized uncertainties and limitations that were present in epidemiologic studies in previous reviews and persisted in the 2020 review. These uncertainties

included exposure measurement error, potential confounding by copollutants, increasing uncertainty of associations at lower $PM_{2.5}$ concentrations, and heterogeneity of effects across different cities or regions (85 FR 82716, December 18, 2020). The then-Administrator also noted the advice given by the CASAC on this matter. As described in section I.C.5 above, the CASAC did not reach consensus on the adequacy of the primary annual $PM_{2.5}$ standard. ''Some CASAC members'' expressed support for retaining the primary annual $PM_{2.5}$ standard while ''other members'' expressed support for revising that standard in order to increase public health protection (Cox, 2019b, p. 1 of consensus letter). The CASAC members who supported retaining the annual standard expressed their concerns with the epidemiologic studies, asserting that these studies did not provide a sufficient basis for revising the existing standards. They also identified several key concerns regarding the associations reported in epidemiologic studies and concluded that ''while the data on associations should certainly be carefully considered, this data should not be interpreted more strongly than warranted based on its methodological limitations'' (Cox, 2019b, p. 8 consensus responses).

Taking into consideration the views expressed by the CASAC members who supported retaining the annual standard, the then-Administrator recognized that epidemiologic studies examined associations between distributions of $PM_{2.5}$ air quality and health outcomes, and they did not identify particular $PM_{2.5}$ exposures that cause effects (U.S. EPA, 2020b, section 3.1.2). While the Administrator remained concerned about placing too much weight on epidemiologic studies to inform conclusions on the adequacy of the primary standards, he noted the approach to considering such studies in the 2012 review. In the 2012 review, it was noted that the evidence of an association in any epidemiologic study was ''strongest at and around the long-term average where the data in the study are most concentrated'' (78 FR 3140, January 15, 2013). In considering the characterization of epidemiologic studies, the then-Administrator viewed that when assessing the mean concentrations of the key short-term and long-term epidemiologic studies in the U.S. that used ground-based monitoring (*i.e.,* those studies where the mean is most directly comparable to the current annual standard), the majority of studies had mean concentrations at or above the level of the existing annual standard, with the mean of the study-reported means or medians equal to 13.5 $\mu g/m^3$, a concentration level above the existing level of the primary annual standard of 12 $\mu g/m^3$. The then-Administrator further noted his caution in directly comparing the reported study mean values to the standard level given that study-reported mean concentrations, by design, are generally lower than the design value of the highest monitor in an area, which determines compliance. In the 2020 PA, analyses of recent air quality in U.S. CBSAs indicated that maximum annual $PM_{2.5}$ design values for a given three-year period were often 10% to 20% higher than average monitored concentrations (*i.e.,* averaged across multiple monitors in the same CBSA) (U.S. EPA, 2020b, Appendix B, section B.7). He further noted his concern in placing too much weight on any one epidemiologic study but instead judged that it was more appropriate to focus on the body of studies together and therefore noted the calculation of the mean of study-reported means (or medians). Thus, while the then-Administrator was cautious in placing too much weight on the epidemiologic evidence alone, he noted that: (1) The reported mean concentration in the majority of the key U.S. epidemiologic studies using ground-based monitoring data were above the level of the existing annual standard; (2) the mean of the reported study means (or medians) (*i.e.,* 13.5 $\mu g/m^3$) was above the level of the current standard; [49] (3) air quality analyses showed the study means to be lower than their corresponding design values by 10–20%; and (4) these analyses must be considered in light of uncertainties inherent in the epidemiologic evidence. When taken together, the then-Administrator judged that, even if it were appropriate to place more weight on the epidemiologic evidence, this information did not call into question the adequacy of the current standards (85 FR 82716–17, December 18, 2020).

In addition to the evidence, the then-Administrator also considered the potential implications of the risk assessment. He noted that all risk assessments have limitations and that he remained concerned about the uncertainties in the underlying epidemiologic data used in the risk assessment. The then-Administrator also noted that in previous reviews, these uncertainties and limitations have often resulted in less weight being placed on quantitative estimates of risk than on the underlying scientific evidence itself (*e.g.,* 78 FR 3086, 3098–99, January 15, 2013). These uncertainties and limitations included uncertainty in the shapes of C–R functions, particularly at low concentrations; uncertainties in the methods used to adjust air quality; and uncertainty in estimating risks for populations, locations and air quality distributions different from those examined in the underlying epidemiologic study (U.S. EPA, 2020b, section 3.3.2.4). Additionally, the then-Administrator noted similar concern expressed by some members of the CASAC who support retaining the existing standards; they highlighted similar uncertainties and limitations in the risk assessment (Cox, 2019b). In light of all of this, the then-Administrator judged it appropriate to place little weight on quantitative estimates of $PM_{2.5}$-associated mortality risk in reaching conclusions about the level of the primary $PM_{2.5}$ standards (85 FR 82717, December 18, 2020).

The then-Administrator additionally considered an emerging body of evidence from accountability studies that examined past reductions in ambient $PM_{2.5}$ and the degree to which those reductions resulted in public health improvements. While the then-Administrator agreed with public commenters that well-designed and conducted accountability studies can be informative, he viewed the interpretation of such studies in the context of the primary $PM_{2.5}$ standards as complicated by the fact that some of the available studies had not evaluated $PM_{2.5}$ specifically (*e.g.,* as opposed to PM_{10} or total suspended particulates), did not show changes in $PM_{2.5}$ air quality, or had not been able to disentangle health impacts of the interventions from background trends in health (U.S. EPA, 2020b, section 3.5.1). He further recognized that the small number of available studies that did report public health improvements following past declines in ambient $PM_{2.5}$ had not examined air quality meeting the existing standards (U.S. EPA, 2020b, Table 3–3). This included U.S. studies that reported increased life expectancy, decreased mortality, and decreased respiratory effects following past declines in ambient $PM_{2.5}$ concentrations. Such studies examined ''starting'' annual average $PM_{2.5}$ concentrations (*i.e.,* prior to the reductions being evaluated) ranging from about 13.2 to >20$\mu g/m^3$ (*i.e.,* U.S. EPA, 2020b, Table 3–3). Given the lack of available accountability studies

[49] The median of the study-reported mean (or median) $PM_{2.5}$ concentrations is 13.3 $\mu g/m^3$, which was also above the level of the existing standard.

reporting public health improvements attributable to reductions in ambient $PM_{2.5}$ in locations meeting the existing standards, together with his broader concerns regarding the lack of experimental studies examining $PM_{2.5}$ exposures typical of areas meeting the existing standards, the then-Administrator judged that there was considerable uncertainty in the potential for increased public health protection from further reductions in ambient $PM_{2.5}$ concentrations beyond those achieved under the existing primary $PM_{2.5}$ standards (85 FR 82717, December 18, 2020).

When the above considerations were taken together, the then-Administrator concluded that the scientific evidence assessed in the 2019 ISA, together with the analyses in the 2020 PA based on that evidence and consideration of CASAC advice and public comments, did not call into question the adequacy of the public health protection provided by the existing annual and 24-hour $PM_{2.5}$ standards. In particular, the then-Administrator judged that there was considerable uncertainty in the potential for additional public health improvements from reducing ambient $PM_{2.5}$ concentrations below the concentrations achieved under the existing primary standards and that, therefore, standards more stringent than the existing standards (*e.g.,* with lower levels) were not supported. That is, he judged that more stringent standards would be more than requisite to protect the public health with an adequate margin of safety. This judgment reflected the Administrator's consideration of the uncertainties in the potential implications of the lower end of the air quality distributions from the epidemiologic studies due in part to the lack of supporting evidence from experimental studies and retrospective accountability studies conducted at $PM_{2.5}$ concentrations meeting the existing standards (85 FR 82717, December 18, 2020).

In reaching this conclusion in the 2020 review, the then-Administrator judged that the existing standards provided an adequate margin of safety. With respect to the annual standard, the level of 12 $\mu g/m^3$ was below the lowest ''starting'' concentration (*i.e.,* 13.2 $\mu g/m^3$) in the available accountability studies that showed public health improvements attributable to reductions in ambient $PM_{2.5}$. In addition, while the then-Administrator placed less weight on the epidemiologic evidence for selecting a standard, he noted that the level of the annual standard was below the reported mean (and median) concentrations in the majority of the key U.S. epidemiologic studies using ground-based monitoring data (noting that these means tend to be 10–20% lower than their corresponding area design values which is the more relevant metric when considering the level of the standard) and below the mean of the reported means (or medians) of these studies (*i.e.,* 13.5 $\mu g/m^3$). In addition, the then-Administrator recognized that concentrations in areas meeting the existing 24-hour and annual standards remained well-below the $PM_{2.5}$ exposure concentrations consistently shown to elicit effects in human exposure studies (85 FR 82717–82718, December 18, 2020).

In addition, based on the then-Administrator's review of the science in the 2020 review, including controlled human exposure studies examining effects following short-term $PM_{2.5}$ exposures, the epidemiologic studies, and accountability studies conducted at levels just above the existing annual standard, he judged that the degree of public health protection provided by the existing annual standard is not greater than warranted. This judgment, together with the fact that no CASAC member expressed support for a less stringent standard, led the then- Administrator to conclude that standards less stringent than the existing standards (*e.g.,* with higher levels) were also not supported (85 FR 82718, December 18, 2020).

In reaching his final decision in the 2020 review, the then-Administrator concluded that the scientific evidence and technical information continued to support the existing annual and 24-hour $PM_{2.5}$ standards. This conclusion reflected the then-Administrator's view that there were important limitations and uncertainties that remained in the evidence. The then-Administrator concluded that these limitations contributed to considerable uncertainty regarding the potential public health implications of revising the existing primary $PM_{2.5}$ standards. Given this uncertainty, and noting the advice from some CASAC members, he concluded that the primary $PM_{2.5}$ standards, including the indicators ($PM_{2.5}$), averaging times (annual and 24-hour), forms (arithmetic mean and 98th percentile, averaged over three years) and levels (12.0 $\mu g/m^3$, 35 $\mu g/m^3$), when taken together, remained requisite to protect the public health. Therefore, in the 2020 review, the Administrator reached the conclusion that the primary 24-hour and annual $PM_{2.5}$ standards, together, were requisite to protect public health from fine particles with an adequate margin of safety, including the health of at-risk populations, and retained the standards, without revision (85 FR 82718, December 18, 2020).

2. Overview of the Health Effects Evidence

The information summarized here and further detailed in section II.B of the proposal (88 FR 5580, January 27, 2023), is an overview of the policy-relevant aspects of the health effects evidence available in this reconsideration; the assessment of this evidence is documented in the 2019 ISA (U.S. EPA, 2019a) and ISA Supplement (U.S. EPA, 2022a) and its policy implications are further discussed in the 2022 PA (U.S. EPA, 2022b). While the 2019 ISA provides the broad scientific foundation for this reconsideration, additional literature has become available since the cutoff date of the 2019 ISA that expands the body of evidence related to mortality and cardiovascular effects for both short- and long-term $PM_{2.5}$ exposure, which can inform the Administrator's judgment on the adequacy of the current primary $PM_{2.5}$ standards. As such, the ISA Supplement builds on the information presented within the 2019 ISA with a targeted identification and evaluation of new scientific information (U.S. EPA, 2022a, section 1.2). The ISA Supplement focuses on $PM_{2.5}$ health effects evidence where the 2019 ISA concludes a ''causal relationship,'' because such health effects are given the most weight in an Administrator's decisions in a NAAQS review. As such, in selecting the health effects to evaluate within the ISA Supplement (*i.e.,* newly available evidence related to short- and long-term $PM_{2.5}$ exposure and mortality and cardiovascular effects), the primary rationale is based on the causality determinations for health effect categories presented in the 2019 PM ISA, and the subsequent use of the health effects evidence in the 2020 PM PA. Specifically, U.S. and Canadian epidemiologic studies for mortality and cardiovascular effects, along with controlled human exposure studies associated with cardiovascular effects at near ambient concentrations, were considered to be of greatest utility in informing the Administrator's conclusions on the adequacy of the current primary $PM_{2.5}$ standards. Additionally, studies examining associations outside the U.S. or Canada reflect air quality and exposure patterns that may be less typical of the U.S., and thus less likely to be informative for purposes of reviewing the NAAQS (U.S. EPA, 2022b, p.1–3). While the ISA Supplement does not include information for health effects other than mortality and cardiovascular effects, the

scientific evidence for other health effect categories is evaluated in the 2019 ISA, which in combination with the ISA Supplement represents the complete scientific record for the reconsideration of the 2020 final decision.

The ISA Supplement also assessed accountability studies because these types of epidemiologic studies were part of the body of evidence that was a focus of the 2020 review. Accountability studies inform our understanding of the potential for public health improvements as ambient $PM_{2.5}$ concentrations have declined over time. Further, the ISA Supplement considered studies that employed statistical approaches that attempt to more extensively account for confounders and are more robust to model misspecification (*i.e.,* used alternative methods for confounder control),[50] given that such studies were highlighted by the CASAC and identified in public comments in the 2020 review. Since the literature cutoff date for the 2019 ISA, multiple accountability studies and studies that employ alternative methods for confounder control have become available for consideration in the ISA Supplement and, subsequently, in this reconsideration.

The ISA Supplement also considered recent health effects evidence that addresses key scientific issues where the literature has expanded since the completion of the 2019 ISA.[51] The 2019 ISA evaluated a couple of controlled human exposure studies that investigated the effect of exposure to near-ambient concentrations of $PM_{2.5}$ (U.S. EPA, 2019a, section 6.1.10 and 6.1.13). The ISA Supplement adds to this limited evidence, including a recent study conducted in young healthy individuals exposed to near-ambient $PM_{2.5}$ concentrations (U.S. EPA, 2022a, section 3.3.1). Given the importance of identifying populations at increased risk of $PM_{2.5}$-related effects, the ISA Supplement also included epidemiologic or exposure studies that examined whether there is evidence of exposure or risk disparities by race/ethnicity or SES. These types of studies provide additional information related to factors that may increase risk of $PM_{2.5}$-related health effects and provide additional evidence for consideration by the Administrator in reaching conclusions regarding the adequacy of the current standards. In addition, the ISA Supplement evaluated studies that examined the relationship between short- and long-term $PM_{2.5}$ exposures and SARS-CoV–2 infection and/or COVID–19 death, as these studies are a new area of research and were raised by a number of public commenters in the 2020 review.

The evidence presented within the 2019 ISA, along with the targeted identification and evaluation of new scientific information in the ISA Supplement, provides the scientific basis for the reconsideration of the 2020 final decision on the primary $PM_{2.5}$ standards. The subsections below briefly summarize the nature of $PM_{2.5}$-related health effects (II.A.2.a), with a focus on those health effects for which the 2019 ISA concluded a ''causal'' or ''likely to be causal'' relationship, the potential public health implications and populations at risk (II.A.2.b), and $PM_{2.5}$ concentrations in key studies reporting health effects (II.A.2.c).

a. Nature of Effects

The evidence base available in the reconsideration includes decades of research on $PM_{2.5}$-related health effects (U.S. EPA, 2004b; U.S. EPA, 2009a; U.S. EPA, 2019a), including the full body of evidence evaluated in the 2019 ISA (U.S. EPA, 2019a), along with the targeted evaluation of recent evidence in the ISA Supplement (U.S. EPA, 2022a). In considering the available scientific evidence, the sections below, and in more detail in section II.B.1 of the proposal (88 FR 5580, January 27, 2023), summarize the relationships between long-and short-term $PM_{2.5}$ exposures and mortality (II.A.2.a.i), cardiovascular effects (II.A.2.a.ii), respiratory effects (II.A.2.a.iii), cancer (II.A.2.a.iv), nervous system effects (II.A.2.a.v) and other effects (II.A.2.a.vi). For these outcomes, the 2019 ISA concluded that the evidence supports either a ''causal'' or a ''likely to be causal'' relationship.[52]

i. Mortality

Long-Term $PM_{2.5}$ Exposures

In the 2012 review, the 2009 ISA reported that the evidence was ''sufficient to conclude that the relationship between long-term $PM_{2.5}$ exposures and mortality is causal'' (U.S. EPA, 2009a, p. 7–96). The strongest evidence supporting this conclusion was provided by epidemiologic studies, particularly those examining two seminal cohorts, the American Cancer Society (ACS) cohort and the Harvard Six Cities cohort. Analyses of the Harvard Six Cities cohort included evidence indicating that reductions in ambient $PM_{2.5}$ concentrations are associated with reduced mortality risk (Laden et al., 2006) and increases in life expectancy (Pope et al., 2009). Further support was provided by other cohort studies conducted in North America and Europe that reported positive associations between long-term $PM_{2.5}$ exposure and mortality (U.S. EPA, 2019a).

Cohort studies, which have become available since the completion of the 2009 ISA and evaluated in the 2019 ISA, continue to provide consistent evidence of positive associations between long-term $PM_{2.5}$ exposures and mortality. These studies add support for associations with all-cause and total (non-accidental) mortality,[53] as well as with specific causes of mortality, including cardiovascular disease and respiratory disease (U.S. EPA, 2019a, section 11.2.2). Several of these studies conducted analyses over longer study durations and periods of follow-up than examined in the original ACS and Harvard Six Cities cohort studies and continue to report positive associations between long-term exposure to $PM_{2.5}$ and mortality (U.S. EPA, 2019a, section 11.2.2.1; Figures 11–18 and 11–19). In addition to studies focusing on the ACS and Harvard Six Cities cohorts, additional studies examining other cohorts also provide evidence of consistent, positive associations between long-term $PM_{2.5}$ exposure and mortality across a wide range of demographic groups (*e.g.,* age, sex, occupation), spatial and temporal extents, exposure assessment metrics, and statistical techniques (U.S. EPA, 2019a, sections 11.2.2.1, 11.2.5; U.S. EPA, 2022a, Table 11–8). This includes some of the largest cohort studies conducted to date, such as analyses of the U.S. Medicare cohort that includes

[50] As noted in the ISA Supplement (U.S. EPA, 2022a, p. 1–3): ''In the peer-reviewed literature, these epidemiologic studies are often referred to as causal inference studies or studies that used causal modeling methods. For the purposes of this Supplement, this terminology is not used to prevent confusion with the main scientific conclusions (*i.e.,* the causality determinations) presented within an ISA. In addition, as is consistent with the weight-of-evidence framework used within ISAs and discussed in the Preamble to the Integrated Science Assessments, an individual study on its own cannot inform causality, but instead represents a piece of the overall body of evidence.''

[51] As with the epidemiologic studies for long- and short-term $PM_{2.5}$ exposure and mortality and cardiovascular effects, epidemiologic studies of exposure or risk disparities and SARS–CoV–2 infection and/or COVID–19 death were limited to those conducted in the U.S. and Canada.

[52] In this reconsideration of the PM NAAQS, the EPA considers the full body of health evidence, placing the greatest emphasis on the health effects for which the evidence has been judged in the 2019 ISA to demonstrate a ''causal'' or ''likely to be causal'' relationship with $PM_{2.5}$ exposures.

[53] The majority of these studies examined non-accidental mortality outcomes, though some Medicare studies lack cause-specific death information and, therefore, examine total mortality.

nearly 61 million enrollees and studies that control for a range of individual and ecological covariates, including race, age, SES, smoking status, body mass index, and annual weather variables (*e.g.,* temperature, humidity) (U.S. EPA, 2019a).

In addition to those cohort studies evaluated in the 2019 ISA, recent North American cohort studies evaluated in the ISA Supplement continue to examine the relationship between long-term $PM_{2.5}$ exposure and mortality and report consistent, positive, and statistically significant associations. These recent studies also utilize large and demographically diverse cohorts that are generally representative of the national populations in both the U.S. and Canada. These ''studies published since the 2019 ISA support and extend the evidence base that contributed to the conclusion of a *causal relationship* between long-term $PM_{2.5}$ exposure and mortality'' (U.S. EPA, 2022a, section 3.2.2.2.1, Figure 3–19, Figure 3–20).

Furthermore, studies evaluated in the 2019 ISA and the ISA Supplement that examined cause-specific mortality expand upon previous research that found consistent, positive associations between $PM_{2.5}$ exposure and specific mortality outcomes, which include cardiovascular and respiratory mortality, as well as other mortality outcomes. For cardiovascular-related mortality, the evidence evaluated in the ISA Supplement is consistent with the evidence evaluated in the 2019 ISA with recent studies reporting positive associations with long-term $PM_{2.5}$ exposure. When evaluating cause-specific cardiovascular mortality, recent studies reported positive associations for a number of outcomes, such as ischemic heart disease (IHD) and stroke mortality (U.S. EPA, 2022a, Figure 3–23). Moreover, recent studies also provide some initial evidence that individuals with pre-existing health conditions, such as heart failure and diabetes, are at an increased risk of $PM_{2.5}$-related health effects (U.S. EPA, 2022a, section 3.2.2.4) and that these individuals have a higher risk of mortality overall, which was previously only examined in studies that used stratified analyses rather than a cohort of people with an underlying health condition (U.S. EPA, 2022a, section 3.2.2.4). With regard to respiratory mortality, epidemiologic studies evaluated in the 2019 ISA and ISA Supplement continue to provide support for associations between long-term $PM_{2.5}$ exposure and respiratory mortality (U.S. EPA, 2019a, section 5.2.10; U.S. EPA, 2022a, Table 3–2).

A series of epidemiologic studies evaluated in the 2019 ISA tested the hypothesis that past reductions in ambient $PM_{2.5}$ concentrations are associated with increased life expectancy or a decreased mortality rate and report that reductions in ambient $PM_{2.5}$ are associated with improvements in longevity (U.S. EPA, 2022a, section 11.2.2.5). Pope et al. (2009) conducted a cross-sectional analysis using air quality data from 51 metropolitan areas across the U.S., beginning in the 1970s through the early 2000s, and found that a 10 μg/m^3 decrease in long-term $PM_{2.5}$ concentration was associated with a 0.61-year increase in life expectancy. In a subsequent analysis, the authors extended the period of analysis to include 2000 to 2007, a time period with lower ambient $PM_{2.5}$ concentrations and found a decrease in long-term $PM_{2.5}$ concentration continued to be associated with an increase in life expectancy, though the magnitude of the increase was smaller than during the earlier time period (*i.e.,* a 10 μg/m^3 decrease in long-term $PM_{2.5}$ concentration was associated with a 0.35-year increase in life expectancy) (Correia et al., 2013). Additional studies conducted in the U.S. or Europe similarly report that reductions in ambient $PM_{2.5}$ are associated with improvements in longevity (U.S. EPA, 2022a, section 11.2.2.5).

Since the literature cutoff date for the 2019 ISA, a few epidemiologic studies were published that examined the relationship between long-term $PM_{2.5}$ exposure and life-expectancy (U.S. EPA, 2022a, section 3.2.1.3) and report results that are consistent with and expand upon the body of evidence from the 2019 ISA. For example, Bennett et al. (2019) reported that $PM_{2.5}$ concentrations above the lowest observed concentration (2.8 μg/m^3) were associated with a 0.15 year decrease in national life expectancy for women and 0.13 year decrease in national life expectancy for men (U.S. EPA, 2022a, section 3.2.2.2.4, Figure 3–25). Another study compared participants living in areas with $PM_{2.5}$ concentrations >12 μg/m^3 to participants living in areas with $PM_{2.5}$ concentrations <12 μg/m^3 and reported that the number of years of life lost due to living in areas with higher $PM_{2.5}$ concentrations was 0.84 years over a 5-year period (Ward-Caviness et al., 2020; U.S. EPA, 2022a, section 3.2.2.2.4).

Additionally, a number of accountability studies, which are epidemiologic studies that evaluate whether an environmental policy or air quality intervention resulted in reductions in ambient air pollution concentrations and subsequent reductions in mortality or morbidity, have emerged and were evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.2.2.3). For example, Sanders et al. (2020a) examined whether policy actions (*i.e.,* the first annual $PM_{2.5}$ NAAQS implementation rule in 2005 for the 1997 annual $PM_{2.5}$ standard with a 3-year annual average of 15.0 μg/m^3) reduced $PM_{2.5}$ concentrations and mortality rates in Medicare beneficiaries between 2000–2013, and found that following implementation of the annual $PM_{2.5}$ NAAQS, annual $PM_{2.5}$ concentrations decreased by 1.59 μg/m^3 (95% CI: 1.39, 1.80) which corresponded to a 0.93% reduction in mortality rates among individuals 65 years and older ([95% CI: 0.10%, 1.77%) in non-attainment counties relative to attainment counties.

The 2019 ISA also evaluated a small number of studies that used alternative methods for confounder control to further assess relationship between long-term $PM_{2.5}$ exposure and mortality (U.S. EPA, 2019a, section 11.2.2.4). In addition, multiple epidemiologic studies that implemented alternative methods for confounder control and were published since the literature cutoff date of the 2019 ISA were evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.2.2.3). These studies used a variety of statistical methods including generalized propensity score (GPS), inverse probability weighting (IPW), and difference-in-difference (DID) to reduce uncertainties related to confounding bias in the association between long-term $PM_{2.5}$ exposure and mortality. These studies reported consistent positive associations between long-term $PM_{2.5}$ exposure and total mortality (U.S. EPA, 2022a, section 3.2.2.3), and provided further support for the associations reported in the cohort studies referenced above.

The 2019 ISA and ISA Supplement also evaluated the degree to which recent studies examining the relationship between long-term $PM_{2.5}$ exposure and mortality addressed key policy-relevant issues and/or previously identified data gaps in the scientific evidence, including methods to estimate exposure, methods to control for confounding (*e.g.,* co-pollutant confounding), the shape of the C–R relationship, as well as examining whether a threshold exists below which mortality effects do not occur. With respect to exposure assessment, based on its evaluation of the evidence, the 2019 ISA concludes that positive associations between long-term $PM_{2.5}$ exposures and mortality are robust

across recent analyses using various approaches to estimate $PM_{2.5}$ exposures (*e.g.,* based on monitors, models, satellite-based methods, or hybrid methods that combine information from multiple sources) (U.S. EPA, 2019a, section 11.2.5.1). Hart et al. (2015) report that correction for bias due to exposure measurement error increases the magnitude of the hazard ratios (confidence intervals widen but the association remains statistically significant), suggesting that failure to correct for exposure measurement error could result in attenuation or underestimation of risk estimates.

The 2019 ISA additionally concludes that positive associations between long-term $PM_{2.5}$ exposures and mortality are robust across statistical models that use different approaches to control for confounders or different sets of confounders (U.S. EPA, 2019a, sections 11.2.3 and 11.2.5), across diverse geographic regions and populations, and across a range of temporal periods including periods of declining PM concentrations (U.S. EPA, 2019a, sections 11.2.2.5 and 11.2.5.3). Additional evidence further demonstrates that associations with mortality remain robust in copollutants analyses (U.S. EPA, 2019a, section 11.2.3), and that associations persist in analyses restricted to long-term exposures (annual average $PM_{2.5}$ concentrations) below 12 $\mu g/m^3$ (Di et al., 2017b) or 10 $\mu g/m^3$ (Shi et al., 2016), indicating that risks are not disproportionately driven by the upper portions of the air quality distribution. Recent studies evaluated in the ISA Supplement further assess potential copollutant confounding and indicate that while there is some evidence of potential confounding of the $PM_{2.5}$-mortality association by copollutants in some of the studies (*i.e.,* those studies of the Mortality Air Pollution Associations in Low Exposure Environments (MAPLE) cohort), this result is inconsistent with other recent studies evaluated in the 2019 ISA that were conducted in the U.S. and Canada that found associations in both single and copollutant models (U.S. EPA, 2019a; U.S. EPA, 2022a, section 3.2.2.4)

Additionally, a few studies use statistical techniques to reduce uncertainties related to potential confounding to further inform conclusions on causality for long-term $PM_{2.5}$ exposure and mortality, as further detailed in section II.B.1.a.i of the proposal (88 FR 5582, January 27, 2023), studies by Greven et al. (2011), Pun et al. (2017), and Eum et al. (2018) completed sensitivity analyses as part of their Medicare cohort study in which they decompose ambient $PM_{2.5}$ into ''spatial'' and ''spatiotemporal'' components in order to evaluate the potential for bias due to unmeasured spatial confounding. Pun et al. (2017) observed positive associations for the ''temporal'' variation model and approximately null associations for the ''spatiotemporal'' variation model for all causes of death except for COPD mortality. The difference in the results of these two models for most causes of death suggests the presence of unmeasured confounding, though the authors do not indicate anything about the direction or magnitude of this bias. It is important to note that the ''temporal'' and ''spatiotemporal'' coefficients are not directly comparable to the results of other epidemiologic studies when examined individually and can only be used in comparison with one another to evaluate the potential for unmeasured confounding bias. Eum et al. (2018) and Wu et al. (2020) also attempted to address long-term trends and meteorological variables as potential confounders and found that not adjusting for temporal trends could overestimate the association, while effect estimates in analyses that excluded meteorological variables remained unchanged compared to the main analyses. While results of these analyses suggest the presence of some unmeasured confounding, they do not indicate the direction or magnitude of the bias.[54]

An additional important consideration in characterizing the public health impacts associated with $PM_{2.5}$ exposure is whether C–R relationships are linear across the range of concentrations or if nonlinear relationships exist along any part of this range. Studies evaluated in the 2019 ISA and the ISA Supplement examine this issue, and continue to provide evidence of linear, no-threshold relationships between long-term $PM_{2.5}$ exposures and all-cause and cause-specific mortality (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 3.2.2.2.7, Table 3–6). Across the studies evaluated in the 2019 ISA and the ISA Supplement, a variety of statistical methods have been used to assess whether there is evidence of deviations in linearity (U.S. EPA, 2019a, Table 11–7; U.S. EPA, 2022a, section 2.2.3.2). Studies have also conducted cut-point analyses that focus on examining risk at specific ambient $PM_{2.5}$ concentrations. Generally, the evidence remains consistent in supporting a no-threshold relationship, and in supporting a linear relationship for $PM_{2.5}$ concentrations >8 $\mu g/m^3$. However, uncertainties remain about the shape of the C–R curve at $PM_{2.5}$ concentrations <8 $\mu g/m^3$, with some recent studies providing evidence for either a sublinear, linear, or supralinear relationship at these lower concentrations (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 2.2.3.2). There was also some limited evidence indicating that the slope of the C–R function may be steeper (supralinear) at lower concentrations for cardiovascular mortality (U.S. EPA, 2022a, section 3.1.1.2.6).

The biological plausibility of $PM_{2.5}$-attributable mortality is supported by the coherence of effects across scientific disciplines (*i.e.,* animal toxicological, controlled human exposure studies, and epidemiologic) when evaluating respiratory and cardiovascular morbidity effects, which are some of the largest contributors to total (nonaccidental) mortality. The 2019 ISA outlines the available evidence for biologically plausible pathways by which inhalation exposure to $PM_{2.5}$ could progress from initial events (*e.g.,* pulmonary inflammation, autonomic nervous system activation) to endpoints relevant to population outcomes, particularly those related to cardiovascular diseases such as ischemic heart disease, stroke and atherosclerosis (U.S. EPA, 2019a, section 6.2.1), and to metabolic effects, including diabetes (U.S. EPA, 2019a, section 7.3.1). The 2019 ISA notes ''more limited evidence from respiratory morbidity'' (U.S. EPA, 2019a, p. 11–101) such as development of chronic obstructive pulmonary disease (COPD) (U.S. EPA, 2019a, section 5.2.1) to support the biological plausibility of mortality due to long-term $PM_{2.5}$ exposures (U.S. EPA, 2019a, section 11.2.1).

Taken together, epidemiologic studies, including those evaluated in the 2019 ISA and more recent studies evaluated in the ISA Supplement, consistently report positive associations between long-term $PM_{2.5}$ exposure and mortality across different geographic locations, populations, and analytic approaches (U.S. EPA, 2019a; U.S. EPA, 2022a, section 3.2.2.4). As such, these studies reduce key uncertainties identified in previous reviews, including those related to potential

[54] In public comments on the 2019 draft PA, the authors of the Pun et al. (2017) study further note that ''the presence of unmeasured confounding. . .was expected given that we did not control for several potential confounders that may impact $PM_{2.5}$-mortality associations, such as smoking, socio-economic status (SES), gaseous pollutants, $PM_{2.5}$ components, and long-term time trends in $PM_{2.5}$'' and that ''spatial confounding may bias mortality risks both towards and away from the null'' (Docket ID EPA–HQ–OAR–2015–0072–0065; accessible in *https://www.regulations.gov/*).

copollutant confounding, and provide additional information on the shape of the C–R curve. As evaluated in the 2019 ISA, experimental and epidemiologic evidence for cardiovascular effects, and respiratory effects to a more limited degree, supports the plausibility of mortality due to long-term $PM_{2.5}$ exposures. Overall, studies evaluated in the 2019 ISA support the conclusion of a causal relationship between long-term $PM_{2.5}$ exposure and mortality, which is supported and extended by evidence from recent epidemiologic studies evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.2.2.4).

Short-Term $PM_{2.5}$ Exposures

The 2009 ISA concluded that ''a causal relationship exists between short-term exposure to $PM_{2.5}$ and mortality'' (U.S. EPA, 2009a). This conclusion was based on the evaluation of both multi- and single-city epidemiologic studies that consistently reported positive associations between short-term $PM_{2.5}$ exposure and non-accidental mortality. These associations were strongest, in terms of magnitude and precision, primarily at lags of 0 to 1 days. Examination of the potential confounding effects of gaseous copollutants was limited, though evidence from single-city studies indicated that gaseous copollutants have minimal effect on the $PM_{2.5}$-mortality relationship (*i.e.,* associations remain robust to inclusion of other pollutants in copollutant models). The evaluation of cause-specific mortality found that effect estimates were larger in magnitude, but also had larger confidence intervals, for respiratory mortality compared to cardiovascular mortality. Although the largest mortality risk estimates were for respiratory mortality, the interpretation of the results was complicated by the limited coherence from studies of respiratory morbidity. However, the evidence from studies of cardiovascular morbidity provided both coherence and biological plausibility for the relationship between short-term $PM_{2.5}$ exposure and cardiovascular mortality.

Multicity studies evaluated in the 2019 ISA and the ISA Supplement provide evidence of primarily positive associations between daily $PM_{2.5}$ exposures and mortality, with percent increases in total mortality ranging from 0.19% (Lippmann et al., 2013) to 2.80% (Kloog et al., 2013) [55] at lags of 0 to 1 days in single-pollutant models. Whereas many studies assign exposures using data from ambient monitors, other studies employ hybrid modeling approaches, which estimate $PM_{2.5}$ concentrations using data from a variety of sources (*i.e.,* from satellites, land use information, and modeling, in addition to monitors) and enable the inclusion of less urban and more rural locations in analyses (*e.g.,* Kloog et al., 2013, Lee et al., 2015, Shi et al., 2016).

Some studies have expanded the examination of potential confounders including long-term temporal trends, weather, and co-occurring pollutants. Mortality associations were found to remain positive, although in some cases were attenuated, when using different approaches to account for temporal trends or weather covariates (*e.g.,* U.S. EPA, 2019a, section 11.1.5.1). For example, Sacks et al. (2012) examined the influence of model specification using the approaches for confounder adjustment from models employed in several multicity studies within the context of a common data set (U.S. EPA, 2019a, section 11.1.5.1). These models use different approaches to control for long-term temporal trends and the potential confounding effects of weather. The authors report that associations between daily $PM_{2.5}$ and cardiovascular mortality were similar across models, with the percent increase in mortality ranging from 1.5–2.0% (U.S. EPA, 2019a, Figure 11–4). Thus, alternative approaches to controlling for long-term temporal trends and for the potential confounding effects of weather may influence the magnitude of the association between $PM_{2.5}$ exposures and mortality but have not been found to influence the direction of the observed association (U.S. EPA, 2019a, section 11.1.5.1). Taken together, the 2019 ISA and the ISA Supplement conclude that recent multicity studies conducted in the U.S., Canada, Europe, and Asia continue to provide consistent evidence of positive associations between short-term $PM_{2.5}$ exposures and total mortality across studies that use different approaches to control for the potential confounding effects of weather (*e.g.,* temperature) (U.S. EPA, 2019a, section 1.4.1.5.1; U.S. EPA, 2022a, section 3.2.1.2).

With regard to copollutants, studies evaluated in the 2019 ISA provide additional evidence that associations between short-term $PM_{2.5}$ exposures and mortality remain positive and relatively unchanged in copollutant models with both gaseous pollutants and $PM_{10–2.5}$ (U.S. EPA, 2019a, section 11.1.4). Additionally, the low ($r < 0.4$) to moderate correlations ($r = 0.4–0.7$) between $PM_{2.5}$ and gaseous pollutants and $PM_{10–2.5}$ increase the confidence in $PM_{2.5}$ having an independent effect on mortality (U.S. EPA, 2019a, section 11.1.4). Consistent with the studies evaluated in the 2019 ISA, studies evaluated in the ISA Supplement that used data from more recent years also indicate that associations between short-term $PM_{2.5}$ exposure and mortality remain unchanged in copollutant models. However, the evidence indicates that the association could be larger in magnitude in the presence of some copollutants such as oxidant gases (Lavigne et al., 2018; Shin et al., 2021).

The generally positive associations reported with mortality are supported by a small group of studies employing alternative methods for confounder control or quasi-experimental statistical approaches (U.S. EPA, 2019a, section 11.1.2.1). For example, two studies by Schwartz et al. report associations between $PM_{2.5}$ instrumental variables and mortality (U.S. EPA, 2019a, Table 11–2), including in an analysis limited to days with 24-hour average $PM_{2.5}$ concentrations $<30\ \mu g/m^3$ (Schwartz et al., 2015; Schwartz et al., 2017). In addition to the main analyses, these studies conducted Granger-like causality tests as sensitivity analyses to examine whether there was evidence of an association between mortality and $PM_{2.5}$ after the day of death, which would support the possibility that unmeasured confounders were not accounted for in the statistical model. Neither study reports evidence of an association with $PM_{2.5}$ after death (*i.e.,* they do not indicate unmeasured confounding). Yorifuji et al. (2016) conducted a quasi-experimental study to examine whether a specific regulatory action in Tokyo, Japan (*i.e.,* a diesel emission control ordinance) resulted in a subsequent reduction in daily mortality (Yorifuji et al., 2016). The authors reported a reduction in mortality in Tokyo due to the ordinance, compared to Osaka, which did not have a similar diesel emission control ordinance in place. In another study, Schwartz et al. (2018) utilized three statistical methods including instrumental variable analysis, a negative exposure control, and marginal structural models to estimate the association between $PM_{2.5}$ and daily mortality (Schwartz et al., 2018). Results from this study continue to support a relationship between short-term $PM_{2.5}$ exposure and mortality. Additional epidemiologic studies evaluated in the ISA Supplement that employed alternative methods for confounder control to examine the association between short-term $PM_{2.5}$ exposure and

[55] As detailed in the Preface to the ISA, risk estimates are for a 10 $\mu g/m^3$ increase in 24-hour avg $PM_{2.5}$ concentrations, unless otherwise noted (U.S. EPA, 2019a).

mortality also report consistent positive associations in studies that examine effects across multiple cities in the U.S. (U.S. EPA, 2022a).

The positive associations for total mortality reported across the majority of studies evaluated are further supported by cause-specific mortality analyses, which generally report consistent, positive associations with both cardiovascular and respiratory mortality (U.S. EPA, 2019a, section 11.1.3). Recent multicity studies evaluated in the ISA Supplement add to the body of evidence indicating a relationship between short-term $PM_{2.5}$ exposure and cause-specific mortality, with more variability in the magnitude and precision of associations for respiratory mortality (U.S. EPA, 2022a; Figure 3–14). For both cardiovascular and respiratory mortality, there has been a limited assessment of potential copollutant confounding, though initial evidence indicates that associations remain positive and relatively unchanged in models with gaseous pollutants and $PM_{10–2.5}$, which further supports the copollutant analyses conducted for total mortality. The strong evidence for ischemic events and heart failure, as detailed in the assessment of cardiovascular morbidity (U.S. EPA, 2019a, Chapter 6), provides biological plausibility for $PM_{2.5}$-related cardiovascular mortality, which comprises the largest percentage of total mortality (*i.e.,* ~33%) (NHLBI, 2017). Although there is evidence for exacerbations of COPD and asthma, the collective body of respiratory morbidity evidence provides limited biological plausibility for $PM_{2.5}$-related respiratory mortality (U.S. EPA, 2019a, Chapter 5).

In the 2009 ISA, one of the main uncertainties identified was the regional and city-to-city heterogeneity in $PM_{2.5}$-mortality associations. Studies evaluated in the 2019 ISA examine both city-specific as well as regional characteristics to identify the underlying contextual factors that could contribute to this heterogeneity (U.S. EPA, 2019a, section 11.1.6.3). Analyses focusing on effect modification of the $PM_{2.5}$ mortality relationship by $PM_{2.5}$ components, regional patterns in $PM_{2.5}$ components and city specific differences in composition and sources indicate some differences in the $PM_{2.5}$ composition and sources across cities and regions, but these differences do not fully explain the observed heterogeneity. Additional studies find that factors related to potential exposure differences, such as housing stock and commuting, as well as city specific factors (*e.g.,* land use, port volume, and traffic information), may also explain some of the observed heterogeneity (U.S. EPA, 2019a, section 11.1.6.3). Collectively, studies evaluated in the 2019 ISA and the ISA Supplement indicate that the heterogeneity in $PM_{2.5}$ mortality risk estimates cannot be attributed to one factor, but instead a combination of factors including, but not limited to, PM composition and sources as well as community characteristics that could influence exposures (U.S. EPA, 2019a, section 11.1.12; U.S. EPA, 2022a, section 3.2.1.2.1).

A number of studies evaluated in the 2019 ISA and ISA Supplement conducted systematic evaluations of the lag structure of associations for the $PM_{2.5}$-mortality relationship by examining either a series of single day or multiday lags and these studies continue to support an immediate effect (*i.e.,* lag 0 to 1 days) of short-term $PM_{2.5}$ exposures on mortality (U.S. EPA, 2019a, section 11.1.8.1; U.S. EPA, 2022a, section 3.2.1.1). Recent studies also conducted analyses comparing the traditional 24-hour average exposure metric with a subdaily metric (*i.e.,* 1-hour max) and provide evidence of a similar pattern of associations for both the 24-hour average and 1-hour max metric, with the association larger in magnitude for the 24-hour average metric.

Multicity studies indicate that positive and statistically significant associations with mortality persist in analyses restricted to short-term (24-hour average $PM_{2.5}$ concentrations) $PM_{2.5}$ exposures below 35 μg/m³ (Lee et al., 2015),[56] below 30 μg/m³ (Shi et al., 2016), and below 25 μg/m³ (Di et al., 2017a), indicating that risks associated with short-term $PM_{2.5}$ exposures are not disproportionately driven by the peaks of the air quality distribution. Additional studies examined the shape of the C–R relationship for short-term $PM_{2.5}$ exposure and mortality and whether a threshold exists below which mortality effects do not occur (U.S. EPA, 2019a, section 11.1.10). These studies used various statistical approaches and consistently demonstrate linear C–R relationships with no evidence of a threshold.

Moreover, recent studies evaluated in the ISA Supplement provide additional support for a linear, no-threshold C–R relationship between short-term $PM_{2.5}$ exposure and mortality, with confidence in the shape decreasing at concentrations below 5 μg/m³ (Shi et al., 2016; Lavigne et al., 2018). Recent analyses provide initial evidence indicating that $PM_{2.5}$-mortality associations persist and may be stronger (*i.e.,* a steeper slope) at lower concentrations (*e.g.,* Di et al., 2017a; Figure 11–12 in U.S. EPA, 2019). However, given the limited data available at the lower end of the distribution of ambient $PM_{2.5}$ concentrations, the shape of the C–R curve remains uncertain at these low concentrations. Although difficulties remain in assessing the shape of the short-term $PM_{2.5}$-mortality C–R relationship, to date, studies have not conducted systematic evaluations of alternatives to linearity and recent studies evaluated in the ISA Supplement continue to provide evidence of a no-threshold linear relationship, with less confidence at concentrations lower than 5 μg/m³.

Overall, epidemiologic studies evaluated in the 2019 ISA and the ISA Supplement build upon and extend the conclusions of the 2009 ISA for the relationship between short-term $PM_{2.5}$ exposures and total mortality. Supporting evidence for $PM_{2.5}$-related cardiovascular morbidity, and more limited evidence from respiratory morbidity, provide biological plausibility for mortality due to short-term $PM_{2.5}$ exposures. The primarily positive associations observed across studies conducted in diverse geographic locations is further supported by the results from copollutant analyses indicating robust associations, along with evidence from analyses examining the C–R relationship. Overall, studies evaluated in the 2019 ISA support the conclusion of a causal relationship between short-term $PM_{2.5}$ exposure and mortality, which is further supported by evidence from recent epidemiologic studies evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.2.1.4, p. 3–69).

ii. Cardiovascular Effects

Long-Term $PM_{2.5}$ Exposures

The scientific evidence reviewed in the 2009 ISA was ''sufficient to infer a causal relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects'' (U.S. EPA, 2009a). The strongest line of evidence comprised findings from several large epidemiologic studies of U.S. and Canadian cohorts that reported consistent positive associations between long-term $PM_{2.5}$ exposure and cardiovascular mortality (Pope et al., 2004; Krewski et al., 2009; Miller et al.,

[56] Lee et al. (2015) restrict exposures below 35 μg/m³ only in areas with annual average concentrations <12 μg/m³. Additionally, Lee et al. (2015) also report that positive and statistically significant associations between short-term $PM_{2.5}$ exposures and mortality persist in analyses restricted to areas with long-term concentrations below 12 μg/m³.

2007; Laden et al., 2006). Studies of long-term $PM_{2.5}$ exposure and cardiovascular morbidity were limited in number. Biological plausibility and coherence with the epidemiologic findings were provided by studies using genetic mouse models of atherosclerosis demonstrating enhanced atherosclerotic plaque development and inflammation, as well as changes in measures of impaired heart function, following 4- to 6-month exposures to $PM_{2.5}$ concentrated ambient particles (CAPs), and by a limited number of studies reporting CAPs-induced effects on coagulation factors, vascular reactivity, and worsening of experimentally induced hypertension in mice (U.S. EPA, 2009a).

Consistent with the evidence assessed in the 2009 ISA, the 2019 ISA concludes that recent studies, together with the evidence available in previous reviews, support a causal relationship between long-term exposure to $PM_{2.5}$ and cardiovascular effects. Additionally, recent epidemiologic studies published since the completion of the 2019 ISA and evaluated in the ISA Supplement expands the body of evidence and further supports such a conclusion (U.S. EPA, 2022a). As discussed above (section II.A.2.a.i), results from U.S. and Canadian cohort studies evaluated in the 2019 ISA conducted at varying spatial and temporal scales and employing a variety of exposure assessment and statistical methods consistently report positive associations between long-term $PM_{2.5}$ exposure and cardiovascular mortality (U.S. EPA, 2019, Figure 6–19, section 6.2.10). Positive associations between long-term $PM_{2.5}$ exposures and cardiovascular mortality are generally robust in copollutant models adjusted for ozone, NO_2, $PM_{10–2.5}$, or SO_2. In addition, most of the results from analyses examining the shape of the C–R relationship between long-term $PM_{2.5}$ exposures and cardiovascular mortality support a linear relationship and do not identify a threshold below which mortality effects do not occur (U.S. EPA, 2019a, section 6.2.16, Table 6–52).

The body of literature examining the relationship between long-term $PM_{2.5}$ exposure and cardiovascular morbidity has greatly expanded since the 2009 ISA, with positive associations reported in several cohorts evaluated in the 2019 ISA (U.S. EPA, 2019a, section 6.2). Though results for cardiovascular morbidity are less consistent than those for cardiovascular mortality (U.S. EPA, 2019a, section 6.2), studies in the 2019 ISA and the ISA Supplement provide some evidence for associations between long-term $PM_{2.5}$ exposures and the progression of cardiovascular disease. Positive associations with cardiovascular morbidity (*e.g.,* coronary heart disease, stroke, arrhythmias, myocardial infarction (MI), atherosclerosis progression) are observed in several epidemiologic studies (U.S. EPA, 2019a, sections 6.2.2 to 6.2.9; U.S. EPA, 2022a, section 3.1.2.2). Additionally, studies evaluated in the ISA Supplement report positive associations among those with pre-existing conditions, among patients followed after a cardiac event procedure, and among those with a first hospital admission for heart attacks among older adults enrolled in Medicare (U.S. EPA, 2022a, sections 3.1.1 and 3.1.2).

Recent studies published since the literature cutoff date of the 2019 ISA and evaluated in the ISA Supplement further assessed the relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects by conducting accountability analyses or by using alternative methods for confounder control in evaluating the association between long-term $PM_{2.5}$ exposure and cardiovascular hospital admissions (U.S. EPA, 2022a, section 3.1.2.3). Studies that apply alternative methods for confounder control increase confidence in the relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects by using methods that reduce uncertainties related to potential confounding through statistical and/or study design approaches. For example, to control for potential confounding Wei et al. (2021) used a doubly robust additive model (DRAM) and found an association between long-term exposure to $PM_{2.5}$ and cardiovascular effects, including MI, stoke, and atrial fibrillation, among the Medicare population. For example, an accountability study by Henneman et al. (2019) utilized a difference-in-difference (DID) approach to determine the relationship between coal-fueled power plant emissions and cardiovascular effects and found that reductions in $PM_{2.5}$ concentrations resulted in reductions of cardiovascular-related hospital admissions. Furthermore, several recent epidemiologic studies evaluated in the ISA Supplement reported that the association between long-term $PM_{2.5}$ exposure with stroke persisted after adjustment for NO_2 but was attenuated in the model with O_3 and oxidant gases represented by the redox weighted average of NO_2 and O_3 (U.S. EPA, 2022a, section 3.1.2.2.8). Overall, these studies report consistent findings that long-term $PM_{2.5}$ exposure is related to increased hospital admissions for a variety of cardiovascular disease outcomes among large nationally representative cohorts and provide additional support for a relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects.

Positive associations reported in epidemiologic studies are supported by toxicological evidence evaluated in the 2019 ISA. The positive associations reported in epidemiologic studies are supported by toxicological evidence for increased plaque progression in mice following long-term exposure to $PM_{2.5}$ collected from multiple locations across the U.S. (U.S. EPA, 2019a, section 6.2.4.2). A small number of epidemiologic studies also report positive associations between long-term $PM_{2.5}$ exposure and heart failure, changes in blood pressure, and hypertension (U.S. EPA, 2019a, sections 6.2.5 and 6.2.7). Associations with heart failure are supported by animal toxicological studies demonstrating decreased cardiac contractility and function, and increased coronary artery wall thickness following long-term $PM_{2.5}$ exposure (U.S. EPA, 2019a, section 6.2.5.2). Similarly, a limited number of animal toxicological studies demonstrating a relationship between long-term $PM_{2.5}$ exposure and consistent increases in blood pressure in rats and mice are coherent with epidemiologic studies reporting positive associations between long-term exposure to $PM_{2.5}$ and hypertension.

Additionally, a number of studies evaluated in the ISA Supplement focusing on morbidity outcomes, including those that focused on incidence of MI, atrial fibrillation (AF), stroke, and congestive heart failure (CHF), expand the evidence pertaining to the shape of the C–R relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects. These studies use statistical techniques that allow for departures from linearity (U.S. EPA, 2022a, Table 3–3), and generally support the evidence characterized in the 2019 ISA showing linear, no-threshold C–R relationship for most cardiovascular disease (CVD) outcomes. However, there is evidence for a sublinear or supralinear C–R relationship for some outcomes (U.S. EPA, 2022a, section 3.1.2.2.9).[57]

Longitudinal epidemiologic analyses also report positive associations with markers of systemic inflammation (U.S. EPA, 2019a, section 6.2.11), coagulation (U.S. EPA, 2019a, section 6.2.12), and

[57] As noted above for mortality, uncertainty in the shape of the C–R relationship increases near the upper and lower ends of the distribution due to limited data.

endothelial dysfunction (U.S. EPA, 2019a, section 6.2.13). These results are coherent with animal toxicological studies generally reporting increased markers of systemic inflammation, oxidative stress, and endothelial dysfunction (U.S. EPA, 2019a, section 6.2.12.2 and 6.2.14).

In summary, the 2019 ISA concludes that there is consistent evidence from multiple epidemiologic studies illustrating that long-term exposure to $PM_{2.5}$ is associated with mortality from cardiovascular causes. Epidemiologic studies evaluated in the ISA Supplement provide additional evidence of positive associations between long-term $PM_{2.5}$ exposure and cardiovascular morbidity (U.S. EPA, 2022a, section 3.1.2.2). Associations with coronary heart disease (CHD), stroke and atherosclerosis progression were observed in several additional epidemiologic studies, providing coherence with the mortality findings. Results from copollutant models generally support an independent effect of $PM_{2.5}$ exposure on mortality. Additional evidence of the independent effect of $PM_{2.5}$ on the cardiovascular system is provided by experimental studies in animals, which support the biological plausibility of pathways by which long-term exposure to $PM_{2.5}$ could potentially result in outcomes such as CHD, stroke, CHF, and cardiovascular mortality. Overall, studies evaluated in the 2019 ISA support the conclusion of a causal relationship between long-term $PM_{2.5}$ exposure and cardiovascular effects, which is supported and extended by evidence from recent epidemiologic studies evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.1.2.2).

Short-Term $PM_{2.5}$ Exposures

The 2009 ISA concluded that ''a causal relationship exists between short-term exposure to $PM_{2.5}$ and cardiovascular effects'' (U.S. EPA, 2009a). The strongest evidence in the 2009 ISA was from epidemiologic studies of emergency department (ED) visits and hospital admissions for IHD and heart failure (HF), with supporting evidence from epidemiologic studies of cardiovascular mortality (U.S. EPA, 2009a). Animal toxicological studies provided coherence and biological plausibility for the positive associations reported with MI, ED visits, and hospital admissions. These included studies reporting reduced myocardial blood flow during ischemia and studies indicating altered vascular reactivity. In addition, effects of $PM_{2.5}$ exposure on a potential indicator of ischemia (*i.e.,* ST segment depression on an electrocardiogram) were reported in both animal toxicological and epidemiologic panel studies.[58] Key uncertainties from the last review resulted from inconsistent results across disciplines with respect to the relationship between short-term exposure to $PM_{2.5}$ and changes in blood pressure, blood coagulation markers, and markers of systemic inflammation. In addition, while the 2009 ISA identified a growing body of evidence from controlled human exposure and animal toxicological studies, uncertainties remained with respect to biological plausibility.

Studies evaluated in the 2019 ISA provide additional support for a causal relationship between short-term $PM_{2.5}$ exposure and cardiovascular effects. This includes generally positive associations observed in multicity epidemiologic studies of emergency department visits and hospital admissions for IHD, heart failure (HF), and combined cardiovascular-related endpoints. In particular, nationwide studies of older adults (65 years and older) using Medicare records report positive associations between $PM_{2.5}$ exposures and hospital admissions for HF (U.S. EPA, 2019a, section 6.1.3.1). Moreover, recent multicity studies, published after the literature cutoff date of the 2019 ISA and evaluated in the ISA Supplement, are consistent with studies evaluated in the 2019 ISA that report positive association between short-term $PM_{2.5}$ exposure and ED visits and hospital admission for IHD, heart attacks, and HF (U.S. EPA, 2022a, section 3.1). Epidemiologic studies conducted in single cities contribute some support to the causality determination, though associations reported in single-city studies are less consistently positive than in multicity studies, and include a number of studies reporting null associations (U.S. EPA, 2019a, sections 6.1.2 and 6.1.3). As a whole, though, the recent body of IHD and HF epidemiologic evidence supports the evidence from previous ISAs reporting mainly positive associations between short-term $PM_{2.5}$ concentrations and emergency department visits and hospital admissions.

Consistent with the evidence assessed in the 2019 ISA, some studies evaluated in the ISA Supplement report no evidence of an association with stroke, regardless of stroke subtype. Additionally, as in the 2019 ISA, evidence evaluated in the ISA Supplement continues to indicate an immediate effect of $PM_{2.5}$ on cardiovascular-related outcomes primarily within the first few days after exposure, and that associations generally persisted in models adjusted for copollutants (U.S. EPA, 2022a, section 3.1.1.2).

The ISA Supplement includes additional epidemiologic studies, published since the literature cutoff date for the 2019 ISA, including accountability analyses and epidemiologic studies that employ alternative methods for confounder control to evaluate the association between short-term $PM_{2.5}$ exposure and cardiovascular-related effects (U.S. EPA, 2022a, section 3.1.1.3). These studies employ a number of statistical approaches and report positive associations, providing additional support for a relationship between short-term $PM_{2.5}$ exposure and cardiovascular effects, while also reducing uncertainties related to potential confounder bias.

A number of controlled human exposure, animal toxicological, and epidemiologic panel studies provide evidence that $PM_{2.5}$ exposure could plausibly result in IHD or HF through pathways that include endothelial dysfunction, arterial thrombosis, and arrhythmia (U.S. EPA, 2019a, section 6.1.1). The most consistent evidence from recent controlled human exposure studies is for endothelial dysfunction, as measured by changes in brachial artery diameter or flow mediated dilation. Multiple controlled human exposure studies that examined the potential for endothelial dysfunction report an effect of $PM_{2.5}$ exposure on measures of blood flow (U.S. EPA, 2019a, section 6.1.13.2). However, these studies report variable results regarding the timing of the effect and the mechanism by which reduced blood flow occurs (*i.e.,* availability vs sensitivity to nitric oxide). In addition, some controlled human exposure studies using CAPs report evidence for small increases in blood pressure (U.S. EPA, 2019a, section 6.1.6.3). Although not entirely consistent, there is also some evidence across controlled human exposure studies for conduction abnormalities/arrhythmia (U.S. EPA, 2019a, section 6.1.4.3), changes in heart rate variability (HRV) (U.S. EPA, 2019a, section 6.1.10.2), changes in hemostasis that could promote clot formation (U.S. EPA, 2019a, section 6.1.12.2), and increases in inflammatory cells and markers (U.S. EPA, 2019a, section 6.1.11.2). A recent study by Wyatt et al.

[58] Some animal studies included in the 2009 ISA examined exposures to mixtures, such as motor vehicle exhaust or woodsmoke. In these studies, it was unclear if the resulting cardiovascular effects could be attributed specifically to the fine particle component of the mixture.

(2020), evaluated in the ISA Supplement, adds to the limited evidence base of controlled human exposure studies conducted at near ambient $PM_{2.5}$ concentrations. The study, completed in healthy young adults subject to intermittent exercise, found some significant cardiovascular effects (*e.g.,* systematic inflammation markers, including C-reactive protein (CRP), and cardiac repolarization). Thus, when taken as a whole, controlled human exposure studies are coherent with epidemiologic studies in that they demonstrate that short-term exposures to $PM_{2.5}$ may result in the types of cardiovascular endpoints that could lead to emergency department visits and hospital admissions for IHD or HF, as well as mortality in some people.

Animal toxicological studies published since the 2009 ISA and evaluated in the 2019 ISA also support a relationship between short-term $PM_{2.5}$ exposure and cardiovascular effects. A study demonstrating decreased cardiac contractility and left ventricular pressure in mice is coherent with the results of epidemiologic studies that report associations between short-term $PM_{2.5}$ exposure and heart failure (U.S. EPA, 2019a, section 6.1.3.3). In addition, and as with controlled human exposure studies, there is generally consistent evidence in animal toxicological studies for indicators of endothelial dysfunction (U.S. EPA, 2019a, section 6.1.13.3). Some studies in animals also provide evidence for changes in a number of other cardiovascular endpoints following short-term $PM_{2.5}$ exposure including conduction abnormalities and arrhythmia (U.S. EPA, 2019a, section 6.1.4.4), changes in HRV (U.S. EPA, 2019a, section 6.1.10.3), changes in blood pressure (U.S. EPA, 2019a, section 6.1.6.4), and evidence for systemic inflammation and oxidative stress (U.S. EPA, 2019a, section 6.1.11.3).

In summary, evidence evaluated in the 2019 ISA extends the consistency and coherence of the evidence base evaluated in the 2009 ISA and prior assessments. Epidemiologic studies reporting robust associations in copollutant models are supported by direct evidence from controlled human exposure and animal toxicologic studies reporting independent effects of $PM_{2.5}$ exposures on endothelial dysfunction as well as endpoints indicating impaired cardiac function, increased risk of arrhythmia, changes in HRV, increases in BP, and increases in indicators of systemic inflammation, oxidative stress, and coagulation (U.S. EPA, 2019, section 6.1.16). For some cardiovascular effects, there are inconsistencies in results across some animal toxicological, controlled human exposure, and epidemiologic panel studies, though this may be due to substantial differences in study design and/or study populations. Overall, the results from epidemiologic panel, controlled human exposure, and animal toxicological studies, in particular those related to endothelial dysfunction, impaired cardiac function, ST segment depression, thrombosis, conduction abnormalities, and changes in blood pressure provide coherence and biological plausibility for the consistent results from epidemiologic studies observing positive associations between short-term $PM_{2.5}$ exposures and IHD and HF, and ultimately cardiovascular mortality. Overall, studies evaluated in the 2019 ISA support the conclusion of a causal relationship between short-term $PM_{2.5}$ exposure and cardiovascular effects, which is supported and extended by evidence from recent epidemiologic studies evaluated in the ISA Supplement (U.S. EPA, 2022a, section 3.1.1.4).

iii. Respiratory Effects

Long-Term $PM_{2.5}$ Exposures

The 2009 ISA concluded that ''a causal relationship is likely to exist between long-term $PM_{2.5}$ exposure and respiratory effects'' (U.S. EPA, 2009a). This conclusion was based mainly on epidemiologic evidence demonstrating associations between long-term $PM_{2.5}$ exposure and changes in lung function or lung function growth in children. Biological plausibility was provided by a single animal toxicological study examining pre- and post-natal exposure to $PM_{2.5}$ CAPs, which found impaired lung development. Epidemiologic evidence for associations between long-term $PM_{2.5}$ exposure and other respiratory outcomes, such as the development of asthma, allergic disease, and COPD; respiratory infection; and the severity of disease was limited, both in the number of studies available and the consistency of the results. Experimental evidence for other outcomes was also limited, with one animal toxicological study reporting that long-term exposure to $PM_{2.5}$ CAPs results in morphological changes in nasal airways of healthy animals. Other animal studies examined exposure to mixtures, such as motor vehicle exhaust and woodsmoke, and effects were not attributed specifically to the particulate components of the mixture.

Cohort studies evaluated in the 2019 ISA provided additional support for the relationship between long-term $PM_{2.5}$ exposure and decrements in lung function growth (as a measure of lung development), indicating a robust and consistent association across study locations, exposure assessment methods, and time periods (U.S. EPA, 2019a, section 5.2.13). This relationship was further supported by a retrospective study that reports an association between declining $PM_{2.5}$ concentrations and improvements in lung function growth in children (U.S. EPA, 2019a, section 5.2.11). Epidemiologic studies also examine asthma development in children (U.S. EPA, 2019a, section 5.2.3), with prospective cohort studies reporting generally positive associations, though several are imprecise (*i.e.,* they report wide confidence intervals). Supporting evidence is provided by studies reporting associations with asthma prevalence in children, with childhood wheeze, and with exhaled nitric oxide, a marker of pulmonary inflammation (U.S. EPA, 2019a, section 5.2.13). Additionally, the 2019 ISA includes an animal toxicological study showing the development of an allergic phenotype and an increase in a marker of airway responsiveness supports the biological plausibility of the development of allergic asthma (U.S. EPA, 2019a, section 5.2.13). Other epidemiologic studies report a $PM_{2.5}$-related acceleration of lung function decline in adults, while improvement in lung function was observed with declining $PM_{2.5}$ concentrations (U.S. EPA, 2019a, section 5.2.11). A longitudinal study found declining $PM_{2.5}$ concentrations are also associated with an improvement in chronic bronchitis symptoms in children, strengthening evidence reported in the 2009 ISA for a relationship between increased chronic bronchitis symptoms and long-term $PM_{2.5}$ exposure (U.S. EPA, 2019a, section 5.2.11). A common uncertainty across the epidemiologic evidence is the lack of examination of copollutants to assess the potential for confounding. While there is some evidence that associations remain robust in models with gaseous pollutants, a number of these studies examining copollutant confounding were conducted in Asia, and thus have limited generalizability due to high annual pollutant concentrations.

When taken together, the 2019 ISA concludes that the epidemiologic evidence strongly supports a relationship with decrements in lung function growth asthma development in children, as well as increased bronchitis symptoms in children with asthma. Additionally, the epidemiologic

evidence strongly supports a relationship with an acceleration of lung function decline in adults, and with respiratory mortality and cause-specific respiratory mortality for COPD and respiratory infection (U.S. EPA, 2019a, p. 1–34). In support of the biological plausibility of associations reported in epidemiologic studies associated with respiratory health effects, animal toxicological studies evaluated in the 2019 ISA continue to provide direct evidence that long-term exposure to $PM_{2.5}$ results in a variety of respiratory effects, including pulmonary oxidative stress, inflammation, and morphologic changes in the upper (nasal) and lower airways. Other results show that changes are consistent with the development of allergy and asthma, and with impaired lung development. Overall, the 2019 ISA concludes that ''the collective evidence is sufficient to conclude that a causal relationship is likely to exist between long-term $PM_{2.5}$ exposure and respiratory effects'' (U.S. EPA, 2019a, section 5.2.13).

Short-Term $PM_{2.5}$ Exposures

The 2009 ISA (U.S. EPA, 2009a) concluded that a ''causal relationship is likely to exist'' between short-term $PM_{2.5}$ exposure and respiratory effects. This conclusion was based mainly on the epidemiologic evidence demonstrating positive associations with various respiratory effects. Specifically, the 2009 ISA described epidemiologic evidence as consistently showing $PM_{2.5}$-associated increases in hospital admissions and ED visits for COPD and respiratory infection among adults or people of all ages, as well as increases in respiratory mortality. These results were supported by studies reporting associations with increased respiratory symptoms and decreases in lung function in children with asthma, though the epidemiologic evidence was inconsistent for hospital admissions or emergency department visits for asthma. Studies examining copollutant models showed that $PM_{2.5}$ associations with respiratory effects were robust to inclusion of CO or SO_2 in the model, but often were attenuated (though still positive) with inclusion of O_3 or NO_2. In addition to the copollutant models, evidence supporting an independent effect of $PM_{2.5}$ exposure on the respiratory system was provided by animal toxicological studies of $PM_{2.5}$ CAPs demonstrating changes in some pulmonary function parameters, as well as inflammation, oxidative stress, injury, enhanced allergic responses, and reduced host defenses. Many of these effects have been implicated in the pathophysiology for asthma exacerbation, COPD exacerbation, or respiratory infection. In the few controlled human exposure studies conducted in individuals with asthma or COPD, $PM_{2.5}$ exposure mostly had no effect on respiratory symptoms, lung function, or pulmonary inflammation. Available studies in healthy people also did not clearly demonstrate respiratory effects following short-term $PM_{2.5}$ exposures.

Epidemiologic studies evaluated in the 2019 ISA continue to provide strong evidence for a relationship between short-term $PM_{2.5}$ exposure and several respiratory-related endpoints, including asthma exacerbation (U.S. EPA, 2019a, section 5.1.2.1), COPD exacerbation (U.S. EPA, 2019a, section 5.1.4.1), and combined respiratory-related diseases (U.S. EPA, 2019a, section 5.1.6), particularly from studies examining ED visits and hospital admissions. The generally positive associations between short-term $PM_{2.5}$ exposure and asthma and COPD as well as ED visits and hospital admissions are supported by epidemiologic studies demonstrating associations with other respiratory-related effects such as symptoms and medication use that are indicative of asthma and COPD exacerbations (U.S. EPA, 2019a, sections 5.1.2.2 and 5.4.1.2). The collective body of epidemiologic evidence for asthma exacerbation is more consistent in children than in adults. Additionally, epidemiologic studies examining the relationship between short-term $PM_{2.5}$ exposure and respiratory mortality provide evidence of consistent positive associations, demonstrating a continuum of effects (U.S. EPA, 2019a, section 5.1.9).

Epidemiologic studies evaluated in the 2019 ISA expand the assessment of potential copollutant confounding evaluated in the 2009 ISA. There is some evidence that $PM_{2.5}$ associations with asthma exacerbation, combined respiratory-related diseases, and respiratory mortality remain relatively unchanged in copollutant models with gaseous pollutants including O_3, NO_2, SO_2, and with more limited evidence for CO, as well as other particle sizes (*i.e.,* $PM_{10-2.5}$) (U.S. EPA, 2019a, section 5.1.10.1).

Insight into whether there is an independent effect of $PM_{2.5}$ on respiratory health is also partially addressed by findings from animal toxicological studies evaluated in the 2019 ISA. Specifically, short-term exposure to $PM_{2.5}$ enhanced asthma-related responses in an animal model of allergic airways disease and enhanced lung injury and inflammation in an animal model of COPD (U.S. EPA, 2019a, sections 5.1.2.4.4 and 5.1.4.4.3). The experimental evidence provides biological plausibility for some respiratory-related endpoints, including limited evidence of altered host defense and greater susceptibility to bacterial infection as well as consistent evidence of respiratory irritant effects. However, animal toxicological evidence for other respiratory effects is inconsistent. A recent study evaluated in the ISA supplement by Wyatt et al. (2020) and conducted at near ambient $PM_{2.5}$ concentrations, adds to the limited evidence base of controlled human exposure studies. The study, completed in healthy young adults subject to intermittent exercise, found some significant respiratory effects (including decrease in lung function), however these findings were inconsistent with the controlled human exposure studies evaluated in the 2019 ISA (U.S. EPA, 2019a, section 5.1.7.2, 5.1.2.3, and 6.1.11.2.1).

The 2019 ISA concludes that ''[t]he strongest evidence of an effect of short-term $PM_{2.5}$ exposure on respiratory effects is provided by epidemiologic studies of asthma and COPD exacerbation. While animal toxicological studies provide biological plausibility for these findings, some uncertainty remains with respect to the independence of $PM_{2.5}$ effects'' (U.S. EPA, 2019a, p. 5–155). When taken together, the 2019 ISA concludes that this evidence ''is sufficient to conclude that a causal relationship is likely to exist between short-term $PM_{2.5}$ exposure and respiratory effects'' (U.S. EPA, 2019a, p. 5–155).

iv. Cancer

The 2009 ISA concluded that the overall body of evidence was ''suggestive of a causal relationship between relevant $PM_{2.5}$ exposures and cancer'' (U.S. EPA, 2009a). This conclusion was based primarily on positive associations observed in a limited number of epidemiologic studies of lung cancer mortality. The few epidemiologic studies that had evaluated $PM_{2.5}$ exposure and lung cancer incidence or cancers of other organs and systems generally did not show evidence of an association. Toxicological studies did not focus on exposures to specific PM size fractions, but rather investigated the effects of exposures to total ambient PM, or other source-based PM such as wood smoke. Collectively, results of in vitro studies were consistent with the larger body of evidence demonstrating that ambient PM and PM from specific combustion sources are mutagenic and genotoxic. However, animal inhalation studies

found little evidence of tumor formation in response to chronic exposures. A small number of studies provided preliminary evidence that PM exposure can lead to changes in methylation of DNA, which may contribute to biological events related to cancer.

Since the completion of the 2009 ISA, additional cohort studies provide evidence that long-term $PM_{2.5}$ exposure is positively associated with lung cancer mortality and with lung cancer incidence, and provide initial evidence for an association with reduced cancer survival (U.S. EPA, 2019a, section 10.2.5). Re-analyses of the ACS cohort using different years of $PM_{2.5}$ data and follow up, along with various exposure assignment approaches, provide consistent evidence of positive associations between long-term $PM_{2.5}$ exposure and lung cancer mortality (U.S. EPA, 2019a, Figure 10–3). Additional support for positive associations with lung cancer mortality is provided by recent epidemiologic studies using individual level data to control for smoking status, as well as by studies of people who have never smoked (though such studies generally report wide confidence intervals due to the small number of lung cancer mortality cases within this population), and in additional analyses of cohorts that relied upon proxy measures to account for smoking status (U.S. EPA, 2019a, section 10.2.5.1.1). Although studies that evaluate lung cancer incidence, including studies of people who have never smoked, are limited in number, studies in the 2019 ISA generally report positive associations with long-term $PM_{2.5}$ exposures (U.S. EPA, 2019a, section 10.2.5.1.2). A subset of the studies focusing on lung cancer incidence also examined histological subtype, providing some evidence of positive associations for adenocarcinomas, the predominate subtype of lung cancer observed in people who have never smoked (U.S. EPA, 2019a, section 10.2.5.1.2). Associations between long-term $PM_{2.5}$ exposure and lung cancer incidence were found to remain relatively unchanged, though in some cases confidence intervals widened, in analyses that attempted to reduce exposure measurement error by accounting for length of time at residential address or by examining different exposure assignment approaches (U.S. EPA, 2019a, section 10.2.5.1.2).

To date, relatively few studies have evaluated the potential for copollutant confounding of the relationship between long-term $PM_{2.5}$ exposure and lung cancer mortality or incidence. A small number of such studies have generally focused on O_3 and report that $PM_{2.5}$ associations remain relatively unchanged in copollutant models (U.S. EPA, 2019a, section 10.2.5.1.3). However, available studies have not systematically evaluated the potential for copollutant confounding by other gaseous pollutants or by other particle size fractions (U.S. EPA, 2019a, section 10.2.5.1.3).

Compared to total (non-accidental) mortality (U.S. EPA, 2019a, section 10.2.4.1.4), fewer studies have examined the shape of the C–R curve for cause-specific mortality outcomes, including lung cancer. Several studies of lung cancer mortality and incidence have reported no evidence of deviations from linearity in the shape of the C–R relationship (Lepeule et al., 2012; Raaschou-Nielsen et al., 2013; Puett et al., 2014), though authors provided only limited discussions of results (U.S. EPA, 2019a, section 10.2.5.1.4).

In support of the biological plausibility of an independent effect of $PM_{2.5}$ on lung cancer, the 2019 ISA notes evidence from experimental and epidemiologic studies demonstrating that $PM_{2.5}$ exposure can lead to a range of effects indicative of mutagenicity, genotoxicity, and carcinogenicity, as well as epigenetic effects (U.S. EPA, 2019a, section 10.2.7). For example, both in vitro and in vivo toxicological studies have shown that $PM_{2.5}$ exposure can result in DNA damage (U.S. EPA, 2019a, section 10.2.2). Although such effects do not necessarily equate to carcinogenicity, the evidence that PM exposure can damage DNA, and elicit mutations, provides support for the plausibility of epidemiologic associations exhibited with lung cancer mortality and incidence. Additional supporting studies indicate the occurrence of micronuclei formation and chromosomal abnormalities (U.S. EPA, 2019a, section 10.2.2.3), and differential expression of genes that may be relevant to cancer pathogenesis, following $PM_{2.5}$ exposures. Experimental and epidemiologic studies that examine epigenetic effects indicate changes in DNA methylation, providing some support that $PM_{2.5}$ exposure contributes to genomic instability (U.S. EPA, 2019a, section 10.2.3). Overall, there is limited evidence that long-term $PM_{2.5}$ exposure is associated with cancers in other organ systems, though there is some evidence that $PM_{2.5}$ exposure may reduce survival in individuals with cancer (U.S. EPA, 2019a, section 10.2.7; U.S. EPA, 2022a, section 2.1.1.4.1).

Epidemiologic evidence for associations between $PM_{2.5}$ and lung cancer mortality and incidence, together with evidence supporting the biological plausibility of such associations, contributes to the 2019 ISA's conclusion that the evidence ''is sufficient to conclude that a causal relationship is likely to exist between long-term $PM_{2.5}$ exposure and cancer'' (U.S. EPA, 2019, section 10.2.7).

v. Nervous System Effects

Reflecting the very limited evidence available in the 2012 review, the 2009 ISA did not make a causality determination for long-term $PM_{2.5}$ exposures and nervous system effects (U.S. EPA, 2009c). Since the 2012 review, this body of evidence has grown substantially (U.S. EPA, 2019, section 8.2). Animal toxicological studies assessed in in the 2019 ISA report that long-term $PM_{2.5}$ exposures can lead to morphologic changes in the hippocampus and to impaired learning and memory. This evidence is consistent with epidemiologic studies reporting that long-term $PM_{2.5}$ exposure is associated with reduced cognitive function (U.S. EPA, 2019a, section 8.2.5). Further, while the evidence is limited, the presence of early markers of Alzheimer's disease pathology has been demonstrated in rodents following long-term exposure to $PM_{2.5}$ CAPs. These findings support reported associations with neurodegenerative changes in the brain (*i.e.,* decreased brain volume), all-cause dementia, or hospitalization for Alzheimer's disease in a small number of epidemiologic studies (U.S. EPA, 2019a, section 8.2.6). Additionally, loss of dopaminergic neurons in the substantia nigra, a hallmark of Parkinson disease, has been reported in mice (U.S. EPA, 2019a, section 8.2.4), though epidemiologic studies provide only limited support for associations with Parkinson's disease (U.S. EPA, 2019a, section 8.2.6). Overall, the lack of consideration of copollutant confounding introduces some uncertainty in the interpretation of epidemiologic studies of nervous system effects, but this uncertainty is partly addressed by the evidence for an independent effect of $PM_{2.5}$ exposures provided by experimental animal studies.

While the findings described above are most relevant to older adults, several studies of neurodevelopmental effects in children have also been conducted. Epidemiologic studies provided limited evidence of an association between $PM_{2.5}$ exposure during pregnancy and childhood on cognitive and motor development (U.S. EPA, 2019, section 8.2.5.2). While some studies report positive associations between long-term

exposure to $PM_{2.5}$ during the prenatal period and autism spectrum disorder (ASD) (U.S. EPA, 2019, section 8.2.7.2), the interpretation of these epidemiologic studies is limited due to the small number of studies, their lack of control for potential confounding by copollutants, and uncertainty related to the critical exposure windows. Biological plausibility is provided for the ASD findings by a study in mice that found inflammatory and morphologic changes in the corpus collosum and hippocampus, as well as ventriculomegaly (*i.e.,* enlarged lateral ventricles) in young mice following prenatal exposure to $PM_{2.5}$ CAPs.

Taken together, the 2019 ISA concludes that studies indicate long-term $PM_{2.5}$ exposures can lead to effects on the brain associated with neurodegeneration (*i.e.,* neuroinflammation and reductions in brain volume), as well as cognitive effects in older adults (U.S. EPA, 2019a, Table 1–2). Animal toxicological studies provide evidence for a range of nervous system effects in adult animals, including neuroinflammation and oxidative stress, neurodegeneration, cognitive effects, and effects on neurodevelopment in young animals. The epidemiologic evidence is more limited, but studies generally support associations between long-term $PM_{2.5}$ exposure and changes in brain morphology, cognitive decrements and dementia. There is also initial, and limited, evidence for neurodevelopmental effects, particularly ASD. The consistency and coherence of the evidence supports the 2019 ISA's conclusion that ''the collective evidence is sufficient to conclude that a causal relationship is likely to exist between long-term $PM_{2.5}$ exposure and nervous system effects'' (U.S. EPA, 2019a, section 8.2.9).

vi. Other Effects

For other health effect categories that were evaluated for their relationship with $PM_{2.5}$ exposures (*i.e.,* short-term $PM_{2.5}$ exposure and nervous system effects and short- and long-term $PM_{2.5}$ exposure and metabolic effects, reproduction and fertility, and pregnancy and birth outcomes (U.S. EPA, 2022a, Table ES–1), the currently available evidence is ''suggestive of, but not sufficient to infer, a causal relationship,'' mainly due to inconsistent evidence across specific outcomes and uncertainties regarding exposure measurement error, the potential for confounding, and potential modes of action (U.S. EPA, 2019a, sections 7.14, 7.2.10, 8.1.6, and 9.1.5). The causality determination for short-term $PM_{2.5}$ exposure and nervous system effects in the 2019 ISA reflects a revision to the causality determination in the 2009 ISA from ''inadequate to infer a causal relationship,'' while this is the first-time assessments of causality were conducted for long-term $PM_{2.5}$ exposure and nervous system effects, as well as short- and long-term $PM_{2.5}$ exposure and metabolic effects reflect.

Recent studies evaluated in the 2019 ISA also further explored the relationship between short-and long-term UFP exposure and health effects. (*i.e.,* cardiovascular effects and short-term UFP exposures; respiratory effects and short-term UFP exposures; and nervous system effects and long- and short-term exposures (U.S. EPA, 2022a, Table ES–1). The currently available evidence is ''suggestive of, but not sufficient to infer, a causal relationship'' for short-term UFP exposure and cardiovascular and respiratory effects and for short- and long-term UFP exposure and nervous system effects, primarily due to uncertainties and limitations in the evidence, specifically, variability across studies in the definition of UFPs and the exposure metric used (U.S. EPA, 2019a, P.3.1; U.S. EPA, 2022a, section 3.3.1.6.3). The causality determinations for the other health effect categories evaluated in the 2019 ISA are ''inadequate to infer a causal relationship.'' Additionally, this is the first time assessments of causality were conducted for short- and long-term UFP exposure and metabolic effects and long-term UFP exposure and nervous system effects (U.S. EPA, 2022a, Table ES–1).

With the advent of the global COVID–19 pandemic, a number of recent studies evaluated in the ISA Supplement examined the relationship between ambient air pollution, specifically $PM_{2.5}$, and SARS–CoV–2 infections and COVID–19 deaths, including a few studies within the U.S. and Canada (U.S. EPA, 2022a, section 3.3.2).[59] Some studies examined whether daily changes in $PM_{2.5}$ can influence SARS–CoV–2 infection and COVID–19 death (U.S. EPA, 2022a, section 3.3.2.1). Additionally, several studies evaluated whether long-term $PM_{2.5}$ exposure increases the risk of SARS–CoV–2 infection and COVID–19 death in North America (U.S. EPA, 2022a, section 3.3.2.2). While there is initial evidence of positive associations with SARS–CoV–2 infection and COVID–19 death, uncertainties remain due to methodological issues that may influence the results, including: (1) The use of ecological study design; (2) studies were conducted during the ongoing pandemic when the etiology of COVID–19 was still not well understood (*e.g.,* specifically, there are important differences in COVID–19-related outcomes by a variety of factors such as race and SES); and (3) studies did not account for crucial factors that could influence results (*e.g.,* stay-at-home orders, social distancing, use of masks, and testing capacity) (U.S. EPA, 2022a, chapter 5). Taken together, while there is initial evidence of positive associations with SARS–CoV–2 infection and COVID–19 death, uncertainties remain due to methodological issues.

b. Public Health Implications and At-Risk Populations

The public health implications of the evidence regarding $PM_{2.5}$-related health effects, as for other effects, are dependent on the type and severity of the effects, as well as the size of the population affected. Such factors are discussed below in the context of our consideration of the health effects evidence related to $PM_{2.5}$ in ambient air. This section also summarizes the current information on population groups at increased risk of the effects of $PM_{2.5}$ in ambient air.

The information available in this reconsideration has not altered our understanding of human populations at risk of health effects from $PM_{2.5}$ exposures. As recognized in the 2020 review, the 2019 ISA cites extensive evidence indicating that ''both the general population as well as specific populations and lifestages are at risk for $PM_{2.5}$-related health effects'' (U.S. EPA, 2019a, p. 12–1). Factors that may contribute to increased risk of $PM_{2.5}$-related health effects include lifestage (children and older adults), pre-existing diseases (cardiovascular disease and

[59] While there is no exact corollary within the 2019 ISA for these types of studies, the 2019 ISA presented evidence that evaluates the potential relationship between short- and long-term $PM_{2.5}$ exposure and respiratory infection (U.S. EPA, 2022a, section 5.1.5 and 5.2.6). Studies assessed in the 2019 ISA report some evidence of positive associations between short-term $PM_{2.5}$ and hospital admissions and ED visits for respiratory infections, however the interpretation of these studies is complicated by the variability in the type of respiratory infection outcome examined (U.S. EPA, 2022a, Figure 5–7). In the 2019 ISA, studies of long-term $PM_{2.5}$ exposure were limited and while there were some positive associations reported, there was minimal overlap in respiratory infection outcomes examined across studies. Exposure to $PM_{2.5}$ has been shown to impair host defense, specifically altering macrophage function, providing a biological pathway by which $PM_{2.5}$ exposure could lead to respiratory infection (U.S. EPA, 2022a, sections 5.1.1 and 5.1.5.) There is some additional evidence that $PM_{2.5}$ exposure can lead to decreases in an individual's immune response, which can subsequently facilitate replication of respiratory viruses (Bourdrel et al., 2021).

respiratory disease), race/ethnicity, and SES.[60]

Children make up a substantial fraction of the U.S. population, and often have unique factors that contribute to their increased risk of experiencing a health effect due to exposures to ambient air pollutants because of their continuous growth and development.[61] Children may be particularly at risk for health effects related to ambient $PM_{2.5}$ exposures compared with adults because they have (1) a developing respiratory system, (2) increased ventilation rates relative to body mass compared with adults, and (3) an increased proportion of oral breathing, particularly in boys, relative to adults (U.S. EPA, 2019a, section 12.5.1.1). There is strong evidence that demonstrates $PM_{2.5}$ associated health effects in children, particularly from epidemiologic studies of long-term $PM_{2.5}$ exposure and impaired lung function growth, decrements in lung function, and asthma development. However, there is limited evidence from stratified analyses that children are at increased risk of $PM_{2.5}$-related health effects compared to adults. Additionally, there is some evidence that indicates that children receive higher $PM_{2.5}$ exposures than adults, and dosimetric differences in children compared to adults can contribute to higher doses (U.S. EPA, 2019a, section 12.5.1.1).

In the U.S., older adults, often defined as adults 65 years of age and older, represent an increasing portion of the population and often have pre-existing diseases or conditions that may compromise biological function. While there is limited evidence to indicate that older adults have higher exposures than younger adults, older adults may receive higher doses of $PM_{2.5}$ due to dosimetric differences. There is consistent evidence from studies of older adults demonstrating generally consistent positive associations in studies examining health effects from short- and long-term $PM_{2.5}$ exposure and cardiovascular or respiratory hospital admissions, emergency department visits, or mortality (U.S. EPA, 2019a, sections 6.1, 6.2, 11.1, 11.2, 12.5.1.2). Additionally, several animal toxicological, controlled human exposure, and epidemiologic studies did not stratify results by lifestage, but instead focused the analyses on older individuals, and can provide coherence and biological plausibility for the occurrence among this lifestage (U.S. EPA, 2019a, section 12.5.1.2).

Individuals with pre-existing disease may be considered at greater risk of an air pollution-related health effect than those without disease because they are likely in a compromised biological state that can vary depending on the disease and severity. With regard to cardiovascular disease, we first note that cardiovascular disease is the leading cause of death in the U.S., accounting for one in four deaths, and approximately 12% of the adult population in the U.S. has a cardiovascular disease (U.S. EPA, 2019a, section 12.3.1). Strong evidence demonstrates that there is a causal relationship between cardiovascular effects and long- and short-term exposures to $PM_{2.5}$. Some of the evidence supporting this conclusion is from studies of panels or cohorts with pre-existing cardiovascular disease, which provide supporting evidence but do not directly demonstrate an increased risk (U.S. EPA, 2019a, section 12.3.1). Epidemiologic evidence indicates that individuals with pre-existing cardiovascular disease may be at increased risk for $PM_{2.5}$-associated health effects compared to those without pre-existing cardiovascular disease. While the evidence does not consistently support increased risk for all pre-existing cardiovascular diseases, there is evidence that certain pre-existing cardiovascular diseases (*e.g.,* hypertension) may be a factor that increases $PM_{2.5}$-related risk. Furthermore, there is strong evidence supporting a causal relationship for long- and short-term $PM_{2.5}$ exposure and cardiovascular effects, particularly for IHD (U.S. EPA, 2019a, chapter 6, section 12.3.1).

With regard to respiratory disease, we first note that the most chronic respiratory diseases in the U.S. are asthma and COPD. Asthma affects a substantial fraction of the U.S. population and is the leading chronic disease among children. COPD primarily affects older adults and contributes to compromised respiratory function and underlying pulmonary inflammation. The body of evidence indicates that individuals with pre-existing respiratory diseases, particularly asthma and COPD, may be at increased risk for $PM_{2.5}$-related health effects compared to those without pre-existing respiratory diseases (U.S. EPA, 2019a, section 12.3.5). There is strong evidence indicating $PM_{2.5}$-associated respiratory effects among those with asthma, which forms the primary evidence base for the likely to be causal relationship between short-term exposures to $PM_{2.5}$ and respiratory health effects (U.S. EPA, 2019a, section 12.3.5). For asthma, epidemiologic evidence demonstrates associations between short-term $PM_{2.5}$ exposures and respiratory effects, particularly evidence for asthma exacerbation, and controlled human exposure and animal toxicological studies demonstrate support for the biological plausibility for asthma exacerbation with $PM_{2.5}$ exposures (U.S. EPA, 2019a, section 12.3.5.1). For COPD, epidemiologic studies report positive associations between short-term $PM_{2.5}$ exposures and hospital admissions and emergency department visits for COPD, with supporting evidence from panel studies demonstration COPD exacerbation. Epidemiologic evidence is supported by some experimental evidence of COPD-related effects, which provides support for the biological plausibility for COPD in response to $PM_{2.5}$ exposures (U.S. EPA, 2019a, section 12.3.5.2).

There is strong evidence for racial and ethnic disparities in $PM_{2.5}$ exposures and $PM_{2.5}$-related health risk, as assessed in the 2019 ISA and with even more evidence available since the literature cutoff date for the 2019 ISA and evaluated in the ISA Supplement. There is strong evidence demonstrating that Black and Hispanic populations, in particular, have higher $PM_{2.5}$ exposures than non-Hispanic White populations (U.S. EPA, 2019a, Figure 12–2; U.S. EPA, 2022a, Figure 3–38). Black populations or individuals that live in predominantly Black neighborhoods experience higher $PM_{2.5}$ exposures, in comparison to non-Hispanic White populations. There is also consistent evidence across multiple studies that demonstrate increased risk of $PM_{2.5}$-related health effects, with the strongest evidence for health risk disparities for mortality (U.S. EPA, 2019a, section 12.5.4). There is also evidence of health risk disparities for both Hispanic and non-Hispanic Black populations compared to non-Hispanic White populations for cause-specific mortality and incident hypertension (U.S. EPA, 2022a, section 3.3.3.2).

Socioeconomic status (SES) is a composite measure that includes metrics such as income, occupation, or education, and can play a role in access to healthy environments as well as access to healthcare. SES may be a factor that contributes to differential risk from $PM_{2.5}$-related health effects. Studies assessed in the 2019 ISA and ISA Supplement provide evidence that lower SES communities are exposed to higher concentrations of $PM_{2.5}$

[60] As described in the 2019 ISA, other factors that have the potential to contribute to increased risk include obesity, diabetes, genetic factors, smoking status, sex, diet, and residential location (U.S. EPA, 2019, chapter 12).

[61] Children, as used throughout this document, generally refers to those younger than 18 years old.

compared to higher SES communities (U.S. EPA, 2019a, section 12.5.3; U.S. EPA, 2022a, section 3.3.3.1.1). Studies using composite measures of neighborhood SES consistently demonstrated a disparity in both $PM_{2.5}$ exposure and the risk of $PM_{2.5}$-related health outcomes. There is some evidence that supports associations larger in magnitude between mortality and long-term $PM_{2.5}$ exposures for those with low income or living in lower income areas compared to those with higher income or living in higher income neighborhoods (U.S. EPA, 2019a, section 12.5.3; U.S. EPA, 2022a, section 3.3.3.1.1). Additionally, evidence supports conclusions that lower SES is associated with cause-specific mortality and certain health endpoints (*i.e.,* HI and CHF), but less so for all-cause or total (non-accidental) mortality (U.S. EPA, 2022a, section 3.3.3.1).

The magnitude and characterization of a public health impact is dependent upon the size and characteristics of the populations affected, as well as the type or severity of the effects. As summarized above, lifestage (children and older adults), race/ethnicity and SES are factors that increase the risk of $PM_{2.5}$-related health effects. The American Community Survey (ACS) for 2019 estimates that approximately 22% and 16% of the U.S. population are children (age<18) and older adults (age 65+), respectively. For all ages, non-Hispanic Black and Hispanic populations comprise approximately 12% and 18% of the overall U.S. population in 2019. Currently available information that helps to characterize key features of these population is included in the 2022 PA (U.S. EPA, 2022b, Table 3–2).

As noted above, individuals with pre-existing cardiovascular disease and pre-existing respiratory disease may also be at increased risk of $PM_{2.5}$-related health effects. Currently available information that helps to characterize key features of populations with cardiovascular or respiratory diseases or conditions is included in the 2022 PA (U.S. EPA, 2022b, Table 3–3). The National Center for Health Statistics data for 2018 indicate that, for adult populations, older adults (*e.g.,* those 65 years and older) have a higher prevalence of cardiovascular diseases compared to younger adults (*e.g.,* those 64 years and younger). For respiratory diseases, older adults also have a higher prevalence of emphysema than younger adults, and adults 44 years or older have a higher prevalence of chronic bronchitis. However, the prevalence for asthma is generally similar across all adult age groups.

With respect to race, American Indians or Alaskan Native populations have the highest prevalence of all heart disease and coronary heart disease, while Black populations have the highest prevalence of hypertension and stroke. Hypertension has the highest prevalence across all racial groups compared to other cardiovascular diseases or conditions, ranging from approximately 22% to 32% of each racial group. Overall, the prevalence of cardiovascular diseases or conditions is lowest for Asians compared to Whites, Blacks, and American Indians or Alaskan Natives. Asthma prevalence is highest among Black and American Indian or Alaska Native populations, while the prevalence of chronic bronchitis and emphysema is generally similar across racial groups. Overall, the prevalence of respiratory diseases is lowest for Asians compared to Whites, Blacks, and American Indians or Alaskan Natives. With regard to ethnicity, cardiovascular and respiratory disease prevalence across all diseases or conditions is generally similar between Hispanic and non-Hispanic populations, although non-Hispanics have a slightly higher prevalence compared to Hispanics.

Taken together, this information indicates that the groups at increased risk of $PM_{2.5}$-related health effects represent a substantial portion of the total U.S. population. In evaluating the primary $PM_{2.5}$ standards, an important consideration is the potential $PM_{2.5}$-related public health impacts in these populations.

c. $PM_{2.5}$ Concentrations in Key Studies Reporting Health Effects

To inform conclusions on the adequacy of the public health protection provided by the current primary $PM_{2.5}$ standards, the sections below summarize the 2022 PA's evaluation of the $PM_{2.5}$ exposures, specifically the concentrations that have been examined in controlled human exposure studies, animal toxicological studies, and epidemiologic studies. The 2022 PA places the greatest emphasis on the health outcomes for which the 2019 ISA concludes that the evidence supports a ''causal'' or a ''likely to be causal'' relationship with short- or long-term $PM_{2.5}$ exposures (U.S. EPA, 2022b, section 3.3.3). As described in greater detail in section II.A.2 above, this includes short- or long-term $PM_{2.5}$ exposures and mortality, cardiovascular effects, and respiratory effects and long-term $PM_{2.5}$ exposures and cancer and nervous system effects. While the causality determinations in the 2019 ISA are informed by studies evaluating a wide range of $PM_{2.5}$ concentrations,[62] the sections below summarize the considerations in the 2022 PA regarding the degree to which the evidence assessed in the 2019 ISA and ISA Supplement supports the occurrence of PM-related health effects at concentrations relevant to informing conclusions on the primary $PM_{2.5}$ standards. In so doing, the 2022 PA focuses on the available studies that are most directly informative to reaching conclusions regarding the adequacy of the current primary $PM_{2.5}$ standards (*e.g.,* epidemiologic studies with annual mean $PM_{2.5}$ concentrations near or below the level of the standard; and controlled human exposure studies at $PM_{2.5}$ exposures that elicit consistent effects, as well as examining $PM_{2.5}$ exposures at concentrations that are at or near the level of the standard).

i. $PM_{2.5}$ Exposure Concentrations Evaluated in Experimental Studies

Evidence for a particular $PM_{2.5}$-related health outcome is strengthened when results from experimental studies demonstrate biologically plausible mechanisms through which adverse human health outcomes could occur (U.S. EPA, 2015, p. 20). Two types of experimental studies are of particular importance in understanding the effects

[62] As described in more detail in section 5 of the Preamble to the ISAs, judgments regarding causality take into consideration a number of aspects when evaluating the available scientific evidence (U.S. EPA, 2015, Table I). In reaching conclusions regarding causality, ''evidence is evaluated for major outcome categories or groups of related endpoints (*e.g.,* respiratory effects, vegetation growth), integrating evidence from across disciplines, and evaluating the coherence of evidence across a spectrum of related endpoints'' (U.S. EPA, 2015, p. 24). Furthermore, ''[i]n drawing judgments regarding causality for the criteria air pollutants, the ISA focuses on evidence of effects in the range of relevant pollutant exposures or doses and not on determination of causality at any dose. Emphasis is placed on evidence of effects at doses (*e.g.,* blood Pb concentration) or exposures (*e.g.,* air concentrations) that are relevant to, or somewhat above, those currently experienced by the population. The extent to which studies of higher concentrations are considered varies by pollutant and major outcome category, but generally includes those with doses or exposures in the range of one to two orders of magnitude above current or ambient conditions to account for intra-species variability and toxicokinetic or toxicodynamic differences between experimental animals and humans. Studies that use higher doses or exposures may also be considered to the extent that they provide useful information to inform understanding of mode of action, inter-species differences, or factors that may increase risk of effects for a population and if biological mechanisms have not been demonstrated to differ based on exposure concentration. Thus, a causality determination is based on weight-of-evidence evaluation for health or welfare effects, focusing on the evidence from exposures or doses generally ranging from recent ambient concentrations to one or two orders of magnitude above recent ambient concentrations'' (U.S. EPA, 2015, p. 24).

of PM exposures: controlled human exposure and animal toxicological studies. In such studies, investigators expose human volunteers or laboratory animals, respectively, to known concentrations of air pollutants under carefully regulated environmental conditions and activity levels. Thus, controlled human exposure and animal toxicological studies can provide information on the health effects of experimentally administered pollutant exposures under highly controlled laboratory conditions (U.S. EPA, 2015, p. 11).

Controlled human exposure studies have reported that $PM_{2.5}$ exposures lasting from less than one hour up to five hours can impact cardiovascular function,[63] and the most consistent evidence from these studies is for impaired vascular function (U.S. EPA, 2019a, section 6.1.13.2). In addition, although less consistent, the 2019 ISA notes that studies examining $PM_{2.5}$ exposures also provide evidence for increased blood pressure (U.S. EPA, 2019a, section 6.1.6.3), conduction abnormalities/arrhythmia (U.S. EPA, 2019a, section 6.1.4.3), changes in heart rate variability (U.S. EPA, 2019a, section 6.1.10.2), changes in hemostasis that could promote clot formation (U.S. EPA, 2019a, section 6.1.12.2), and increases in inflammatory cells and markers (U.S. EPA, 2019a, section 6.1.11.2). The 2019 ISA concludes that, when taken as a whole, controlled human exposure studies demonstrate that short-term exposure to $PM_{2.5}$ may impact cardiovascular function in ways that could lead to more serious outcomes (U.S. EPA, 2019a, section 6.1.16). Thus, such studies can provide insight into the potential for specific $PM_{2.5}$ exposures to result in physiological changes that could increase the risk of more serious effects. Table 3–4 in the 2022 PA summarizes information from the 2019 ISA and 2022 ISA supplement on available controlled human exposure studies that evaluate effects on markers of cardiovascular function following exposure to $PM_{2.5}$ (U.S. EPA, 2022b). Most of the controlled human exposure studies in Table 3–4 of the 2022 PA have evaluated average $PM_{2.5}$ concentrations at or above about 100 μg/m³, with exposure durations typically up to about two hours. Statistically significant effects on one or more indicators of cardiovascular function are often, though not always, reported following 2-hour exposures to average $PM_{2.5}$ concentrations at and above about 120 μg/m³, with less consistent evidence for effects following exposures to concentrations lower than 120 μg/m³. Impaired vascular function, the effect identified in the 2019 ISA as the most consistent across studies (U.S. EPA, 2019a, section 6.1.13.2) is shown following 2-hour exposures to $PM_{2.5}$ concentrations at and above 149 μg/m³. Mixed results are reported in the studies that evaluated longer exposure durations (*i.e.,* longer than 2 hours) and lower (*i.e.,* near-ambient) $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 3.3.3.1). For example, significant effects for some outcomes were reported following 5-hour exposures to 24 μg/m³ in Hemmingsen et al. (2015b), but not for other outcomes following 5-hour exposures to 24 μg/m³ in Hemmingsen et al. (2015a) and not following 24-hour exposures to 10.5 μg/m³ in Bräuner et al. (2008). Additionally, Wyatt et al. (2020) found significant effects for some cardiovascular (*e.g.,* systematic inflammation markers, cardiac repolarization, and decreased pulmonary function) effects following 4-hour exposures to 37.8 μg/m³ in healthy young participants (18–35 years, n=21) who were subject to intermittent moderate exercise. The higher ventilation rate and longer exposure duration in this study compared to most controlled human exposure studies is roughly equivalent to a 2-hour exposure of 75–100 μg/m³ of $PM_{2.5}$. Therefore, dosimetric considerations may explain the observed changes in inflammation in young healthy individuals. Though this study provides evidence of some effects at lower $PM_{2.5}$ concentrations, overall, there is inconsistent evidence for inflammation in other controlled human exposure studies evaluated in the 2019 ISA (U.S. EPA, 2019a, sections 5.1.7., 5.1.2.3.3, and 6.1.11.2.1; U.S. EPA, 2022a, section 3.3.1).

While controlled human exposure studies are important in establishing biological plausibility, it is unclear how the results from these studies alone and the importance of the effects observed in these studies, should be interpreted with respect to adversity to public health. More specifically, impaired vascular function can signal an intermediate effect along the potential biological pathways for cardiovascular effects following short-term exposure to $PM_{2.5}$ and show a role for exposure to $PM_{2.5}$ leading to potential worsening of IHD and heart failure followed potentially by ED visits, hospital admissions, or mortality (U.S. EPA, 2019a, section 6.1 and Figure 6–1). However, just observing the occurrence of impaired vascular function alone does not clearly suggest an adverse health outcome. Additionally, associated judgments regarding adversity or health significance of measurable physiological responses to air pollutants have been informed by guidance, criteria or interpretative statements developed within the public health community, including the American Thoracic Society (ATS) and the European Respiratory Society (ERS), which cooperatively updated the ATS 2000 statement *What Constitutes an Adverse Health Effect of Air Pollution* (ATS, 2000) with new scientific findings, including the evidence related to air pollution and the cardiovascular system (Thurston et al., 2017).[64] With regard to vascular function, the ATS/ERS statement considers the adversity of both chronic and acute reductions in endothelial function. While the ATS/ERS statement concluded that chronic endothelial and vascular dysfunction can be judged to be a biomarker of an adverse health effect from air pollution, they also conclude that ''the health relevance of acute reductions in endothelial function induced by air pollution is less certain'' (Thurston et al., 2017). This is particularly informative to our consideration of the controlled human exposure studies which are short-term in nature (*i.e.,* generally ranging from 2- to 5-hours), including those studies that are conducted at near-ambient $PM_{2.5}$ concentrations.

The 2022 PA also notes that it is important to recognize that controlled human exposure studies include a small number of individuals compared to epidemiologic studies. Additionally, these studies tend to include generally healthy adult individuals, who are at a lower risk of experiencing health effects.

[63] In contrast, controlled human exposure studies provide little evidence for respiratory effects following short-term $PM_{2.5}$ exposures (U.S. EPA, 2019a, section 5.1, Table 5–18). Therefore, this section focuses on cardiovascular effects evaluated in controlled human exposure studies of $PM_{2.5}$ exposure.

[64] The ATS/ERS described its 2017 statement as one ''intended to provide guidance to policymakers, clinicians and public health professionals, as well as others who interpret the scientific evidence on the health effects of air pollution for risk management purposes'' and further notes that ''considerations as to what constitutes an adverse health effect, in order to provide guidance to researchers and policymakers when new health effects markers or health outcome associations might be reported in future.'' The most recent policy statement by the ATS, which once again broadens its discussion of effects, responses and biomarkers to reflect the expansion of scientific research in these areas, reiterates that concept, conveying that it does not offer ''strict rules or numerical criteria, but rather proposes considerations to be weighed in setting boundaries between adverse and nonadverse health effects,'' providing a general framework for interpreting evidence that proposes a ''set of considerations that can be applied in forming judgments'' for this context (Thurston et al., 2017).

These studies, therefore, often do not include children, older adults, or individuals with pre-existing conditions. As such, these studies are somewhat limited in their ability to inform at what concentrations effects may be elicited in at-risk populations.

Nonetheless, to provide some insight into what these controlled human exposure studies may indicate regarding short-term exposure to peak $PM_{2.5}$ concentrations and how concentrations relate to ambient $PM_{2.5}$ concentrations, analyses in the 2022 PA (U.S. EPA, 2022b, Figure 2–19) examine monitored 2-hour $PM_{2.5}$ concentrations (the exposure window most often utilized in the controlled human exposure studies) at sites meeting the current primary $PM_{2.5}$ standards to evaluate the degree to which 2-hour ambient $PM_{2.5}$ concentrations at such locations are likely to exceed the 2-hour exposure concentrations in the controlled human exposure studies at which statistically significant effects are reported in multiple studies for one or more indicators of cardiovascular function. At sites meeting the current primary $PM_{2.5}$ standards, most 2-hour concentrations are below 10 $\mu g/m^3$, and almost never exceed 30 $\mu g/m^3$. The extreme upper end of the distribution of 2-hour $PM_{2.5}$ concentrations is shifted higher during the warmer months (April to September), generally corresponding to the period of peak wildfire frequency in the U.S. At sites meeting the current primary $PM_{2.5}$ standards, the highest 2-hour concentrations measured tend to occur during the period of peak wildfire frequency (*i.e.,* 99.9th percentile of 2-hour concentrations is 62 $\mu g/m^3$ during the warm season considered as a whole). Most of the sites measuring these very high concentrations are in the northwestern U.S. and California (U.S. EPA, 2022b, Appendix A, Figure A–1), where wildfires have been relatively common in recent years. When the typical fire season is excluded from the analysis, the extreme upper end of the distribution is reduced (*i.e.,* 99.9th percentile of 2-hour concentrations is 55 $\mu g/m^3$).[65] Given these results, the 2022 PA concludes that $PM_{2.5}$ exposure concentrations evaluated in most of these controlled human exposure studies are well-above the 2-hour ambient $PM_{2.5}$ concentrations typically measured in locations meeting the current primary standards.

With respect to animal toxicological studies, the 2019 ISA relies on animal toxicological studies to support the plausibility of a wide range of $PM_{2.5}$-related health effects. While animal toxicological studies often examine more severe health outcomes and longer exposure durations than controlled human exposure studies, there is uncertainty in extrapolating the effects seen in animals, and the $PM_{2.5}$ exposures and doses that cause those effects, to human populations. The 2022 PA considers these uncertainties when evaluating what the available animal toxicological studies may indicate with regard to the current primary $PM_{2.5}$ standards.

As with controlled human exposure studies, most animal toxicological studies evaluated in the 2019 ISA have examined effects following exposure to $PM_{2.5}$ well above the concentrations likely to be allowed by the current $PM_{2.5}$ standards. Such studies have generally examined short-term exposures to $PM_{2.5}$ concentrations ranging from 100 to >1,000 $\mu g/m^3$ and long-term exposures to concentrations from 66 to >400 $\mu g/m^3$ (*e.g.,* see U.S. EPA, 2019a, Table 1–2). Two exceptions are animal toxicological studies reporting impaired lung development following long-term exposures (*i.e.,* 24 hours per day for several months prenatally and postnatally) to an average $PM_{2.5}$ concentration of 16.8 $\mu g/m^3$ (Mauad et al., 2008) and increased carcinogenic potential following long-term exposures (*i.e.,* 2 months) to an average $PM_{2.5}$ concentration of 17.7 $\mu g/m^3$ (Cangerana Pereira et al., 2011). These two studies report serious effects following long-term exposures to $PM_{2.5}$ concentrations similar to the ambient concentrations reported in some $PM_{2.5}$ epidemiologic studies (U.S. EPA, 2019a, Table 1–2), though still above the ambient concentrations likely to occur in areas meeting the current primary $PM_{2.5}$ standards. However, noting uncertainty in extrapolating the effects seen in animals, and the $PM_{2.5}$ exposures and doses that cause those effects to human populations, animal toxicological studies are of limited utility in informing decisions on the public health protection provided by the current or alternative primary $PM_{2.5}$ standards. Therefore, the animal toxicological studies are most useful in providing further evidence to support the biological mechanisms and plausibility of various adverse effects.

ii. Ambient $PM_{2.5}$ Concentrations in Locations of Epidemiologic Studies

As summarized in section II.A.2.a above, epidemiologic studies examining associations between daily or annual average $PM_{2.5}$ exposures and mortality or morbidity represent a large part of the evidence base supporting several of the 2019 ISA's ''causal'' and ''likely to be causal'' determinations. The 2022 PA considers the ambient $PM_{2.5}$ concentrations present in areas where epidemiologic studies have evaluated associations with mortality or morbidity, and what such concentrations may indicate regarding the adequacy of the primary $PM_{2.5}$ standards. The use of information from epidemiologic studies to inform conclusions on the primary $PM_{2.5}$ standards is complicated by the fact that such studies evaluate associations between distributions of ambient $PM_{2.5}$ and health outcomes, and do not identify the specific exposures that can lead to the reported effects. Rather, health effects can occur over the entire distribution of ambient $PM_{2.5}$ concentrations evaluated, and epidemiologic studies conducted to date do not identify a population-level threshold below which it can be concluded with confidence that $PM_{2.5}$-associated health effects do not occur. Therefore, the 2022 PA evaluates the $PM_{2.5}$ air quality distributions over which epidemiologic studies support health effect associations (U.S. EPA, 2022b, section 3.3.3.2). In the absence of discernible thresholds, the 2022 PA considers the study-reported ambient $PM_{2.5}$ concentrations reflecting estimated exposure with a focus around the middle portion of the $PM_{2.5}$ air quality distribution, where the bulk of the observed data reside and which provides the strongest support for reported health effect associations. The section below, as well as in more detail in section II.B.3.b.i of the proposal (88 FR 5594, January 27, 2023), describes the consideration of the key epidemiologic studies and observations from these studies, as evaluated in the 2022 PA (U.S. EPA, 2022b, section 3.3.3.2).

As an initial matter, in considering the $PM_{2.5}$ air quality distributions associated with mortality or morbidity in the key epidemiologic studies, the 2022 PA recognizes that in previous reviews, the decision framework used to judge adequacy of the existing $PM_{2.5}$ standards, and what levels of any potential alternative standards should be considered, placed significant weight on epidemiologic studies that assessed associations between $PM_{2.5}$ exposure and health outcomes that were most strongly supported by the body of scientific evidence. In doing so, the decision framework recognized that while there is no specific point in the air quality distribution of any

[65] Similar analyses of 4-hour and 5-hour $PM_{2.5}$ concentrations are presented in Appendix A, Figure A–2 and Figure A–3, respectively of the 2022 PA (U.S. EPA, 2022b).

epidemiologic study that represents a ''bright line'' at and above which effects have been observed and below which effects have not been observed, there is significantly greater confidence in the magnitude and significance of observed associations for the part of the air quality distribution corresponding to where the bulk of the health events in each study have been observed, generally at or around the mean concentration. This is the case both for studies of daily $PM_{2.5}$ exposures and for studies of annual average $PM_{2.5}$ exposures (U.S. EPA, 2022b, section 3.3.3.2.1).

As discussed further in the 2022 PA, studies of daily $PM_{2.5}$ exposures examine associations between day-to-day variation in $PM_{2.5}$ concentrations and health outcomes, often over several years (U.S. EPA, 2022b, section 3.3.3.2.1). While there can be considerable variability in daily exposures over a multi-year study period, most of the estimated exposures reflect days with ambient $PM_{2.5}$ concentrations around the middle of the air quality distributions examined (*i.e.,* ''typical'' days rather than days with extremely high or extremely low concentrations). Similarly, for studies of annual $PM_{2.5}$ exposures, most of the health events occur at estimated exposures that reflect annual average $PM_{2.5}$ concentrations around the middle of the air quality distributions examined. In both cases, epidemiologic studies provide the strongest support for reported health effect associations for this middle portion of the $PM_{2.5}$ air quality distribution, which corresponds to the bulk of the underlying data, rather than the extreme upper or lower ends of the distribution. Consistent with this, as noted in the 2022 PA (U.S. EPA, 2022b, section 3.3.1.1), several epidemiologic studies report that associations persist in analyses that exclude the upper portions of the distributions of estimated $PM_{2.5}$ exposures, indicating that ''peak'' $PM_{2.5}$ exposures are not disproportionately responsible for reported health effect associations.

Thus, in considering $PM_{2.5}$ air quality data from epidemiologic studies, consistent with approaches in the 2012 and 2020 reviews (78 FR 3161, January 15, 2013; U.S. EPA, 2011, sections 2.1.3 and 2.3.4.1; 85 FR 82716–82717, December 18, 2020; U.S. EPA, 2020b, sections 3.1.2 and 3.2.3), the 2022 PA evaluates study-reported means (or medians) of daily and annual average $PM_{2.5}$ concentrations as indicators for the middle portions of the air quality distributions, over which studies generally provide strong support for reported associations and for which confidence in the magnitude and significance of associations observed in the epidemiologic studies is greatest (78 FR 3101, January 15, 2013). In addition to the overall study means, the 2022 PA also focuses on concentrations somewhat below the means (*e.g.,* 25th and 10th percentiles), when such information is available from the epidemiologic studies, which again is consistent with approaches used in previous reviews. In so doing, the 2022 PA notes, as in previous reviews, that a relatively small portion of the health events are observed in the lower part of the air quality distribution and confidence in the magnitude and significance of the associations begins to decrease in the lower part of the air quality distribution. Furthermore, consistent with past reviews, there is no single percentile value within a given air quality distribution that is most appropriate or ''correct'' to use to characterize where our confidence in associations becomes appreciably lower. However, and as detailed further in the 2022 PA, the range from the 25th to 10th percentiles is a reasonable range to consider as a region where there is appreciably less confidence in the associations observed in epidemiologic studies compared to the means (U.S. EPA, 2022b, p. 3–69).[66]

In evaluating the overall study-reported means, and concentrations somewhat below the means from epidemiologic studies, the 2022 PA focuses on the form, averaging time and level of the current primary annual $PM_{2.5}$ standard. Consistent with the approaches used in the 2012 and 2020 reviews (78 FR 3161–3162, January 15, 2013; 85 FR 82716–82717, December 18, 2020), the annual standard has been utilized as the primary means of providing public health protection against the bulk of the distribution of short- and long-term $PM_{2.5}$ exposures. Thus, the evaluation of the study-reported mean concentrations from key epidemiologic studies lends itself best to evaluating the adequacy of the annual $PM_{2.5}$ standard (rather than the 24-hour standard with its 98th percentile form). This is true for the study-reported means from both long-term and short-term exposure epidemiologic studies, recognizing that the overall mean $PM_{2.5}$ concentrations reported in studies of short-term (24-hour) exposures reflect averages across the study population and over the years of the study. Thus, mean concentrations from short-term exposure studies reflect long-term averages of 24-hour $PM_{2.5}$ exposure estimates. In this manner, the examination of study-reported means in key epidemiologic studies in the 2022 PA aims to evaluate the protection provided by the annual $PM_{2.5}$ standard against the exposures where confidence is greatest for associations with mortality and morbidity. In addition, the protection provided by the annual standard is evaluated in conjunction with that provided by the 24-hour standard, with its 98th percentile form, which aims to provide supplemental protection against the short-term exposures to peak $PM_{2.5}$ concentrations that can occur in areas with strong contributions from local or seasonal sources, even when overall ambient mean $PM_{2.5}$ concentrations in an area remain relatively low.

In focusing on the annual standard, and in evaluating the range of study-reported exposure concentrations for which the strongest support for adverse health effects exists, the 2022 PA examines exposure concentrations in key epidemiologic studies to determine whether the current primary annual $PM_{2.5}$ standard provides adequate protection against these exposure concentrations. This means, as in past reviews, application of a decision framework based on assessing means reported in key epidemiologic studies must also consider how the study means were computed and how these values compare to the annual standard metric (including the level, averaging time and form) and the use of the monitor with the highest $PM_{2.5}$ design value in an area for compliance. In the 2012 review, it was recognized that the key epidemiologic studies computed the study mean using an average across monitor-based $PM_{2.5}$ concentrations. As such, the Agency noted that this decision framework applied an approach of using maximum monitor concentrations to determine compliance with the standard, while selecting the standard level based on consideration of composite monitor concentrations. Further, the Agency included analyses (Hassett-Sipple et al., 2010; Frank, 2012) that examined the differences in these two metrics (*i.e.,* maximum monitor concentrations and composite monitor concentrations) across the U.S. and in areas included in the key epidemiologic studies and found that the maximum design value in an area was generally higher than the monitor average across that area, with the difference varying

[66] As detailed in the 2011 PA, we note the interrelatedness of the distributional statistics and a range of one standard deviation around the mean which represents approximately 68% of normally distributed data, and in that one standard deviation below the mean falls between the 25th and 10th percentiles (U.S. EPA, 2011, p. 2–71; U.S. EPA, 2005, p. 5–22).

based on location and concentration. This information was taken into account in the Administrator's final decision in selecting a level for the primary annual $PM_{2.5}$ standard the 2012 review and discussed more specifically in her considerations on adequate margin of safety.

Consistent with the approach taken in 2012, in assessing how the overall mean (or median) $PM_{2.5}$ concentrations reported in key epidemiologic studies can inform conclusions on the primary annual $PM_{2.5}$ standard, the 2022 PA notes that the relationship between mean $PM_{2.5}$ concentrations and the area design value continues to be an important consideration in evaluating the adequacy of the current or potential alternative annual $PM_{2.5}$ standard levels in this reconsideration. In a given area, the area design value is based on the monitor in an area with the highest $PM_{2.5}$ concentrations and is used to determine compliance with the standard. The highest $PM_{2.5}$ concentrations spatially distributed in the area would generally occur at or near the area design value monitor and the distribution of $PM_{2.5}$ concentrations would generally be lower in other locations and at monitors in that area. As such, when an area is meeting a specific annual standard level, the annual average exposures in that area are expected to be at concentrations lower than that level and the average of the annual average exposures across that area are expected (*i.e.,* a metric similar to the study-reported mean values) to be lower than that level.[67]

Another important consideration is that there are a substantial number of different types of epidemiologic studies available since the 2012 review, included in both the 2019 ISA and the ISA Supplement, that make understanding the relationship between the mean $PM_{2.5}$ concentrations and the area design value even more important (U.S. EPA, 2019a; U.S. EPA, 2022a). While the key epidemiologic studies in the 2012 review were all monitor-based studies, the newer studies include hybrid modeling approaches, which have emerged in the epidemiologic literature as an alternative to approaches that only use ground-based monitors to estimate exposure. As assessed in the 2019 ISA and ISA Supplement, a substantial number of epidemiologic studies used hybrid model-based methods in evaluating associations between $PM_{2.5}$ exposure and health effects (U.S. EPA, 2019a; U.S. EPA, 2022a). Hybrid model-based studies employ various fusion techniques that combine ground-based monitored data with air quality modeled estimates and/or information from satellites to estimate $PM_{2.5}$ exposures.[68] Additionally, hybrid modeling approaches tend to broaden the areas captured in the exposure assessment, and in so doing, tend to report lower mean $PM_{2.5}$ concentrations than monitor-based approaches because they include more suburban and rural areas where concentrations are lower. While these studies provide a broader estimation of $PM_{2.5}$ exposures compared to monitor-based studies (*i.e.,* $PM_{2.5}$ concentrations are estimated in areas without monitors), the hybrid modeling approaches result in study-reported means that are more difficult to relate to the annual standard metric and to the use of maximum monitor design values to assess compliance. In addition, and to further complicate the comparison, when looking across these studies, variations exist in how exposure is estimated between such studies, which in turn affects how the study means are calculated. Two important variations across studies include: (1) Variability in spatial scale used (*i.e.,* averages computed across the nation (or large portions of the country) versus a focus on only CBSAs) and (2) variability in exposure assignment methods (*i.e.,* averaging across all grid cells [non-population weighting], averaging across a scaled-up area like a ZIP code [aspects of population weighting applied], and/or applying population weighting). To elaborate further on the variability in exposure assignment methods, studies that use hybrid modeling approaches can estimate $PM_{2.5}$ concentrations at different spatial resolutions, including at 1 km x 1 km grid cells, at 12 km x 12 km grid cells, or at the census tract level. Mean reported $PM_{2.5}$ concentrations can then be estimated either by averaging up to a larger spatial resolution that corresponds to the spatial resolution for which health data exists (*e.g.,* ZIP code level) and therefore apply aspects of population weighting. These values are then averaged across all study locations at the larger spatial resolution (*e.g.,* averaged across all ZIP codes in the study) over the study period, resulting in the study-reported mean 24-hour average or average annual $PM_{2.5}$ concentration. Other studies that use hybrid modeling methods to estimate $PM_{2.5}$ concentrations may use each grid cell to calculate the study-reported mean 24-hour average or average annual $PM_{2.5}$ concentration. As such, these types of studies do not apply population weighting in their mean concentrations. In studies that use each grid cell to report a mean $PM_{2.5}$ concentration and do not apply aspects of population weighting, the study mean may not reflect the exposure concentrations used in the epidemiologic study to assess the reported association. The impact of the differences in methods is an important consideration when comparing mean concentrations across studies (U.S. EPA, 2022b, section 3.3.3.2.1). Thus, the 2022 PA also considers the methods used to estimate $PM_{2.5}$ concentrations, which vary from traditional methods using monitoring data from ground-based monitors[69] to those using more complex hybrid modeling approaches and how these methods calculate the study-reported mean $PM_{2.5}$ concentration.[70]

Given the emergence of the hybrid model-based epidemiologic studies since the 2012 review, the 2022 PA explores the relationship between the approaches used in these studies to estimate $PM_{2.5}$ concentrations and the impact that the different methods have on the study-reported mean $PM_{2.5}$ concentrations. The 2022 PA further seeks to understand how the approaches and resulting mean concentrations compare across studies, as well as what the resulting mean values represent relative to the annual standard. In so doing, the 2022 PA presents analyses that compare the area annual design values, composite monitor $PM_{2.5}$ concentrations, and mean concentrations from two hybrid modeling approaches, including evaluation of the means when population weighting is applied and when population weighting is not

[67] In setting a standard level that would require the design value monitor to meet a level equal to the study-reported mean $PM_{2.5}$ concentrations would generally result in lower concentrations of $PM_{2.5}$ across the entire area, such that even those people living near an area design value monitor (where PM concentrations are generally highest) will be exposed to $PM_{2.5}$ concentrations below the air quality conditions reported in the epidemiologic studies.

[68] More detailed information about hybrid model methods and performance is described in section 2.3.3.2 of the 2022 PA (U.S. EPA, 2022b).

[69] In those studies that use ground-based monitors alone to estimate long- or short-term $PM_{2.5}$ concentrations, approaches include: (1) $PM_{2.5}$ concentrations from a single monitor within a city/county; (2) average of $PM_{2.5}$ concentrations across all monitors within a city/county or other defined study area (*e.g.,* CBSA); or (3) population-weighted averages of exposures. Once the study location average $PM_{2.5}$ concentration is calculated, the study-reported long-term average is derived by averaging daily/annual $PM_{2.5}$ concentrations across all study locations over the entire study period.

[70] Detailed information on the methods by which mean $PM_{2.5}$ concentrations are calculated in key monitor- and hybrid model-based U.S. and Canadian epidemiologic studies are presented in Tables 3–6 through 3–9 in the 2022 PA (U.S. EPA, 2022b).

applied (U.S. EPA, 2022b, section 2.3.3.1).

In the air quality analyses comparing composite monitored $PM_{2.5}$ concentrations with annual $PM_{2.5}$ design values in U.S. CBSAs, maximum annual $PM_{2.5}$ design values were approximately 10% to 20% higher than annual average composite monitor concentrations (*i.e.,* averaged across multiple monitors in the same CBSA) (sections I.D.5.a above and U.S. EPA, 2022b, section 2.3.3.1, Figure 2–28 and Table 2–3). The difference between the maximum annual design value and average concentration in an area can be smaller or larger than this range (10–20%), depending on a variety of factors such as the number of monitors, monitor siting characteristics, the distribution of ambient $PM_{2.5}$ concentrations, and how the average concentrations are calculated (*i.e.,* averaged across monitors versus across modeled grid cells). Results of this analysis suggest that there will be a distribution of concentrations across an area and the maximum annual average monitored concentration in an area (at the design value monitor, used for compliance with the standard), will generally be 10–20% higher than the average $PM_{2.5}$ concentration across the other monitors in the area. Thus, in considering how the annual standard levels would relate to the study-reported means from key monitor-based epidemiologic studies, the 2022 PA generally concludes that an annual standard level that is no more than 10–20% higher than monitor-based study-reported mean $PM_{2.5}$ concentrations would generally maintain air quality exposures to be below those associated with the study-reported mean $PM_{2.5}$ concentrations, exposures for which the strongest support for adverse health effects occurring is available.

The 2022 PA also evaluates data from two hybrid modeling approaches (DI2019 and HA2020) that have been used in several recent epidemiologic studies (U.S. EPA, 2022b, section 2.3.3.2.4).[71] The analysis shows that the means differ when $PM_{2.5}$ concentrations are estimated in urban areas only (CBSAs) versus when the averages were calculated with all or most grid cells nationwide, likely because areas included outside of CBSAs tend to be more rural and have lower estimated $PM_{2.5}$ concentrations. The 2022 PA recognizes the importance of this variability in the means since the study areas included in the calculation of the mean, and more specifically whether a study is focused on nationwide, regional, or urban areas, will affect the calculation of the study mean based on how many rural areas, with lower estimated $PM_{2.5}$ concentrations, are included in the study area. While the determination of what spatial scale to use to estimate $PM_{2.5}$ concentrations does not inherently affect the quality of the epidemiologic study, the spatial scale can influence the calculated reported long-term mean concentration across the study area and period. The results of the analysis show that, regardless of the hybrid modeling approach assessed, the annual average $PM_{2.5}$ concentrations in CBSA-only analyses are 4–8% higher than for nationwide analyses, likely as a result of higher $PM_{2.5}$ concentrations in more densely populated areas, and exclusion of more rural areas (U.S. EPA, 2022b, Table 2–4). When evaluating comparisons between surfaces that estimate exposure using aspects of population weighting versus surfaces that do not calculate means using population weighting, surfaces that calculate long-term mean $PM_{2.5}$ concentrations with population-weighted averages have higher average annual $PM_{2.5}$ concentrations, compared to annual $PM_{2.5}$ concentrations in analyses that do not apply population weighting.[72] Analyses show that average maximum annual design values are 40 to 50% higher when compared to annual average $PM_{2.5}$ concentrations estimated without population weighting versus 15% to 18% higher when compared to average annual $PM_{2.5}$ concentrations estimated with population weighting applied (similar to the differences observed for the composite monitor comparison values for the monitor-based epidemiologic studies) (U.S. EPA, 2022b, section 2.3.3.2.4). Given these results, it is worth noting that for the studies using the hybrid modeling approaches, the choice of methodology employed in calculating the study-reported means (*i.e.,* using population weighting or not), and not a difference in estimates of exposure in the study itself, can produce substantially different study-reported mean values, where approaches that do not apply population weighting leading to much lower estimated mean $PM_{2.5}$ concentrations.

Based on these results, and similar to conclusions for the monitor-based studies, the 2022 PA generally concludes that study-reported mean concentrations in the studies that employ hybrid modeling approaches and calculate a population-weighted mean are associated with air quality conditions that would be achieved by meeting annual standard levels that are 15–18% higher than study-reported means. Therefore, an annual standard level that is no more than 15–18% higher than the study-reported means would generally maintain air quality exposures to be below those associated with the study-reported mean $PM_{2.5}$ concentrations, exposures for which we have the strongest support for adverse health effects occurring. For the studies that utilize hybrid modeling approaches but do not incorporate population weighting in calculating the mean, the annual design values associated with these air quality conditions are expected to be much higher (*i.e.,* 40–50% higher) and this larger difference makes it more difficult to consider how these studies can be used to determine the adequacy of the protection afforded by the current or potential alternative annual standards. Additionally, as noted above in studies that utilize hybrid modeling approaches and that do not incorporate population weighting in calculating the mean (*e.g.,* use each grid cell to calculate a mean $PM_{2.5}$ concentration), the study mean does not reflect the exposure concentrations used in the epidemiologic study to assess the reported association.

The 2022 PA notes that while these analyses can be useful to informing the understanding of the relationship between study-reported mean concentrations and the level of the annual standard, some limitations of this analysis must be recognized (U.S. EPA, 2022a, section 3.3.3.2.1). First, the comparisons used only two hybrid modeling approaches. Although these two hybrid modeling surfaces have been used in a number of recent epidemiologic studies, they represent just two of the many hybrid modeling approaches that have been used in epidemiologic studies to estimate $PM_{2.5}$ concentrations. These methods continue to evolve, with further development and improvement to prediction models that estimate $PM_{2.5}$ concentrations in epidemiologic studies. In addition to differences in hybrid modeling approaches, epidemiologic studies also use different methods to assign a population weighted average $PM_{2.5}$ concentration to their study population, and the assessment presented in the

[71] More details on the evaluation of the two hybrid modeling approaches is provided in section 2.3.3.2.4 of the 2022 PA (U.S. EPA, 2022b).

[72] The annual $PM_{2.5}$ concentrations for the population-weighted averages ranged from 8.2–10.2 $\mu g/m^3$, while those that do not apply population weighting ranged from 7.0–8.6 $\mu g/m^3$. Average maximum annual design values ranged from 9.5 to 11.7 $\mu g/m^3$.

2022 PA does not evaluate all of the potential methods that could be used.

Additionally, while some of these epidemiologic studies also provide information on the broader distributions of exposure estimates and/or health events and the $PM_{2.5}$ concentrations corresponding to the lower percentiles of those data (*e.g.,* 25th and/or 10th), the air quality analysis in the 2022 PA focuses on mean $PM_{2.5}$ concentrations and a similar comparison for lower percentiles of data was not assessed. Therefore, any direct comparison of study-reported $PM_{2.5}$ concentrations corresponding to lower percentiles and annual design values is more uncertain than such comparisons with the mean. Finally, air quality analysis presented in the 2022 PA and detailed above in section I.D.5 included two hybrid modeling-based approaches that used U.S.-based air quality information for estimating $PM_{2.5}$ concentrations. As such, the analyses are most relevant to interpreting the study-reported mean concentrations from U.S. epidemiologic studies and do not provide additional information about how the mean exposures concentrations reported in epidemiologic studies in other countries would compare to annual design values observed in the U.S. In addition, while information from Canadian studies can be useful in assessing the adequacy of the annual standard, differences in the exposure environments and population characteristics between the U.S. and other countries can affect the study-reported mean value and its relationship with the annual standard level. Sources and pollutant mixtures, as well as $PM_{2.5}$ concentration gradients, may be different between countries, and the exposure environments in other countries may differ from those observed in the U.S. Furthermore, differences in population characteristics and population densities can also make it challenging to directly compare studies from countries outside of the U.S. to a design value in the U.S.

As with the experimental studies discussed above, the 2022 PA focuses on epidemiologic studies assessed in the 2019 ISA and ISA Supplement that have the potential to be most informative in reaching decisions on the adequacy of the primary $PM_{2.5}$ standards. The 2022 PA focuses on epidemiologic studies that provide strong support for ''causal'' or ''likely to be causal'' relationships with $PM_{2.5}$ exposures in the 2019 ISA. Further, the 2022 PA also focuses on the health effect associations that are determined in the 2019 ISA and ISA Supplement to be consistent across studies, coherent with the broader body of evidence (*e.g.,* including animal and controlled human exposure studies), and robust to potential confounding by co-occurring pollutants and other factors.[73] In particular the 2022 PA considers the U.S. and Canadian epidemiologic studies to be more useful for reaching conclusions on the current standards than studies conducted in other countries, given that the results of the U.S. and Canadian studies are more directly applicable for quantitative considerations, whereas studies conducted in other countries reflect different populations, exposure characteristics, and air pollution mixtures. Additionally, epidemiologic studies outside of the U.S. and Canada generally reflect higher $PM_{2.5}$ concentrations in ambient air than are currently found in the U.S., and are less relevant to informing questions about adequacy of the current standards.[74] However, and as noted above, the 2022 PA also recognizes that while information from Canadian studies can be useful in assessing the adequacy of the annual standard, there are still important differences between the exposure environments in the U.S. and Canada and interpreting the data (*e.g.,* mean concentrations) from the Canadian studies in the context of a U.S.-based standard may present challenges in directly and quantitatively informing questions regarding the adequacy of the current or potential alternative the levels of the annual standard. Lastly, the 2022 PA emphasizes multicity/multistate studies that examine health effect associations, as such studies are more encompassing of the diverse atmospheric conditions and population demographics in the U.S. than studies that focus on a single city or State. Figures 3–4 through 3–7 in the 2022 PA summarize the study details for the key U.S. and Canadian epidemiologic studies (U.S. EPA, 2022b, section 3.3.3.2.1).[75]

The key epidemiologic studies identified in the 2022 PA indicate generally positive and statistically significant associations between estimated $PM_{2.5}$ exposures (short- or long-term) and mortality or morbidity across a range of ambient $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 3.3.3.2.1), report overall mean (or median) $PM_{2.5}$ concentrations, and include those for which the years of $PM_{2.5}$ air quality data used to estimate exposures overlap entirely with the years during which health events are reported.[76] Additionally, for studies that estimate $PM_{2.5}$ exposure using hybrid modeling approaches, the 2022 PA also considers the approach used to estimate $PM_{2.5}$ concentrations and the approach used to validate hybrid model predictions when evaluating those studies as key epidemiologic studies[77] and focuses on those studies that use recent methods based on surfaces that are with fused with monitored $PM_{2.5}$

[73] As described in the Preamble to the ISAs (U.S. EPA, 2015), ''the U.S. EPA emphasizes the importance of examining the pattern of results across various studies and does not focus solely on statistical significance or the magnitude of the direction of the association as criteria of study reliability. Statistical significance is influenced by a variety of factors including, but not limited to, the size of the study, exposure and outcome measurement error, and statistical model specifications. Statistical significance may be informative; however, it is just one of the means of evaluating confidence in the observed relationship and assessing the probability of chance as an explanation. Other indicators of reliability such as the consistency and coherence of a body of studies as well as other confirming data may be used to justify reliance on the results of a body of epidemiologic studies, even if results in individual studies lack statistical significance. Traditionally, statistical significance is used to a larger extent to evaluate the findings of controlled human exposure and animal toxicological studies. Understanding that statistical inferences may result in both false positives and false negatives, consideration is given to both trends in data and reproducibility of results. Thus, in drawing judgments regarding causality, the U.S. EPA emphasizes statistically significant findings from experimental studies, but does not limit its focus or consideration to statistically significant results in epidemiologic studies.''

[74] This emphasis on studies conducted in the U.S. or Canada is consistent with the approach in the 2012 and 2020 reviews of the PM NAAQS (U.S. EPA, 2011, section 2.1.3; U.S. EPA, 2020b, section 3.2.3.2.1) and with approaches taken in other NAAQS reviews. However, the importance of studies in the U.S., Canada, and other countries in informing an ISA's considerations of the weight of the evidence that informs causality determinations is recognized.

[75] The cohorts examined in the studies included in Figure 3–4 to Figure 3–7 of the 2022 PA include large numbers of individuals in the general population, and often also include those populations identified as at-risk (*i.e.,* children, older adults, minority populations, and individuals with pre-existing cardiovascular and respiratory disease).

[76] For some studies of long-term $PM_{2.5}$ exposures, exposure is estimated from air quality data corresponding to only part of the study period, often including only the later years of the health data, and are not likely to reflect the full ranges of ambient $PM_{2.5}$ concentrations that contributed to reported associations. While this approach can be reasonable in the context of an epidemiologic study that is evaluating health effect associations with long-term $PM_{2.5}$ exposures, under the assumption that spatial patterns in $PM_{2.5}$ concentrations are not appreciably different during time periods for which air quality information is not available (*e.g.,* Chen et al., 2016), the 2022 PA focuses on the distribution of ambient $PM_{2.5}$ concentrations that could have contributed to reported health outcomes. Therefore, the 2022 PA identifies studies as key epidemiologic studies when the years of air quality data and health data overlap in their entirety.

[77] Such studies are identified as those that use hybrid modeling approaches for which recent methods and models were used (*e.g.,* recent versions and configurations of the air quality models); studies that are fused with $PM_{2.5}$ data from national monitoring networks (*i.e.,* FRM/FEM data); and studies that reported a thorough model performance evaluation for core years of the study.

concentration data (U.S. EPA, 2022b, section 3.3.3.2.1).

Figure 1 below (U.S. EPA, 2022b, Figure 3–8) highlights the overall mean (or median) $PM_{2.5}$ concentrations reported in key U.S. studies that use ground-based monitors alone to estimate long- or short-term $PM_{2.5}$ exposure.[78] For the small subset of studies with available information on the broader distributions of underlying data, Figure 1 below also identifies the study-period $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of health events[79] (see Appendix B, Section B.2 of the 2022 PA for more information). Figure 2 (U.S. EPA, 2022a, Figure 3–14) presents overall means of predicted $PM_{2.5}$ concentrations for key U.S. model-based epidemiologic studies that apply aspects of population-weighting, and the concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events[80] when available (see Appendix B, section B.3 for additional information).[81]

[78] Canadian studies that use ground-based monitors estimate long- or short-term $PM_{2.5}$ exposures are found in Figure 3–9 of the 2022 PA, including concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events, when available (U.S. EPA, 2022b).

[79] That is, 25% of the total health events occurred in study locations with mean $PM_{2.5}$ concentrations (*i.e.,* averaged over the study period) below the 25th percentiles identified in Figure 3–8 of the 2022 PA and 10% of the total health events occurred in study locations with mean $PM_{2.5}$ concentrations below the 10th percentiles identified.

[80] For most studies in Figure 2 below (Figure 3–14 in the 2022 PA), 25th percentiles of exposure estimates are presented. The exception is Di et al. (2017b), for which Figure 2 (U.S. EPA, 2022b, Figure 3–14) presents the short-term $PM_{2.5}$ exposure estimates corresponding to the 25th and 10th percentiles of deaths in the study population (*i.e.,* 25% and 10% of deaths occurred at concentrations below these concentrations). In addition, the authors of Di et al. (2017b) provided population-weighted exposure values. The 10th and 25th percentiles of these population-weighted exposure estimates are 7.9 and 9.5 $\mu g/m^3$, respectively.

[81] Overall mean (or median) $PM_{2.5}$ concentrations reported in key Canadian studies that use model-based approaches to estimate long- or short-term $PM_{2.5}$ concentrations and the concentrations corresponding to the 25th and 10th percentiles of estimated exposures or health events, when available are found in Figure 3–9 of the 2022 PA (U.S. EPA, 2022b).

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Figure 1. Monitor-based $PM_{2.5}$ Concentrations in Key U.S. Epidemiologic Studies. (Asterisks denote studies included in the ISA Supplement)

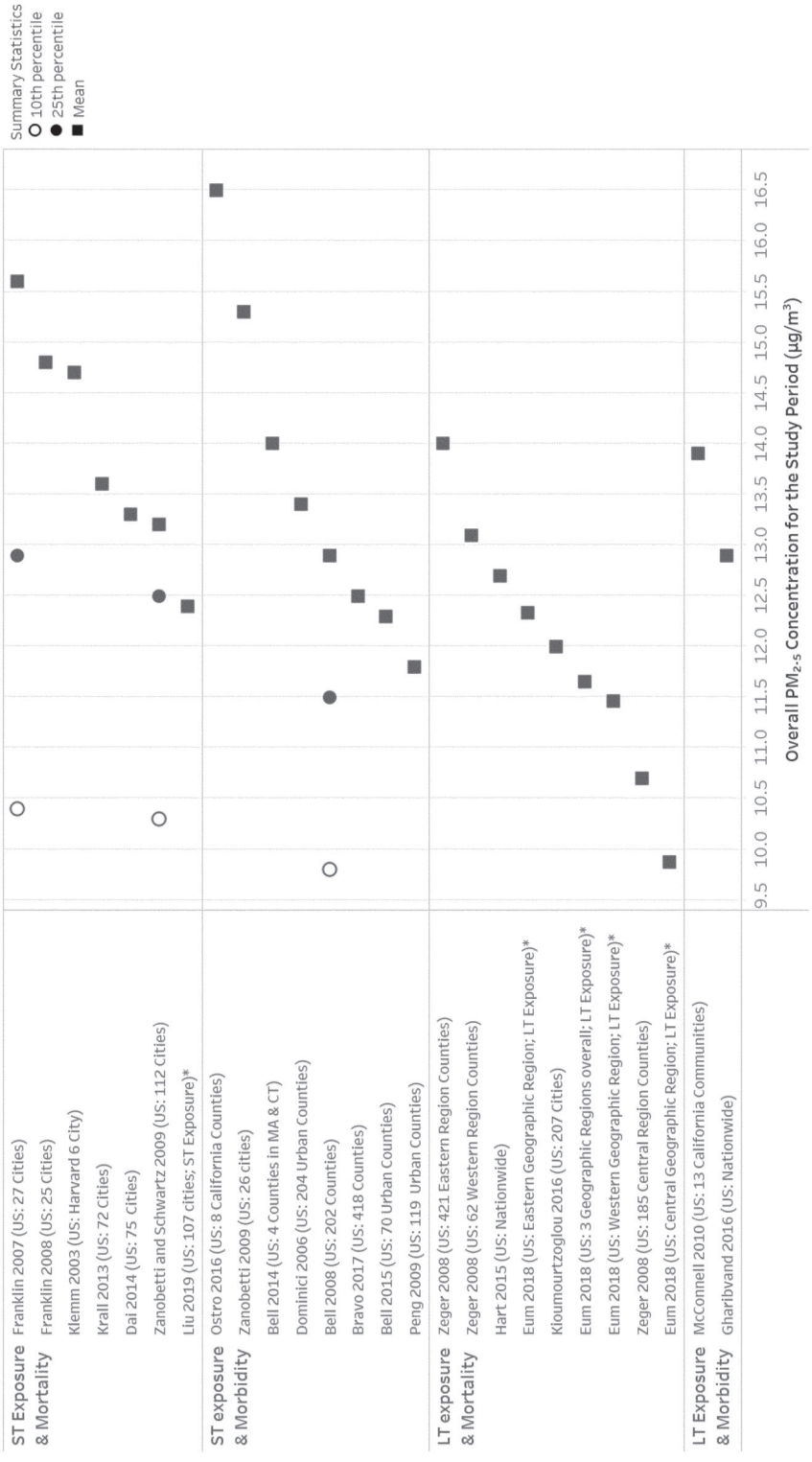
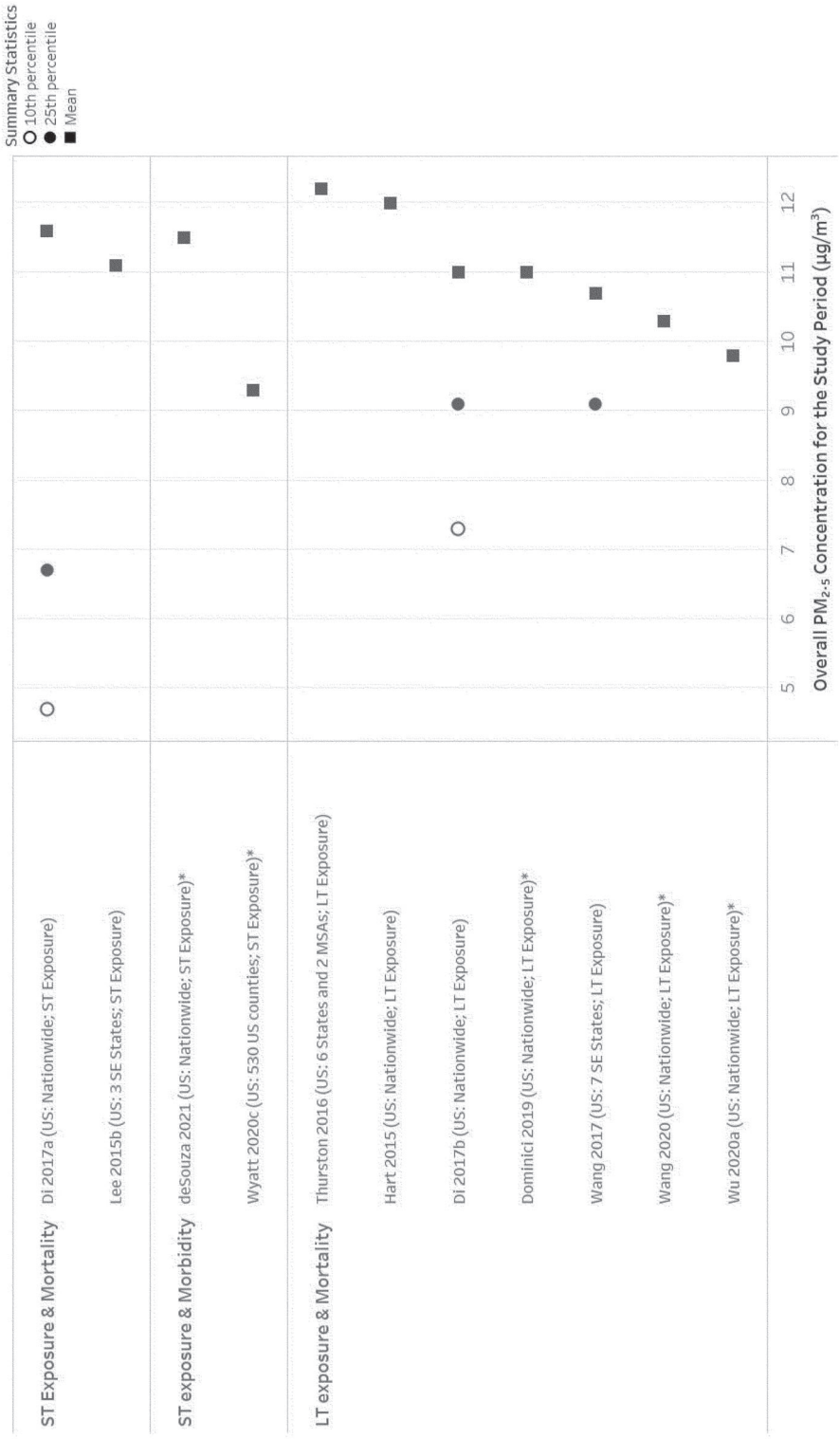


Figure 2. Hybrid Model-Predicted $PM_{2.5}$ Concentrations in Key U.S. Epidemiologic Studies that Apply Aspects of Population-Weighting. (Asterisks denote studies included in the ISA Supplement)



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Based on its evaluation of study-reported mean concentrations, the 2022 PA notes that key epidemiologic studies conducted in the U.S. or Canada report generally positive and statistically significant associations between estimated $PM_{2.5}$ exposures (short- or long-term) and mortality or morbidity across a wide range of ambient $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 3.3.3.2.1). The 2022 PA makes a number of observations with regard to the study-reported $PM_{2.5}$ concentrations in the key U.S. and Canadian epidemiologic studies.

The 2022 PA first considers the $PM_{2.5}$ concentrations from the key U.S. epidemiologic studies. For studies that use monitors to estimate $PM_{2.5}$ exposures, overall mean $PM_{2.5}$ concentrations range between 9.9 µg/m³ [82] to 16.5 µg/m³ (Figure 1 above and

[82] This is generally consistent with, but slightly below, the lowest study-reported mean $PM_{2.5}$ concentration from monitor-based studies available

Continued

U.S. EPA, 2022b, Figure 3–8). For key U.S. epidemiologic studies that use hybrid model-predicted exposures and apply aspects of population-weighting, mean $PM_{2.5}$ concentrations range from 9.3 μg/m³ to just above 12.2 μg/m³ (Figure 2 above and U.S. EPA, 2022b, Figure 3–14). In studies that average up from the grid cell level to the ZIP code, postal code, or census tract level, mean $PM_{2.5}$ concentrations range from 9.8 μg/m³ to 12.2 μg/m³. The one study that population-weighted the grid cell prior to averaging up to the ZIP code or census tract level reported mean $PM_{2.5}$ concentrations of 9.3 μg/m³. Based on air quality analyses noted above, these hybrid modelled epidemiologic studies are expected to report means similar to those from monitor-based studies.

Other key U.S. epidemiologic studies that use hybrid modeling approaches estimate mean $PM_{2.5}$ exposure by averaging each grid cell across the entire study area, whether that be the nation or a region of the country. These studies do not weight the estimated exposure concentrations based on population density or location of health events. As such, the study mean reported in these studies may not reflect the exposure concentrations used in the epidemiologic study to assess the reported association. As a result, these reported mean concentrations are the most different (and much lower) than the means reported in monitor-based studies. Due to the methodology employed in calculating the study-reported means and not necessarily a difference in estimates of exposure, these epidemiologic studies are expected to report some of the lowest mean values. For these studies, the reported mean $PM_{2.5}$ concentrations range from 8.1 μg/m³ to 11.9 μg/m³ (U.S. EPA, 2022b, Figure 3–14). As noted above, for studies that utilize hybrid modeling approaches but do not incorporate population weighting into the reported mean calculation, the associated annual design values would be expected to be much higher (*i.e.,* 40–50% higher) than the study-reported means. This larger difference between design values and study-reported mean concentrations makes it more difficult to consider how these studies can be used to determine the adequacy of the protection afforded by the current or potential alternative annual standards (U.S. EPA, 2022b, section 3.3.3.2.1).

In addition to the mean $PM_{2.5}$ concentrations, a subset of the key U.S. epidemiologic studies report $PM_{2.5}$ concentrations corresponding to the 25th and 10th percentiles of health data or exposure estimates to provide insight into the concentrations that comprise the lower quartile of the air quality distributions. In studies that use monitors to estimate $PM_{2.5}$ exposures, 25th percentiles of health events correspond to $PM_{2.5}$ concentrations (*i.e.,* averaged over the study period for each study city) at or above 11.5 μg/m³ and 10th percentiles of health events correspond to $PM_{2.5}$ concentrations at or above 9.8 μg/m³ (*i.e.,* 25% and 10% of health events, respectively, occur in study locations with $PM_{2.5}$ concentrations below these values) (Figure 1 above and U.S. EPA, 2022b, Figure 3–8). Of the key U.S. epidemiologic studies that use hybrid modeling approaches and apply population-weighting to estimate long-term $PM_{2.5}$ exposures, the ambient $PM_{2.5}$ concentrations corresponding to 25th percentiles of estimated exposures are 9.1 μg/m³ (Figure 2 and U.S. EPA, 2022b, Figure 3–14). In key U.S. epidemiologic studies that use hybrid modeling approaches and apply population-weighting to estimate short-term $PM_{2.5}$ exposures, the ambient concentrations corresponding to 25th percentiles of estimated exposures, or health events, are 6.7 μg/m³ (Figure 2 and U.S. EPA, 2022b, Figure 3–14). In key U.S. epidemiologic studies that use hybrid modeling approaches and do not apply population-weighting to estimate $PM_{2.5}$ exposures, the ambient concentrations corresponding to 25th percentiles of estimated exposures, or health events, range from 4.6 to 9.2 μg/m³ (U.S. EPA, 2022b, Figure 3–14).[83] In the key epidemiologic studies that apply hybrid modeling approaches with population-weighting and with information available on the 10th percentile of health events, the ambient $PM_{2.5}$ concentration corresponding to that 10th percentile range from 4.7 μg/m³ to 7.3 μg/m³ (Figure 2 and U.S. EPA, 2022b, Figure 3–14).

The 2022 PA next considers the $PM_{2.5}$ concentrations from the key Canadian epidemiologic studies. Generally, the study-reported mean concentrations in Canadian studies are lower than those reported in the U.S. studies for both monitor-based and hybrid model methods. For the majority of key Canadian epidemiologic studies that use monitor-based exposure, mean $PM_{2.5}$ concentrations generally ranged from 7.0 μg/m³ to 9.0 μg/m³ (U.S. EPA, 2022b, Figure 3–9). For these studies, 25th percentiles of health events correspond to $PM_{2.5}$ concentrations at or above 6.5 μg/m³ and 10th percentiles of health events correspond to $PM_{2.5}$ concentrations at or above 6.4 μg/m³ (U.S. EPA, 2022b, Figure 3–9). For the key Canadian epidemiologic studies that use hybrid model-predicted exposure, the mean $PM_{2.5}$ concentrations are generally lower than in U.S. model-based studies (U.S. EPA, 2022b, Figure 3–10), ranging from approximately 6.0 μg/m³ to just below 10.0 μg/m³ (U.S. EPA, 2022b, Figure 3–11). The majority of the key Canadian epidemiologic studies that used hybrid modeling were completed at the nationwide scale, while four studies were completed at the regional geographic spatial scale. In addition, all the key Canadian epidemiologic studies apply aspects of population weighting, where all grid cells within a postal code are averaged, individuals are assigned exposure at the postal code resolution, and study mean $PM_{2.5}$ concentrations are based on the average of individual exposures. The majority of studies estimating exposure nationwide range between just below 6.0 μg/m³ to 8.0 μg/m³ (U.S. EPA, 2022b, Figure 3–11). One study by Erickson et al. (2020) presents an analysis related immigrant status and length of residence in Canada versus non-immigrant populations, which accounts for the four highest mean $PM_{2.5}$ concentrations which range between 9.0 μg/m³ and 10.0 μg/m³ (U.S. EPA, 2022b, Figure 3–11). The four studies that estimate exposure at the regional scale report mean $PM_{2.5}$ concentrations that range from 7.8 μg/m³ to 9.8 μg/m³ (U.S. EPA, 2022b, Figure 3–11). Three key Canadian epidemiologic studies report information on the 25th percentile of health events. In these studies, the ambient $PM_{2.5}$ concentration corresponding to the 25th percentile is approximately 8.0 μg/m³ in two studies, and 4.3 μg/m³ in a third study (U.S. EPA, 2022b, Figure 3–11).

In addition to the expanded body of evidence from the key U.S. epidemiologic studies discussed above, there are also a subset of epidemiologic studies that have emerged that further inform an understanding of the relationship between $PM_{2.5}$ exposure and health effects, including studies with the highest exposures excluded (restricted analyses), epidemiologic studies that employed statistical approaches that attempt to more extensively account for confounders and are more robust to model misspecification (*i.e.,* used alternative

in the 2020 PA, which was 10.7 μg/m³ (U.S. EPA, 2020a, Figure 3–7).

[83] In the one study that reports 25th percentile exposure estimates of 4.6 μg/m³ (Shi et al., 2016), the authors report that most deaths occurred at or above the 75th percentile of annual exposure estimates (*i.e.,* 10 μg/m³). The short-term exposure estimates accounting for most deaths are not presented in the published study.

methods for confounder control),[84] and accountability studies (U.S. EPA, 2019a, U.S. EPA, 2021a, U.S. EPA, 2022a).

Restricted analyses are studies that examine health effect associations in analyses with the highest exposures excluded, restricting analyses to daily exposures less than the 24-hour primary $PM_{2.5}$ standard and annual exposures less than the annual $PM_{2.5}$ standard. The 2022 PA presents a summary of restricted analyses evaluated in the 2019 ISA and ISA Supplement (U.S. EPA, 2022b, Table 3–10). The restricted analyses can be informative in assessing the nature of the association between long-term exposures (*e.g.,* annual average concentrations <12.0 μg/m³) or short-term exposures (*e.g.,* daily concentrations <35 μg/m³) when looking only at exposures to lower concentrations, including whether the association persists in such restricted analyses compared to the same analyses for all exposures, as well as whether the association is stronger, in terms of magnitude and precision, than when completing the same analysis for all exposures. While these studies are useful in supporting the confidence and strength of associations at lower concentrations, these studies also have inherent uncertainties and limitations, including uncertainty in how studies exclude concentrations (*e.g.,* are they excluded at the modeled grid cell level, the ZIP code level) and in how concentrations in studies that restrict air quality data relate to design values for the annual and 24-hour standards. Further, these studies often do not report descriptive statistics (*e.g.,* mean $PM_{2.5}$ concentrations, or concentrations at other percentiles) that allow for additional consideration of this information. As such, while these studies can provide additional supporting evidence for associations at lower concentrations, the 2022 PA notes that there are also limitations in how to interpret these studies when evaluating the adequacy of the current or potential alternative standards.

Restricted analyses provide additional information on the nature of the association between long- or short-term exposures when analyses are restricted to lower $PM_{2.5}$ concentrations and indicate that effect estimates are generally greater in magnitude in the restricted analyses for long- and short-term $PM_{2.5}$ exposure compared to the main analyses. In two U.S. studies that report mean $PM_{2.5}$ concentrations in restricted analyses and that estimate effects associated with long-term exposure to $PM_{2.5}$, the effect estimates are greater in the restricted analyses than in the main analyses. Di et al. (2017a) and Dominici et al. (2019) report positive and statistically significant associations in analyses restricted to concentrations less than 12.0 μg/m³ for all-cause mortality and effect estimates are greater in the restricted analyses than effect estimates reported in main analyses. In addition, both studies report mean $PM_{2.5}$ concentrations of 9.6 μg/m³. While none of the U.S. studies of short-term exposure present mean $PM_{2.5}$ concentrations for the restricted analyses, these studies generally have mean 24-hour average $PM_{2.5}$ concentrations in the main analyses below 12.0 μg/m³, and report increases in the effect estimates in the restricted analyses compared to the main analyses. Additionally, in the one Canadian study of long-term $PM_{2.5}$ exposure, Zhang et al. (2021) conducted analyses where annual $PM_{2.5}$ concentrations were restricted to concentrations below 10.0 μg/m³ and 8.8 μg/m³, which presumably have lower mean concentrations than the mean of 7.8 μg/m³ reported in the main analyses, though restricted analysis mean $PM_{2.5}$ concentrations are not reported. Effect estimates for non-accidental mortality are greater in analyses restricted to $PM_{2.5}$ concentrations less than 10.0 μg/m³, but less in analyses restricted to <8.8 μg/m³.

The second type of studies that have recently emerged and further inform the consideration of the relationship between $PM_{2.5}$ exposure and health effects in the 2022 PA are those that employ alternative methods for confounder control. Alternative methods for confounder control seek to mimic randomized experiments through the use of study design and statistical methods to more extensively account for confounders and are more robust to model misspecification. The 2022 PA presents a summary of the studies that employ alternative methods for confounder control, and employ a variety of statistical methods, which are evaluated in the 2019 ISA and ISA Supplement (U.S. EPA, 2022b, Table 3–11). These studies reported consistent results among large study populations across the U.S. and can further inform the relationship between long- and short-term $PM_{2.5}$ exposure and total mortality. Studies that employ alternative methods for confounder control to assess the association between long-term exposure to $PM_{2.5}$ and mortality reduce uncertainties related to confounding and provide additional support for the associations reported in the broader body of cohort studies that examined long-term $PM_{2.5}$ exposure and mortality.

Lastly, there is a subset of epidemiologic studies that assess whether long-term reductions in ambient $PM_{2.5}$ concentrations result in corresponding reductions in health outcomes. These include studies that evaluate the potential for improvements in public health, including reductions in mortality rates, increases in life expectancy, and reductions in respiratory disease as ambient $PM_{2.5}$ concentrations have declined over time. Some of these studies, accountability studies, provide insight on whether the implementation of environmental policies or air quality interventions result in changes/reductions in air pollution concentrations and the corresponding effect on health outcomes.[85] The 2022 PA presents a summary of these studies, which are assessed in the 2019 ISA and ISA Supplement (U.S. EPA, 2022b, Table 3–12). These studies lend support for the conclusion that improvements in air quality are associated with improvements in public health.

More specifically, of the accountability studies that account for changes in $PM_{2.5}$ concentrations due to a policy or the implementation of an intervention and whether there was evidence of changes in associations with mortality or cardiovascular effects as a result of changes in annual $PM_{2.5}$ concentrations, Corrigan et al. (2018), Henneman et al. (2019) and Sanders et al. (2020a) present analyses with starting $PM_{2.5}$ concentrations (or concentrations prior to the policy or intervention) below 12.0 μg/m³. Henneman et al. (2019) explored changes in modeled $PM_{2.5}$ concentrations following the retirement of coal fired power plants in the U.S., and found that reductions from mean annual $PM_{2.5}$ concentrations of 10.0 μg/m³ in 2005 to mean annual $PM_{2.5}$ concentrations of 7.2 μg/m³ in 2012 from coal-fueled power plants resulted in corresponding reductions in the number of cardiovascular-related

[84] As noted in the ISA Supplement (U.S. EPA, 2022a, p. 1–3): ''In the peer-reviewed literature, these epidemiologic studies are often referred to as alternative methods for confounder control. For the purposes of this Supplement, this terminology is not used to prevent confusion with the main scientific conclusions (*i.e.,* the causality determinations) presented within an ISA. In addition, as is consistent with the weight-of-evidence framework used within ISAs and discussed in the Preamble to the Integrated Science Assessments, an individual study on its own cannot inform causality, but instead represents a piece of the overall body of evidence.''

[85] Given the nature of these studies, the majority tend to focus on time periods in the past during which ambient $PM_{2.5}$ concentrations were substantially higher than those measured more recently (*e.g.,* see U.S. EPA, 2022b, Figure 2–16).

hospital admissions, including for all cardiovascular disease, acute MI, stroke, heart failure, and ischemic heart disease in those aged 65 and older. Corrigan et al. (2018) examined whether there was a change in the cardiovascular mortality rate before (2000–2004) and after (2005–2010) implementation of the first annual $PM_{2.5}$ NAAQS implementation based on mortality data from the National Center for Health Statistics and reported 1.10 (95% confidence interval (CI): 0.37, 1.82) fewer cardiovascular deaths per year per 100,000 people for each 1 μg/m³ reduction in annual $PM_{2.5}$ concentrations. When comparing whether counties met the annual $PM_{2.5}$ standard (attainment counties), there were 1.96 (95% CI: 0.77, 3.15) fewer cardiovascular deaths for each 1 μg/m³ reduction in annual $PM_{2.5}$ concentrations between the two periods for attainment counties, whereas in non-attainment counties (*e.g.,* counties that did not meet the annual $PM_{2.5}$ standard), there were 0.59 (95% CI: − 0.54, 1.71) fewer cardiovascular deaths between the two periods. And lastly, Sanders et al. (2020a) examined whether policy actions (*i.e.,* the first annual $PM_{2.5}$ NAAQS implementation rule in 2005 for the 1997 annual $PM_{2.5}$ standard with a 3-year annual average of 15 μg/m³) reduced $PM_{2.5}$ concentrations and mortality rates in Medicare beneficiaries between 2000–2013. They report evidence of changes in associations with mortality (a decreased mortality rate of ~0.5 per 1,000 in attainment and non-attainment areas) due to changes in annual $PM_{2.5}$ concentrations in both attainment and non-attainment areas. Additionally, attainment areas had starting concentrations below 12.0 μg/m³ prior to implementation of the annual $PM_{2.5}$ NAAQS in 2005. In addition, following implementation of the annual $PM_{2.5}$ NAAQS, annual $PM_{2.5}$ concentrations decreased by 1.59 μg/m³ (95% CI: 1.39, 1.80) which corresponded to a reduction in mortality rates among individuals 65 years and older (0.93% [95% CI: 0.10%, 1.77%]) in non-attainment counties relative to attainment counties. In a life expectancy study, Bennett et al. (2019) reports increases in life expectancy in all but 14 counties (1325 of 1339 counties) that have exhibited reductions in $PM_{2.5}$ concentrations from 1999 to 2015. These studies provide support for improvements in public health following the implementation of policies, including in areas with $PM_{2.5}$ concentrations below the level of the current annual standard, as well as increases in life expectancy in areas with reductions in $PM_{2.5}$ concentrations.

d. Uncertainties in the Health Effects Evidence

The 2022 PA recognizes that there are a number of uncertainties and limitations associated with the available health effects evidence. Although the epidemiologic studies clearly demonstrate associations between long- and short-term $PM_{2.5}$ exposures and health outcomes, several uncertainties and limitations in the health effects evidence remain. Epidemiologic studies evaluating short-term $PM_{2.5}$ exposure and health effects have reported heterogeneity in associations between cities and geographic regions within the U.S. Heterogeneity in the associations observed across epidemiologic studies may be due in part to exposure error related to measurement-related issues, the use of central fixed-site monitors to represent population exposure to $PM_{2.5}$, and a limited understanding of factors including exposure error related to measurement-related issues, variability in $PM_{2.5}$ composition regionally, and factors that result in differential exposures (*e.g.,* topography, the built environment, housing characteristics, personal activity patterns). Heterogeneity is expected when the methods or the underlying distribution of covariates vary across studies (U.S. EPA, 2019a, p. 6–221). Studies assessed in the 2019 ISA and ISA Supplement have advanced the state of exposure science by presenting innovative methodologies to estimate PM exposure, detailing new and existing measurement and modeling methods, and further informing our understanding of the influence of exposure measurement error due to exposure estimation methods on the associations between $PM_{2.5}$ and health effects reported in epidemiologic studies (U.S. EPA, 2019a, section 1.2.2; U.S. EPA, 2022a). Data from $PM_{2.5}$ monitors continue to be commonly used in health studies as a surrogate for $PM_{2.5}$ exposure, and often provide a reasonable representation of exposures throughout a study area (U.S. EPA, 2019a, section 3.4.2.2; U.S. EPA, 2022a, section 3.2.2.2.2). However, an increasing number of studies employ hybrid modeling methods to estimate $PM_{2.5}$ exposure using data from several sources, often including satellites and models, in addition to ground-based monitors. These hybrid models typically have good cross-validation, especially for $PM_{2.5}$, and have the potential to reduce exposure measurement error and uncertainty in the health effect estimates from epidemiologic models of long-term exposure (U.S. EPA, 2019a, section 3.5; U.S. EPA, 2022a, section 2.3.3).

While studies using hybrid modeling methods have reduced exposure measurement error and uncertainty in the health effect estimates, these studies use a variety of approaches to estimate $PM_{2.5}$ concentrations and to assign exposure to assess the association between health outcomes and $PM_{2.5}$ exposure. This variability in methodology has inherent limitations and uncertainties, as described in more detail in section 2.3.3.1.5 of the 2022 PA, and the performance of the modeling approaches depends on the availability of monitoring data which varies by location. Factors that likely contribute to poorer model performance often coincide with relatively low ambient $PM_{2.5}$ concentrations, in areas where predicted exposures are at a greater distance to monitors, and under conditions where the reliability and availability of key datasets (*e.g.,* air quality modeling) are limited. Thus, uncertainty in hybrid model predictions becomes an increasingly important consideration as lower predicted concentrations are considered.

Regardless of whether a study uses monitoring data or a hybrid modeling approach when estimating $PM_{2.5}$ exposures, one key limitation that persists is associated with the interpretation of the study-reported mean $PM_{2.5}$ concentrations and how they compare to design values, the metric that describes the air quality status of a given area relative to the NAAQS.[86] As discussed above in section II.B.3.b, the overall mean $PM_{2.5}$ concentrations reported by key epidemiologic studies reflect averaging of short- or long-term $PM_{2.5}$ exposure estimates across location (*i.e.,* across multiple monitors or across modeled grid cells) and over time (*i.e.,* over several years). For monitor-based studies, the comparison is somewhat more straightforward than for studies that use hybrid modeling methods, as the monitors used to estimate exposure in the epidemiologic studies are generally the same monitors that are used to calculate design values for a given area. It is expected that areas meeting a $PM_{2.5}$ standard with a particular level would be expected to have average $PM_{2.5}$ concentrations (*i.e.,* averaged across space and over time in the area) somewhat below that standard level., but the difference between the maximum annual design value and

[86] For the annual $PM_{2.5}$ standard, design values are calculated as the annual arithmetic mean $PM_{2.5}$ concentration, averaged over 3 years. For the 24-hour standard, design values are calculated as the 98th percentile of the annual distribution of 24-hour $PM_{2.5}$ concentrations, averaged over three years (Appendix N of 40 CFR part 50).

average concentration in an area can be smaller or larger than analyses presented above in section I.D.5.a, likely depending on factors such as the number of monitors, monitor siting characteristics, and the distribution of ambient $PM_{2.5}$ concentrations. For studies that use hybrid modeling methods to estimate $PM_{2.5}$ concentrations, the comparison between study-reported mean $PM_{2.5}$ concentrations and design values is more complicated given the variability in the modeling methods, temporal scales (*i.e.,* daily versus annual), and spatial scales (*i.e.,* nationwide versus urban) across studies. Analyses above in section I.D.5.b and detailed more in the 2022 PA (U.S. EPA, 2022b, section 2.3.3.2.4) present a comparison between two hybrid modeling surfaces, which explored the impact of these factors on the resulting mean $PM_{2.5}$ concentrations and provided additional information about the relationship between mean concentrations from studies using hybrid modeling methods and design values. However, the results of those analyses only reflect two surfaces and two types of approaches, so uncertainty remains in understanding the relationship between estimated modeled $PM_{2.5}$ concentrations and design values more broadly across hybrid modeling studies. Moreover, this analysis was completed using two hybrid modeling methods that estimate $PM_{2.5}$ concentrations in the U.S., thus an additional uncertainty includes understanding the relationship between modeled $PM_{2.5}$ concentrations and design values reported in Canada.

In addition, where $PM_{2.5}$ and other pollutants (*e.g.,* ozone, nitrogen dioxide, and carbon monoxide) are correlated, it can be difficult to distinguish whether attenuation of effects in some studies results from copollutant confounding or collinearity with other pollutants in the ambient mixture (U.S. EPA, 2019a, section 1.5.1; U.S. EPA, 2022a, section 2.2.1). Studies evaluated in the 2019 ISA and ISA Supplement further examined the potential confounding effects of both gaseous and particulate copollutants on the relationship between long- and short-term $PM_{2.5}$ exposure and health effects. As noted in the Appendix to the 2019 ISA (U.S. EPA, 2019a, Table A–1), copollutant models are not without their limitations, such as instances for which correlations are high between pollutants resulting in greater copollutant confounding bias in results. However, the studies continue to provide evidence indicating that associations with $PM_{2.5}$ are relatively unchanged in copollutants models (U.S. EPA, 2019a, section 1.5.1; U.S. EPA, 2022a, section 2.2.1).

Another area of uncertainty is associated with other potential confounders, beyond copollutants. Some studies have expanded the examination of potential confounders to not only include copollutants, but also systematic evaluations of the potential impact of inadequate control from long-term temporal trends and weather (U.S. EPA, 2019a, section 11.1.5.1). Analyses examining these covariates further confirm that the relationship between $PM_{2.5}$ exposure and mortality is unlikely to be biased by these factors. Other studies have explored the use of alternative methods for confounder control to more extensively account for confounders and are more robust to model misspecification that can further inform the causality determination for long-term and short-term $PM_{2.5}$ and mortality and cardiovascular effects (U.S. EPA, 2019a, section 11.2.2.4; U.S. EPA, 2022a, sections 3.1.1.3, 3.1.2.3, 3.2.1.2, and 3.2.2.3). These studies indicate that bias from unmeasured confounders can occur in either direction, although controlling for these confounders did not result in the elimination of the association, but instead provided additional support for associations between long-term $PM_{2.5}$ exposure and mortality when accounting for additional confounders (U.S. EPA, 2022a, section 3.2.2.2.6).

Another important limitation associated with the evidence is that, while epidemiologic studies indicate associations between $PM_{2.5}$ and health effects, the currently available evidence does not identify particular $PM_{2.5}$ concentrations that do not elicit health effects. Rather, health effects can occur over the entire distribution of ambient $PM_{2.5}$ concentrations evaluated, and epidemiologic studies conducted to date do not identify a population-level threshold below which it can be concluded with confidence that $PM_{2.5}$-related effects do not occur.

Overall, evidence assessed in the 2019 ISA and ISA Supplement continues to indicate a linear, no-threshold C–R relationship for $PM_{2.5}$ concentrations >8 $\mu g/m^3$. However, uncertainties remain about the shape of the C–R curve at $PM_{2.5}$ concentrations <8 $\mu g/m^3$, with some recent studies providing evidence for either a sublinear, linear, or supralinear relationship at these lower concentrations (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 2.2.3.2).

There are also a number of uncertainties and limitations associated with the experimental evidence (*i.e.,* controlled human exposure studies and animal toxicological studies). With respect to controlled human exposure studies, the PA recognizes that these studies include a small number of individuals compared to epidemiologic studies. Additionally, these studies tend to include generally healthy adult individuals, who are at a lower risk of experiencing health effects. These studies, therefore, often do not include populations that are at increased risk of $PM_{2.5}$-related health effects, including children, older adults, or individuals with pre-existing conditions. As such, these studies are somewhat limited in their ability to inform at what concentrations effects may be elicited in at-risk populations. With respect to animal toxicological studies, while these studies often examine more severe health outcomes and longer exposure durations and higher exposure concentrations than controlled human exposure studies, there is uncertainty in extrapolating the effects seen in animals, and the $PM_{2.5}$ exposures and doses that cause those effects, to human populations.

Consideration of health effects are informed by the epidemiologic, controlled human exposure, and animal toxicological studies. The evaluation and integration of the scientific evidence in the ISA focuses on evaluating the findings from the body of evidence across disciplines, including evaluating the strengths and weaknesses in the overall collection of studies across disciplines. Integrating evidence across disciplines can strengthen causal inference, such that a weak inference from one line of evidence can be addressed by other lines of evidence, and coherence of these lines of evidence can add support to a cause-effect interpretation of the association. Evaluation and integration of the evidence also includes consideration of uncertainties that are inherent in the scientific findings (U.S. EPA, 2015, pp. 13–15), some of which are described above.

3. Summary of Exposure and Risk Estimates

Beyond the consideration of the scientific evidence, discussed above in section II.B, the EPA also considers the extent to which new or updated quantitative analyses of $PM_{2.5}$ air quality, exposure, or health risks could inform conclusions on the adequacy of the public health protection provided by the current primary $PM_{2.5}$ standards. Additionally, the 2022 PA includes an at-risk analysis that assesses $PM_{2.5}$-attributable risk associated with $PM_{2.5}$ air quality that has been adjusted to simulate air quality scenarios of policy

interest (*e.g.,* ''just meeting'' the current or potential alternative standards). Drawing on the summary in section II.C of the proposal, the sections below provide a brief overview of key aspects of the assessment design (II.A.3.a), key limitations and uncertainties (II.A.3.b), and exposure/risk estimates (II.A.3.c).

a. Key Design Aspects

Risk assessments combine data from multiple sources and involve various assumptions and uncertainties. Input data for these analyses includes C–R functions from epidemiologic studies for each health outcome and ambient annual or 24-hour $PM_{2.5}$ concentrations for the study areas utilized in the risk assessment (U.S. EPA, 2022b, section 3.4.1). Additionally, quantitative and qualitative methods were used to characterize variability and uncertainty in the risk estimates (U.S. EPA, 2022b, section 3.4.1.7).

Concentration-response functions used in the risk assessment are from large, multicity U.S. epidemiologic studies that evaluate the relationship between $PM_{2.5}$ exposures and mortality. Epidemiologic studies and concentration-response studies that were used in the risk assessment to estimate risk were identified using criteria that take into account factors such as study design, geographic coverage, demographic populations, and health endpoints (U.S. EPA, 2022b, section 3.4.1.1).[87] The risk assessment focuses on all-cause or nonaccidental mortality associated with long-term and short-term $PM_{2.5}$ exposures, for which the 2019 ISA concluded that the evidence provides support for a ''causal relationship'' (U.S. EPA, 2022b, section 3.4.1.2).[88]

As described in more detail in the 2022 PA, the risk assessment first estimated health risks associated with air quality for 2015 adjusted to simulate ''just meeting'' the current primary $PM_{2.5}$ standards (*i.e.,* the annual standard with its level of 12.0 μg/m^3 and the 24-hour standard with its level of 35 μg/m^3). Air quality modeling was then used to simulate air quality just meeting an alternative standard with a level of 10.0 μg/m^3 (annual) and 30 μg/m^3 (24-hour). In addition to the model-based approach, for the subset of 30 areas controlled by the annual standard linear interpolation and extrapolation were employed to simulate just meeting alternative annual standards with levels of 11.0 (interpolated between 12.0 and 10.0 μg/m^3), 9.0 μg/m^3, and 8.0 μg/m^3 (both extrapolated from 12.0 and 10.0 μg/m^3) (U.S. EPA, 2022b, section 3.4.1.3). The 2022 PA notes that there is greater uncertainty regarding whether a revised 24-hour standard (*i.e.,* with a lower level) is needed to further limit ''peak'' $PM_{2.5}$ concentration exposure and whether a lower 24-hour standard level would most effectively reduce $PM_{2.5}$-associated health risks associated with ''typical'' daily exposures. The risk assessment estimates health risks associated with air quality adjusted to meet a revised 24-hour standard with a level of 30 μg/m^3, in conjunction with estimating the health risks associated with meeting a revised annual standard with a level of 10.0 μg/m^3 (U.S. EPA, 2022b, section 3.4.1.3). More details on the air quality adjustment approaches used in the risk assessment are described in section 3.4.1.4 and Appendix C of the 2022 PA (U.S. EPA, 2022b).

When selecting U.S. study areas for inclusion in the risk assessment, the available ambient monitors, geographic diversity, and ambient $PM_{2.5}$ air quality concentrations were taken into consideration (U.S. EPA, 2022b, section 3.4.1.4). When these factors were applied, 47 urban study areas were identified, which include nearly 60 million people aged 30–99, or approximately 30% of the U.S population in this age range (U.S. EPA, 2022b, section 3.4.1.5, Appendix C, section C.1.3). Of the 47 study areas, there were 30 study areas where just meeting the current standards is controlled by the annual standard,[89] 11 study areas where just meeting the current standards is controlled by the daily standard,[90] and 6 study areas where the controlling standard differed depending on the air quality adjustment approach (U.S. EPA, 2022b, section 3.4.1.5).[91]

In addition to the overall risk assessment, the 2022 PA also includes an at-risk analysis and estimates exposures and health risks of specific populations identified as at-risk that would be allowed under the current and potential alternative standards to further inform the Administrator's conclusions regarding the adequacy of the public health protection provided by the current primary $PM_{2.5}$ standards. In so doing, the 2022 PA evaluates exposure and $PM_{2.5}$ mortality risk for older adults (*e.g.,* 65 years and older), stratified for White, Black, Asian, Native American, Non-Hispanic, and Hispanic individuals residing in the same study areas included in the overall risk assessment. This analysis utilizes a recent epidemiologic study that provides race- and ethnicity-specific risk coefficients (Di et al., 2017b).

b. Key Limitations and Uncertainties

Uncertainty in risk estimates (*e.g.,* in the size of risk estimates) can result from a number of factors, including the assumptions about the shape of the C–R function with mortality at low ambient PM concentrations, the potential for confounding and/or exposure measurement error in the underlying epidemiologic studies, and the methods used to adjust $PM_{2.5}$ air quality. More specifically, the use of air quality modeling to adjust $PM_{2.5}$ concentrations are limited as they rely on model predictions, are based on emission changes scaled by fixed percentages, and use only two of the full set of possible emission scenarios and linear interpolation/extrapolation to adjust air quality that may not fully capture potential non-linearities associated with real-world changes in air quality. Additionally, the selection of case study areas is limited to urban areas predominantly located CA and in the Eastern U.S. that are controlled by the annual standard. While the risk assessment does not report quantitative uncertainty in the risk estimates as exposure concentrations are reduced, it does provide information on the distribution of concentrations associated with the risk estimates when evaluating progressively lower alternative annual standards. Based on these data, as lower alternative annual standards are evaluated, larger proportions of the distributions in risk occur at or below 10 μg/m^3 (at concentrations below or near most of the study-reported means from the key U.S. epidemiologic studies) and at or below 8 μg/m^3 (the concentration at which the ISA reports increasing uncertainty in the shape of the C–R curve based on the body of epidemiologic evidence).

[87] Additional detail regarding the selection of epidemiologic studies and specification of C–R functions is provided in the 2022 PA (U.S. EPA, 2022b, Appendix C, section C.1.1).

[88] While the 2019 ISA also found that evidence supports the determination of a ''causal relationship'' between long- and short-term $PM_{2.5}$ exposures and cardiovascular effects, cardiovascular mortality was not included as a health outcome as it will be captured in the estimates of all-cause mortality.

[89] For these areas, the annual standard is the ''controlling standard'' because when air quality is adjusted to simulate just meeting the current or potential alternative annual standards, that air quality also would meet the 24-hour standard being evaluated.

[90] For these areas, the 24-hour standard is the controlling standard because when air quality is adjusted to simulate just meeting the current or potential alternative 24-hour standards, that air quality also would meet the annual standard being evaluated. Some areas classified as being controlled by the 24-hour standard also violate the annual standard.

[91] In these 6 areas, the controlling standard depended on the air quality adjustment method used and/or the standard scenarios evaluated.

Similarly, the at-risk analysis is also subject to many of these same uncertainties noted above. Additionally, the at-risk analysis included C–R functions from only one study (Di et al., 2017b), which reported associations between long-term $PM_{2.5}$ exposures and mortality, stratified by race/ethnicity, in populations age 65 and older, as opposed to the multiple studies used in the overall risk assessment to convey risk estimate variability. These and other sources of uncertainty in the overall risk assessment and the at-risk analyses are characterized in more depth in the 2022 PA (U.S. EPA, 2022b, section 3.4.1.7, section 3.4.1.8, Appendix C, section C.3).

c. Summary of Risk Estimates

Although limitations in the underlying data and approaches lead to some uncertainty regarding estimates of $PM_{2.5}$-associated risk, the risk assessment estimates that the current primary $PM_{2.5}$ standards could allow a substantial number of $PM_{2.5}$-associated deaths in the U.S. For example, when air quality in the 47 study areas is adjusted to simulate just meeting the current standards, the risk assessment estimates up to 45,100 deaths in 2015 are attributable to long-term $PM_{2.5}$ exposures associated with just meeting the current annual and 24-hour $PM_{2.5}$ standards (U.S. EPA, 2022b, section 3.4.2.1). Additionally, as described in more detail in the 2022 PA, the at-risk analysis suggests that a lower annual standard level (*i.e.,* below 12 $\mu g/m^3$ and down as low as 8 $\mu g/m^3$) will help to reduce $PM_{2.5}$ exposure and may also help to mitigate exposure and risk disparities in populations identified as particularly at-risk for adverse effects from PM exposures (*i.e.,* minority populations).

Compared to the current annual standard, meeting a revised annual standard with a lower level is estimated to reduce $PM_{2.5}$-associated health risks in the 30 study areas controlled by the annual standard by about 7–9% for a level of 11.0 $\mu g/m^3$, 15–19% for a level of 10.0 $\mu g/m^3$, 22–28% for a level of 9.0 $\mu g/m^3$, and 30–37% for a level of 8.0 $\mu g/m^3$) (U.S. EPA, 2022b, Table 3–17). Meeting a revised annual standard with a lower level may also help to mitigate exposure and risk disparities in populations identified as particularly at-risk for adverse effects from PM exposures (*i.e.,* minority populations) in simulated scenarios just meeting alternative annual standards. However, though reduced, disparities by race and ethnicity persist even at an alternative annual standard level of 8 $\mu g/m^3$, the lowest alternative annual standard included in the risk assessment (U.S. EPA, 2022b, section 3.4.2.4).

Revising the level of the 24-hour standard to 30 $\mu g/m^3$ is estimated to lower $PM_{2.5}$-associated risks across a more limited population and number of areas than revising the annual standard (U.S. EPA, 2022, section 3.4.2.4). Risk reduction predictions are largely confined to areas located in the western U.S., several of which are also likely to experience risk reductions upon meeting a revised annual standard. In the 11 areas controlled by the 24-hour standard, when air quality is simulated to just meet the current 24-hour standard, $PM_{2.5}$ exposures are estimated to be associated with as many as 2,570 deaths annual. Compared to just meeting the current standard, air quality just meeting an alternative 24-hour standard level of 30 $\mu g/m^3$ is associated with reductions in estimated risk of 9–13% (U.S. EPA, 2022b, section 3.4.2.3).

B. Conclusions on the Primary $PM_{2.5}$ Standards

In drawing conclusions on the adequacy of the current primary $PM_{2.5}$ standards, in view of the advances in scientific knowledge and additional information now available, the Administrator has considered the evidence base, information, and policy judgments that were the foundation of the 2012 and 2020 reviews and reflects upon the body of evidence and information newly available in this reconsideration. In so doing, the Administrator has taken into account both evidence-based and risk-based considerations, as well as advice from the CASAC and public comments. Evidence-based considerations draw upon the EPA's integrated assessment of the scientific evidence of health effects related to $PM_{2.5}$ exposure presented in the 2019 ISA and ISA Supplement (summarized in the proposal in sections II.B (88 FR 5580, January 27, 2023) and II.D.2.a (88 FR 5609, January 27, 2023), and also in section II.A.2 above) to address key policy-relevant questions in the reconsideration. Similarly, the risk-based considerations draw upon the assessment of population exposure and risk (summarized in the proposal in sections II.C (88 FR 5605, January 27, 2023) and II.D.2.b (88 FR 5614, January 27, 2023), and also in section II.A.3 above) in addressing policy-relevant questions focused on the potential for $PM_{2.5}$ exposures associated with mortality under air quality conditions just meeting the current and potential alternative standards.

The approach to reviewing the primary standards is consistent with requirements of the provisions of the CAA related to the review of the NAAQS and with how the EPA and the courts have historically interpreted the CAA. As discussed in section I.A above, these provisions require the Administrator to establish primary standards that, in the Administrator's judgment, are requisite (*i.e.,* neither more nor less stringent than necessary) to protect public health with an adequate margin of safety. Consistent with the Agency's approach across all NAAQS reviews, the EPA's approach to informing these judgments is based on a recognition that the available health effects evidence generally reflects a continuum that includes ambient air exposures for which scientists generally agree that health effects are likely to occur through lower levels at which the likelihood and magnitude of response become increasingly uncertain. The CAA does not require the Administrator to establish a primary standard at a zero-risk level or at background concentration levels, but rather at a level that reduces risk sufficiently so as to protect public health, including the health of sensitive groups, with an adequate margin of safety.

The decisions on the adequacy of the current primary $PM_{2.5}$ standards described below is a public health policy judgment by the Administrator that draws on the scientific evidence for health effects, quantitative analyses of population exposures and/or health risks, and judgments about how to consider the uncertainties and limitations that are inherent in the scientific evidence and quantitative analyses. The four basic elements of the NAAQS (*i.e.,* indicator, averaging time, form, and level) have been considered collectively in evaluating the public health protection afforded by the current standards.

Section II.B.2 below briefly summarizes the basis for the Administrator's proposed decision, drawing from section II.D.3 of the proposal (88 FR 5617, January 27, 2023). The advice and recommendations of the CASAC and public comments on the proposed decision are addressed below in sections II.B.1 and II.B.3, respectively. The Administrator's final conclusions in this reconsideration regarding the adequacy of the current primary $PM_{2.5}$ standards and whether any revisions are appropriate are described in section II.B.4.

1. CASAC Advice

As part of its review of the 2019 draft PA, the CASAC provided advice on the adequacy of the public health protection afforded by the current primary $PM_{2.5}$ standards. Its advice is documented in

a letter sent to the EPA Administrator (Cox, 2019b). In this letter, the committee recommended retaining the current 24-hour $PM_{2.5}$ standard but did not reach consensus on whether the scientific and technical information support retaining or revising the current annual standard. In particular, though the CASAC agreed that there is a long-standing body of health evidence supporting relationships between $PM_{2.5}$ exposures and various health outcomes, including mortality and serious morbidity effects, individual CASAC members ''differ[ed] in their assessments of the causal and policy significance of these associations'' (Cox, 2019b, p. 8 of consensus responses). Drawing from this evidence, ''some CASAC members'' expressed support for retaining the current annual standard while ''other members'' expressed support for revising that standard in order to increase public health protection (Cox, 2019b, p.1 of letter). These views are summarized below.

The CASAC members who supported retaining the current annual standard expressed the view that substantial uncertainty remains in the evidence for associations between $PM_{2.5}$ exposures and mortality or serious morbidity effects. These committee members asserted that ''such associations can reasonably be explained in light of uncontrolled confounding and other potential sources of error and bias'' (Cox, 2019b, p. 8 of consensus responses). They noted that associations do not necessarily reflect causal effects, and they contended that recent epidemiologic studies assessed in the 2019 ISA that report positive associations at lower estimated exposure concentrations mainly confirm what was anticipated or already assumed in setting the 2012 NAAQS. In particular, they concluded that such studies have some of the same limitations as prior studies and do not provide new information calling into question the existing standard. They further asserted that ''accountability studies provide potentially crucial information about whether and how much decreasing $PM_{2.5}$ causes decreases in future health effects'' (Cox, 2019b, p. 10 of consensus responses), and they cited recent reviews (*i.e.,* Henneman et al., 2017; Burns et al., 2019) to support their position that in such studies, ''reductions of $PM_{2.5}$ concentrations have not clearly reduced mortality risks'' (Cox, 2019b, p. 8 of consensus responses). Thus, the committee members who supported retaining the current annual standard advise that, ''while the data on associations should certainly be carefully considered, this data should not be interpreted more strongly than warranted based on its methodological limitations'' (Cox, 2019b, p. 8 of consensus responses).

These members of the CASAC further concluded that the quantitative risk assessment included in the 2019 draft PA does not provide a valid basis for revising the current standards. This conclusion was based on concerns that (1) ''the risk assessment treats regression coefficients as causal coefficients with no justification or validation provided for this decision;'' (2) the estimated regression concentration-response functions ''have not been adequately adjusted to correct for confounding, errors in exposure estimates and other covariates, model uncertainty, and heterogeneity in individual biological (causal) [concentration-response] functions;'' (3) the estimated concentration-response functions ''do not contain quantitative uncertainty bands that reflect model uncertainty or effects of exposure and covariate estimation errors;'' and (4) ''no regression diagnostics are provided justifying the use of proportional hazards . . . and other modeling assumptions'' (Cox, 2019b, p. 9 of consensus responses). These committee members also contended that details regarding the derivation of concentration-response functions, including specification of the beta values and functional forms, were not well-documented, hampering the ability of readers to evaluate these design details. Thus, these members ''think that the risk characterization does not provide useful information about whether the current standard is protective'' (Cox, 2019b, p. 11 of consensus responses).

Drawing from their evaluation of the evidence and the risk assessment in the 2019 draft PA, these committee members concluded that ''the Draft PM PA does not establish that new scientific evidence and data reasonably call into question the public health protection afforded by the . . . 2012 $PM_{2.5}$ annual standard'' (Cox, 2019b, p.1 of letter).

In contrast, ''[o]ther members of CASAC conclude[d] that the weight of the evidence, particularly reflecting recent epidemiology studies showing positive associations between $PM_{2.5}$ and health effects at estimated annual average $PM_{2.5}$ concentrations below the current standard, does reasonably call into question the adequacy of the 2012 annual $PM_{2.5}$ [standard] to protect public health with an adequate margin of safety'' (Cox, 2019b, p.1 of letter). The committee members who supported this conclusion noted that the body of health evidence for $PM_{2.5}$ not only includes the repeated demonstration of associations in epidemiologic studies, but also includes support for biological plausibility established by controlled human exposure and animal toxicology studies. They pointed to recent studies demonstrating that the associations between $PM_{2.5}$ and health effects occur in a diversity of locations, in different time periods, with different populations, and using different exposure estimation and statistical methods. They concluded that ''the entire body of evidence for PM health effects justifies the causality determinations made in the Draft PM ISA'' (Cox, 2019b, p. 8 of consensus responses).

The members of the CASAC who supported revising the current annual standard particularly emphasized recent findings of associations with $PM_{2.5}$ in areas with average long-term $PM_{2.5}$ concentrations below the level of the annual standard and studies that show positive associations even when estimated exposures above 12 $\mu g/m^3$ are excluded from analyses. They found it ''highly unlikely'' that the extensive body of evidence indicating positive associations at low estimated exposures could be fully explained by confounding or by other non-causal explanations (Cox, 2019b, p. 8 of consensus responses). They additionally concluded that ''the risk characterization does provide a useful attempt to understand the potential impacts of alternate standards on public health risks'' (Cox, 2019b, p. 11 of consensus responses). These CASAC members concluded that the available evidence reasonably calls into question the protection provided by the current primary $PM_{2.5}$ standards and supports revising the annual standard to increase that protection (Cox, 2019b).

As a part of this reconsideration, the CASAC reviewed the 2021 draft PA (developed to support the reconsideration as described in section I.C.5 above). As a part of their review of the 2021 draft PA, the CASAC provided advice on the adequacy of the current primary $PM_{2.5}$ standards. The range of views summarized here generally reflects differing judgments as to the relative weight to place on various types of evidence, the risk-based information, and the associated uncertainties, as well as differing judgments about the importance of various $PM_{2.5}$-related health effects from a public health perspective.

In its comments on the 2021 draft PA, the CASAC stated that: ''[o]verall the CASAC finds the Draft PA to be well-

written and appropriate for helping to 'bridge the gap' between the agency's scientific assessments and quantitative technical analyses, and the judgments required of the Administrator in determining whether it is appropriate to retain or revise the National Ambient Air Quality Standards (NAAQS)'' (Sheppard, 2022a, p. 1 of consensus letter). The CASAC also stated that the ''[d]raft PA adequately captures and appropriately characterizes the key aspects of the evidence assessed and integrated in the 2019 ISA and Draft ISA Supplement of $PM_{2.5}$-related health effects'' (Sheppard, 2022b, p. 2 of consensus letter). The CASAC also stated that ''[t]he interpretation of the risk assessment for the purpose of evaluating the adequacy of the current primary $PM_{2.5}$ annual standard is appropriate given the scientific findings presented'' (Sheppard, 2022a, p. 2 of consensus letter).

With regard to the adequacy of the current primary annual $PM_{2.5}$ standard, ''all CASAC members agree that the current level of the annual standard is not sufficiently protective of public health and should be lowered'' (Sheppard, 2022a, p. 2 of consensus letter). Additionally, ''the CASAC reached consensus that the indicator, form, and averaging time should be retained, without revision'' (Sheppard, 2022a, p. 2 of consensus letter). With regard to the level of the primary annual $PM_{2.5}$ standard, the CASAC had differing recommendations for the appropriate range for an alternative level. The majority of the CASAC ''judge[d] that an annual average in the range of 8–10 $\mu g/m^3$'' was most appropriate, while the minority of the CASAC members stated that ''the range of the alternative standard of 10–11 $\mu g/m^3$ is more appropriate'' (Sheppard, 2022a, p. 16 of consensus responses). The CASAC did highlight, however, that ''the alternative standard level of 10 $\mu g/m^3$ is within the range of acceptable alternative standards recommended by all CASAC members, and that an annual standard below 12 $\mu g/m^3$ is supported by a larger and coherent body of evidence'' (Sheppard, 2022a, p. 16 of consensus responses).

In reaching conclusions on a recommended range of 8–10 $\mu g/m^3$ for the primary annual $PM_{2.5}$ standard, the majority of the CASAC placed weight on various aspects of the available scientific evidence and quantitative risk assessment information discussed in the 2021 draft PA (Sheppard, 2022a, p. 16 of consensus responses). In particular, these members cited recent U.S.- and Canadian-based epidemiologic studies that show positive associations between $PM_{2.5}$ exposure and mortality with study-reported mean concentrations below 10 $\mu g/m^3$. Further, these members also noted that the lower portions of the air quality distribution (*i.e.,* concentrations below the mean) provide additional information to support associations between health effects and $PM_{2.5}$ concentrations lower than the reported long-term mean concentration. In addition, the CASAC members recognized that the available evidence has not identified a threshold concentration, below which an association no longer remains, pointing to the conclusion in the draft ISA Supplement that the ''evidence remains clear and consistent in supporting a no-threshold relationship, and in supporting a linear relationship for $PM_{2.5}$ concentrations >8 $\mu g/m^3$'' (Sheppard, 2022a, p. 16 of consensus responses). Finally, these CASAC members placed weight on the at-risk analysis as providing support for protection of at-risk demographic groups, including minority populations.

In recommending a range of 10–11 $\mu g/m^3$ for the primary annual $PM_{2.5}$ standard, the minority of the CASAC emphasized that there were few key epidemiologic studies that reported positive and statistically significant health effects associations for $PM_{2.5}$ air quality distributions with overall mean concentrations below 9.6 $\mu g/m^3$ (Sheppard, 2022a, p. 17 of consensus responses). In so doing, the minority of the CASAC specifically noted the variability in the relationship between study-reported means and area annual design values based on the methods utilized in the studies, noting that design values are generally higher than area average exposure levels. Further, the minority of the CASAC stated that ''uncertainties related to copollutants and confounders make it difficult to justify a recommendation below 10–11 $\mu g/m^3$'' (Sheppard, 2022a, p. 17 of consensus responses). Finally, the minority of the CASAC placed less weight on the risk assessment results, noting large uncertainties, including the approaches used for adjusting air quality to simulate just meeting the current and alternative standards.

With regard to the current primary 24-hour $PM_{2.5}$ standard, in their review of the 2021 draft PA, the CASAC did not reach consensus regarding the adequacy of the public health protection provided by the current standard. As described further below, the majority of the CASAC members concluded ''that the available evidence calls into question the adequacy of the current 24-hour standard'' (Sheppard, 2022a, p. 3 of consensus letter), while the minority of the CASAC members agreed with ''the EPA's preliminary conclusion [in the draft PA] to retain the current 24-hour $PM_{2.5}$ standard without revision'' (Sheppard, 2022a, p. 4 of consensus letter). The CASAC recommended that in future reviews, the EPA should also consider alternative forms for the primary 24-hour $PM_{2.5}$ standard. Specifically, the CASAC ''suggests considering a rolling 24-hour average and examining alternatives to the 98th percentile of the 3-year average,'' pointing to concerns that computing 24-hour average $PM_{2.5}$ concentrations using the current midnight-to-midnight timeframe could potentially underestimate the effects of high 24-hour exposures, especially in areas with wood-burning stoves and wintertime stagnation (Sheppard, 2022a, p. 18 of consensus responses).

As noted above, the majority of the CASAC favored revising the level of the primary 24-hour $PM_{2.5}$ standard, suggesting that a range of 25–30 $\mu g/m^3$ would be adequately protective. In so doing, the majority of the CASAC placed weight on the available epidemiologic evidence, including epidemiologic studies that restricted analyses to 24-hour $PM_{2.5}$ concentrations below 25 $\mu g/m^3$. These members also placed weight on results of controlled human exposure studies with exposures close to the current standard, which they note provide support for the epidemiologic evidence to lower the standard. These members noted the limitations in using controlled human exposure studies alone in considering the adequacy of the 24-hour standard, recognizing that controlled human exposure studies preferentially recruit less susceptible individuals and have a typical exposure duration shorter than 24 hours. These members also placed ''greater weight on the scientific evidence than on the values estimated by the risk assessment,'' citing their concerns that the risk assessment ''may not adequately capture areas with wintertime stagnation and residential wood-burning where the annual standard is less likely to be protective'' (Sheppard, 2022a, p. 17 of consensus responses). Furthermore, these CASAC members ''also are less confident that the annual standard could adequately protect against health effects of short-term exposures'' (Sheppard, 2022a, p. 17 of consensus responses).

The minority of the CASAC agreed with the EPA's preliminary conclusion in the 2021 draft PA to retain the current primary 24-hour $PM_{2.5}$ standard. In so doing, the minority of the CASAC placed greater weight on the risk assessment, noting that the risk

assessment accounts for both the level and the form of the current standard and the manner by which attainment with the standard is determined. Further, the minority of the CASAC stated that the ''risk assessment indicates that the annual standard is the controlling standard across most of the urban study areas evaluated and revising the level of the 24-hour standard is estimated to have minimal impact on the $PM_{2.5}$-associated risks'' and therefore, ''the annual standard can be used to limit both long- and short-term $PM_{2.5}$ concentrations'' (Sheppard, 2022a, p. 18 of consensus responses). Further, the minority of the CASAC placed more weight on the controlled human exposure studies, which show ''effects at $PM_{2.5}$ concentrations well above those typically measured in areas meeting the current standards'' and which suggest that ''the current standards are providing adequate protection against these exposures'' (Sheppard, 2022a, p. 18 of consensus responses).

While the CASAC members expressed differing opinions on the appropriate revisions to the current standards, they did ''find that both primary standards, 24-hour and annual, are critical to protect public health given the evidence on detrimental health outcomes at both short-term and long-term exposures including peak events'' (Sheppard, 2022a, p. 13 of consensus responses). The comments from the CASAC also took note of uncertainties that remain in this reconsideration of the primary $PM_{2.5}$ standards and they identified a number of additional areas for future research and data gathering and dissemination that would inform future reviews of the primary $PM_{2.5}$ NAAQS (Sheppard, 2022a, pp. 14–15 of consensus responses).

2. Basis for the Proposed Decision

In reaching his proposed decisions to revise the level of the primary annual $PM_{2.5}$ standard from its current level of 12.0 $\mu g/m^3$ to within the range of 9.0 to 10.0 $\mu g/m^3$, and to retain the current primary 24-hour $PM_{2.5}$ standard (88 FR 5558, January 27, 2023), the Administrator carefully considered the assessment of the current evidence and conclusions reached in the 2019 ISA and ISA Supplement; the currently available exposure and risk information, including associated limitations and uncertainties, described in detail in the 2022 PA; the considerations and staff conclusions and associated rationales presented in the 2022 PA; the advice and recommendations from the CASAC; and public comments that had been offered up to that point (88 FR 5558, January 27, 2023).

In reaching his proposed conclusions on whether the currently available scientific evidence and quantitative risk-based information support or call into question the adequacy of the public health protection afforded by the current primary $PM_{2.5}$ standards, and as is the case with NAAQS reviews in general, the extent to which the current primary $PM_{2.5}$ standards are judged to be adequate will depend on a variety of factors, including science policy and public health policy judgments to be made by the Administrator on the strength and uncertainties of the scientific evidence. The factors relevant to judging the adequacy of the standards also include the interpretation of, and decisions as to the weight to place on, different aspects of the results of the risk assessment for the study areas included and the associated uncertainties. Thus, in reaching proposed conclusions of the current standards, the Administrator recognized that such a determination depends in part on judgments regarding aspects of the evidence and risk estimates, and judgments about the degree of protection that is requisite to protect public health with an adequate margin of safety.

The Administrator's full rationale for his proposed conclusions is presented in section II.D.3 of proposal (88 FR 5658, January 27, 2023), but is also briefly summarized here. In reaching the proposed decision to revise the annual standard level to 9–10 $\mu g/m^3$, the Administrator placed weight on the full body of scientific information. He noted that the 2019 ISA finds that exposure to $PM_{2.5}$ causes mortality and cardiovascular effects and is likely to cause respiratory effects, cancer, and nervous system effects as detailed further in section II.B.1 of the proposal. As detailed further in section II.B.4 of the proposal, he additionally noted that the 2019 ISA identifies at-risk populations at greater risk of health effects from exposure to $PM_{2.5}$, including children, older adults, people with pre-existing respiratory or cardiovascular disease, minority populations, and low socioeconomic status (SES) populations.

The Administrator also recognized that epidemiologic studies provide the strongest scientific evidence when evaluating the adequacy of the level of the annual standard. He noted that there is no specific point in the air quality distribution of any epidemiologic study that represents a 'bright line' at and above which effects have been observed and below which effects have not been observed. In his proposed decision, he noted previous decision-making frameworks, which placed weight on values at or near the study-reported mean $PM_{2.5}$ concentrations, which is where the most confidence in the reported association of the epidemiologic study exists. He further noted that there are a number of epidemiologic studies available in this reconsideration that use new $PM_{2.5}$ exposure estimation techniques (*e.g.,* hybrid modeling) that were not used in epidemiologic studies that were available in previous reviews. These recent epidemiologic studies that use new exposure estimation techniques report long-term mean $PM_{2.5}$ concentrations that are well below corresponding design values, which is an important consideration in reaching decisions on the level of the annual $PM_{2.5}$ standard.

In reaching his proposed decision, the Administrator noted that a level of 9–10 $\mu g/m^3$ would near or below the reported 25th percentiles in key U.S. based epidemiologic studies, while also recognizing that he has less confidence in the magnitude and significance of the association at even lower percentiles (*e.g.,* 10th percentile), where even fewer health events are observed. The Administrator also noted that a proposed level of 9–10 $\mu g/m^3$ would be near the mean $PM_{2.5}$ reported in Canadian based studies, though he also recognized that there are a number of factors associated with the studies in Canada (*e.g.,* exposure environments) that make it more difficult to compare mean concnetrations from Canadian studies to design values, which determine compliance with the standard in the U.S.

The Administrator took note of additional pieces of scientific evidence, which were not available in previous reviews, including restricted analyses, which support that the association seen in epidemiologic studies does not just occur from the peaks of the exposure distribution. Additionally, he notes that a level of 9–10 $\mu g/m^3$ would be below the starting concentration in newly available accountability studies, though he did note that it is more difficult to interpret these studies in the context of selecting the level of the annual $PM_{2.5}$ standard.

Further, the Administrator took into consideration the advice of the CASAC, noting that all members included 10 $\mu g/m^3$ in their recommended range, and that the proposed range of 9–10 $\mu g/m^3$ for the level of the primary annual $PM_{2.5}$ standard was within the range recommended by the majority of the CASAC.

In reaching the proposed conclusion of a range between 9–10 $\mu g/m^3$, the Administrator noted that a level as high

as 11 μg/m³ might not provide an adequate margin of safety, given that 11 μg/m³ was well above many of the epidemiologic study-reported mean $PM_{2.5}$ concentrations. Additionally, the Administrator noted the uncertainties associated with the scientific and quantitative information supporting a level as low as 8 μg/m³, which call into question the potential public health improvements of a standard below 9 μg/m³. The Administrator specifically noted the lack of key U.S. studies with mean concentrations below 9.3 μg/m³ and he further noted that the risk assessment suggests that the risk remaining under a standard of 8 μg/m³ would occur at very low concentrations (*e.g.,* mainly 7 μg/m³ and below).

As such, the Administrator's proposed decision noted that the current $PM_{2.5}$ annual standard did not adequately provide requisite protection against exposures to $PM_{2.5}$ and that a proposed range of 9–10 μg/m³ would provide an adequate margin of safety.

In his proposed decision to retain the current primary 24-hour $PM_{2.5}$ standard with a level of 35 μg/m³, the Administrator first considered the scientific information related to short-term exposures to $PM_{2.5}$ and health effects. He noted that the controlled human exposure studies are the strongest line of evidence for informing his conclusions regarding the adequacy of the current 24-hour standard. In so doing, the Administrator recognized that controlled human exposure studies are conducted with healthy adult volunteers and that these studies do not include individuals who may be at increased risk of $PM_{2.5}$-related health effects (*i.e.,* children, older adults, people with pre-existing diseases). He also noted that the effects observed in the controlled human exposure studies (*e.g.,* changes in vascular function) are not effects that are judged to be clearly adverse. He recognized the most consistent evidence of effects in these studies occurs at higher concentrations (*e.g.,* >120 μg/m³) following 1–5 hour exposures, and that one study observed effects at concentrations as low as 38 μg/m³ following 4-hour exposures. However, the Administrator reiterated that these studies do not tell us at exactly what concentrations an adverse effect might occur, especially for at-risk populations. As noted above in section II.A.2.c, controlled human exposure studies tend to include generally healthy adult individuals who are at a lower risk of experiencing health effects, and often do not include at-risk populations (*e.g.,* children, older adults, or individuals with pre-existing conditions). As such, the Administrator recognized that these studies are somewhat limited in their ability to inform at what concentrations effects may be elicited in in at-risk populations. The Administrator also considered air quality analyses in the 2022 PA that demonstrate that there will be very few, if any, days with $PM_{2.5}$ concentrations at levels evaluated in controlled human exposure studies that are associated with effects in areas that meet the current primary 24-hour $PM_{2.5}$ standard.

The Administrator also noted that as, in previous PM NAAQS reviews, the protection provided by the suite of standards (*e.g.,* annual and 24-hour standards) is evaluated together. He noted that the annual standard is the controlling standard in most areas of the country. He also considered air quality analyses in the 2022 PA that suggest that revision of the annual standard to a level between 9–10 μg/m³ would also control 24-hour $PM_{2.5}$ concentrations in most areas to, or below, 30 μg/m³. Finally, the Administrator noted the agreement with the advice from the minority of CASAC and additionally noted the limited rationale and evidence provided by the majority CASAC's recommendation to support revision of the 24-hour standard. As such, the Administrator proposed to retain the current 24-hour standard with its level of 35 μg/m³.

Additionally, the Administrator proposed to conclude that it is appropriate to retain all other elements (*i.e.,* indicator, averaging time, and form) of the annual and 24-hour standards.

3. Comments on the Proposed Decision

With respect to the adequacy of the primary annual $PM_{2.5}$ standard, a number of commenters, primarily those from industry and industry groups, non-governmental organizations, and some State and local governments, disagree with the EPA's proposed decision to revise the level of the primary annual $PM_{2.5}$ standard. These commenters generally expressed the view that the current standards provide the requisite degree of public health protection and should be retained, consistent with the 2020 final decision. In supporting their view, these commenters assert that the scientific evidence available in this reconsideration is essentially unchanged since the 2020 final decision and that the additional scientific evidence and quantitative risk information available for the reconsideration does not support strengthening the primary annual $PM_{2.5}$ standard. These commenters also assert that uncertainties associated with the available scientific evidence have not changed since the 2020 final decision, and they note that these uncertainties were essential factors in the then-Administrator's decision to retain the primary annual $PM_{2.5}$ standard. These commenters argue that, while the current Administrator acknowledges these uncertainties, he does not place enough weight on them in reaching his conclusions regarding the current standard. The commenters specifically highlight uncertainties related to exposure misclassification, confounding, and other sources of potential bias, which they claim supports retaining the current level of the annual standard. These commenters also note that these uncertainties were emphasized by the minority of the CASAC in their review of the 2021 draft PA, and the commenters further suggest that the lack of consensus from the CASAC on the appropriate level for the primary annual $PM_{2.5}$ standard show that the research is unclear. The commenters contend that there is not support in this reconsideration for deviating from the then-Administrator's decision in 2020.

In contrast, other commenters, primarily from public health and environmental organizations, some State and local elected representatives, and some State and local government agencies agree with the EPA's proposed decision that the primary annual $PM_{2.5}$ standard is not adequate. These commenters support revising the level of the primary annual $PM_{2.5}$ standard and emphasize that the available scientific evidence, in particular epidemiologic studies, along with the CASAC's advice in their review for the 2021 draft PA, provide strong support for the proposed decision. In particular, these commenters agree with the EPA's conclusions about the strength of the scientific evidence, including uncertainties, and they emphasize that the CASAC reached consensus in their review of the 2021 draft PA that the current primary annual $PM_{2.5}$ standard is not adequate. Some of these commenters also note that a revised primary annual $PM_{2.5}$ standard would result in significant public health benefits by reducing morbidity and mortality associated with $PM_{2.5}$ exposure, especially for at-risk populations.

The EPA agrees with commenters that the primary annual $PM_{2.5}$ standard is not adequate. The EPA recognizes the longstanding body of health evidence supporting relationships between $PM_{2.5}$ exposures (short- and long-term) and both mortality and serious morbidity effects. The evidence available in this reconsideration (*i.e.,* the studies

assessed in the 2019 ISA and ISA Supplement summarized above in section II.A.2.a) reaffirms, and in some cases strengthens, the conclusions from the 2009 ISA regarding the health effects of $PM_{2.5}$ exposures. As noted above, epidemiologic studies demonstrate generally positive and often statistically significant associations between $PM_{2.5}$ exposures and health effects. Such studies report associations between estimated $PM_{2.5}$ exposures and non-accidental, cardiovascular, or respiratory mortality; cardiovascular or respiratory hospitalizations or emergency room visits; and other mortality/morbidity outcomes (*e.g.,* lung cancer mortality or incidence, asthma development). Recent experimental evidence, as well as evidence from epidemiologic panel studies, strengthens support for potential biological pathways through which $PM_{2.5}$ exposures could lead to the serious effects reported in many population-level epidemiologic studies, including support for pathways that could lead to cardiovascular, respiratory, nervous system, and cancer-related effects. Moreover, these recent epidemiologic studies strengthen support for health effect associations at $PM_{2.5}$ concentrations lower than in those evaluated in epidemiologic studies available at the time of previous reviews.

Additionally, as discussed in more detail in section I.C.5.b above, the ISA Supplement focused on studies that were most likely to inform decisions on the appropriate standard, but not to reassess areas that, based on the assessment of available science published since the cutoff date of the 2019 ISA and through 2021, were judged unlikely to have new information that would be useful for the Administrator's decision making. The ISA Supplement included U.S. and Canadian epidemiologic studies for health effect categories where the 2019 ISA concluded a causal relationship (*i.e.,* short- and long-term $PM_{2.5}$ exposure and cardiovascular effects and mortality), as well as U.S. and Canadian epidemiologic studies that employed alternative methods for confounder control or conducted accountability analyses (*i.e.,* studies that examined the effect of a policy on reducing $PM_{2.5}$ concentrations). These studies, summarized in section II.A.2.a above, examine both short- and long-term $PM_{2.5}$ exposure and cardiovascular effects and mortality. Additionally, studies that employ alternative methods for confounder control, as described in II.A.2.a above and in Table 3–11 and of the 2022 PA (U.S. EPA, 2022b), use a variety of statistical methods to control for confounding bias. These studies consistently report positive associations, which further supports the broader body of epidemiologic evidence for both cardiovascular effects and mortality.

In addition, there are epidemiologic studies that provide supplemental information for consideration in reaching conclusions that the current suite of $PM_{2.5}$ standards is not adequate. These studies include analyses that restrict annual average $PM_{2.5}$ concentrations to concentrations below 12 $\mu g/m^3$ and provide support for positive and statistically significant associations with mortality and cardiovascular morbidity at mean $PM_{2.5}$ concentrations below the current level of the primary annual $PM_{2.5}$ standard (described above in section II.A.2.c.ii and in Table 3–10 of the 2022 PA (U.S. EPA, 2022b)). Recent accountability studies that have starting annual $PM_{2.5}$ concentrations at or below 12 $\mu g/m^3$ suggest public health improvements may occur at concentrations below 12 $\mu g/m^3$. These studies indicate positive and statistically significant associations with mortality and morbidity (*e.g.,* cardiovascular hospital admissions) and reductions in $PM_{2.5}$ concentrations in ambient air (described above in section II.A.2.c.ii and in Table 3–12 of the 2022 PA (U.S. EPA, 2022b)).

Thus, in considering the available scientific evidence to inform conclusions on the adequacy of the primary $PM_{2.5}$ standards, the Administrator recognizes that the 2019 ISA and the ISA Supplement together provides a strong scientific foundation for concluding that the current primary $PM_{2.5}$ standards are not adequate.

In addition to the scientific evidence above, the risk assessment estimates that the current primary annual $PM_{2.5}$ standard could allow a substantial number of deaths in the U.S. Although the Administrator recognizes that while the risk estimates can help to place the evidence for specific health effects into a broader public health context, they should be considered along with the inherent uncertainties and limitations of such analyses when informing judgments about the potential for additional public health protection associated with $PM_{2.5}$ exposures and related health effects. The Administrator takes into consideration these uncertainties, which are described in more detail in section II.A.3.b above, but notes that the general magnitude of risk estimates supports the potential for significant public health impacts, particularly for lower alternative annual standard levels.

In the CASAC's review of the 2019 draft PA, the CASAC did not reach consensus on whether the current annual standard is adequate, with the majority of the CASAC recommending that the annual standard be retained and the minority of the CASAC recommending that the standard be revised. In their review of the 2021 draft PA, the CASAC unanimously recommended that the current annual standard is not sufficiently protective of public health (Sheppard, 2022a, p. 2 of consensus letter).

The EPA disagrees with the commenters who state that the available scientific and quantitative information available in this reconsideration does not provide support for the current Administrator to reach a different decision than the then-Administrator reached in the 2020 final action. The EPA agrees with these commenters that there are uncertainties associated with the currently available scientific evidence. The EPA has considered these uncertainties extensively both in reaching conclusions in the 2022 PA (U.S. EPA, 2022b, sections 3.4.3, 3.6.1, and 4.6.3) and in the proposal (88 FR 5604, 5609, January 27, 2023), and the EPA addresses more detailed public comments about these uncertainties, including those related to copollutant confounding, unmeasured confounding, and temporal and spatiotemporal confounding, in the Response to Comments document. However, we disagree with the commenters that the evidence does not provide support for the Administrator's conclusion that the current primary annual $PM_{2.5}$ standard is not adequate to protect public health with an adequate margin of safety, and should be revised. As described above, epidemiologic studies in the 2019 ISA and the ISA Supplement support and extend the evidence evaluated in the 2009 ISA, through studies conducted in diverse populations and geographic locations, using various statistical models and approaches to control for potential confounders, and using a variety of exposure assessment methodologies. Therefore, the consistent, positive associations reported across studies (U.S. EPA, 2019a, Figures 11–1 and 11–18; U.S. EPA, 2022a) are unlikely to be to be the result of unmeasured confounding and other biases are unlikely to account for the consistent positive associations observed across epidemiologic studies.

Additionally, this reconsideration includes epidemiologic studies that were not before the then-Administrator for consideration in reaching his final decisions at the time of the 2020 decision and that specifically evaluate

confounding using alternative methods for confounder control). These recent epidemiologic studies provide support for the current Administrator's conclusion that the suite of primary $PM_{2.5}$ standards are not adequate. While confounding was an uncertainty noted by the then-Administrator in the 2020 decision, he recognized ''that methodological study designs to address confounding, such as causal inference methods, are an emerging field of study'' (85 FR 82710, December 18, 2020). The ISA Supplement considered studies that employed statistical approaches that attempt to more extensively account for confounders and are more robust to model misspecification (*i.e.,* used alternative methods for confounder control),[92] given that such studies were highlighted by the CASAC in their review of the 2019 draft PA and identified in public comments on the 2020 proposal. Since the literature cutoff date for the 2019 ISA, multiple studies that employ alternative methods for confounder control have become available for consideration in the ISA Supplement and, subsequently, in this reconsideration. For example, one study before the Administrator in this reconsideration that was not available in the 2019 ISA is Schwartz et al. (2021), which used a causal modeling approach focused on exposure changes and controls for measured confounders by design in order to evaluate the association between long-term $PM_{2.5}$ exposure and mortality in the Medicare population. The study authors found significant associations of $PM_{2.5}$ with increased mortality rates using a causal modeling approach robust to omitted confounding. The results of this study and other studies in the ISA Supplement that employ alternative methods to control for confounders lend support to the robustness of positive associations between $PM_{2.5}$ exposure and multiple morbidity and mortality endpoints exhibited across epidemiologic studies, and also indicate that unmeasured confounding and other biases are unlikely to account for the consistent positive associations observed across epidemiologic studies (U.S. EPA, 2022b, sections 3.1.1.3, 3.1.2.3, 3.2.1.3, and 3.2.2.3).

Further, the EPA disagrees with the commenters who argue that the Administrator did not appropriately consider the strengths and limitations of the health evidence in reaching his decision to revise the current primary annual $PM_{2.5}$ standard in this reconsideration. In reaching his proposed decision, the Administrator considered the entire body of evidence and how to appropriately weigh the uncertainties associated with the health evidence (88 FR 5617, January 27, 2023). Such an approach is consistent with setting standards that are neither more nor less stringent than necessary, recognizing that ''Congress provided that the Administrator is to use his judgment in setting air quality standards precisely to permit him to act in the face of uncertainty,'' the Administrator must set standards on ''the frontiers of scientific and medical knowledge'' and ''Congress directed the Administrator to err on the side of caution in making the necessary decisions.'' *Lead Indus. Ass'n, Inc.* v. *EPA,* 647 F.2d 1130, 1155 & n.50 (D.C. Cir. 1980) (quoting H.R. Rep. No. 95–294, at 50). As such, a determination of identifying a specific level at which the standard should be set necessarily requires the Administrator's judgement (*e.g.,* weighing the uncertainties and margin of safety).

Additionally, the EPA disagrees with the commenters that contend that there is no basis in this reconsideration for deviating from the previous Administrator's decision in 2020. It is well-established that in CAA section 109 Congress specifically left the determination of the requisite NAAQS to the judgment of the Administrator and, moreover, that ''decisions about the appropriate NAAQS level must 'necessarily . . . rest largely on policy judgments.' '' *Mississippi* v. *EPA,* 744 F.3d 1344, 1357 (D.C. Cir. 2013) (quoting *Lead Industries Ass'n* v. *EPA,* 647 F.2d 1130, 1147 (D.C. Cir. 1980)). As the Court of Appeals for the D.C. Circuit has noted, ''Every time EPA reviews a NAAQS, it (presumably) does so against contemporary policy judgments and the existing corpus of scientific knowledge.'' *Id.,* at 1343.

In this reconsideration, both the existing corpus of scientific knowledge as well as the Administrator's policy judgments about how to interpret and weigh that evidence to protect public health with an adequate margin of safety have changed. The expansion of the air quality criteria to encompass additional studies, information and analyses in the ISA Supplement and 2022 PA, as well as the additional consideration of the scientific record by the CASAC and the public provided the Administrator with significant additional information on which to base his decision.[93] In addition, in this reconsideration, the Administrator is reaching different judgments about how to weigh the epidemiologic evidence, including the uncertainties in the scientific evidence, and how to ensure an adequate margin of safety to protect against uncertain harms, compared to the approach in the 2020 final decision. For example, as discussed in greater detail above in section II.A.1 and in the 2020 notice of final rulemaking (85 FR 82717, December 18, 2020), in considering the epidemiologic evidence as part of his decision to retain the current primary annual $PM_{2.5}$ standard in the 2020 decision, the then-Administrator placed weight on the mean of the study-reported means (or medians) (*i.e.,* 13.5 $\mu g/m^3$) from key U.S. epidemiologic studies that are monitor-based being above the level of the current primary annual $PM_{2.5}$ standard of 12.0 $\mu g/m^3$. By contrast, in this reconsideration, the current Administrator has taken an approach more similar to how the EPA has considered study-reported mean $PM_{2.5}$ concentrations relative to the level of the primary annual $PM_{2.5}$ standard in other recent PM NAAQS reviews. In so doing, in reaching his decision to revise the level of the primary annual $PM_{2.5}$ standard to 9.0 $\mu g/m^3$, he is using an approach that places weight on selecting a level for the standard that is below the study-reported mean $PM_{2.5}$ concentrations reported in key U.S. epidemiologic studies, including recent epidemiologic studies that use hybrid model-based methods, as well as being near or below the 25th percentile $PM_{2.5}$ concentrations in those key U.S. epidemiologic studies that report these concentrations.

As such and further detailed in section II.B.4 below, in considering the adequacy of the current primary PM standards in this reconsideration, the Administrator has carefully considered the: (1) Policy-relevant evidence and conclusions contained in the 2019 ISA and 2022 ISA Supplement; (2) the quantitative information presented and

[92] As noted in the ISA Supplement: ''In the peer-reviewed literature, these epidemiologic studies are often referred to as causal inference studies or studies that used causal modeling methods. For the purposes of this Supplement, this terminology is not used to prevent confusion with the main scientific conclusions (*i.e.,* the causality determinations) presented within an ISA. In addition, as is consistent with the weight-of-evidence framework used within ISAs and discussed in the Preamble to the Integrated Science Assessments, an individual study on its own cannot inform causality, but instead represents a piece of the overall body of evidence'' (U.S. EPA, 2022a, p. 1–3).

[93] The EPA notes that, in considering the additional scientific evidence available in this reconsideration, one member of the CASAC who reviewed both the 2019 draft PA and the 2021 draft PA found that the available scientific and quantitative information available in this reconsideration supported revising the level of the primary annual $PM_{2.5}$ standard, whereas he recommended retaining the standard during the review of the 2019 draft PA.

assessed in the 2022 PA; (3) the evaluation of this evidence, the quantitative information, and the rationale and conclusions presented in the 2022 PA; (4) the advice and recommendations from the CASAC; and (5) public comments. The Administrator concludes that the current suite of primary $PM_{2.5}$ standards are not adequate to protect public health with an adequate margin of safety.

The four basic elements of the NAAQS (indicator, averaging time, form, and level) are considered collectively in evaluating the health protection afforded by a standard. The EPA received relatively few comments on the averaging time and form for the primary $PM_{2.5}$ standards, but those who did provide comments on these elements were primarily from public health and environmental organizations, State and local elected representatives, and State and local government agencies. Some commenters assert that the current 24-hour averaging time for the primary 24-hour $PM_{2.5}$ standard does not adequately protect against short-term peaks. These commenters further state that the 24-hour averaging time protects against chronic exposures but does not adequately protect against serious acute risks from certain sources such as prescribed burning. Also, a few commenters explicitly recommend that a subdaily averaging time would be more appropriate, although none of the commenters recommended a specific averaging time for consideration. Additionally, some commenters cite to the CASAC's advice in their review of the 2021 draft PA that future reviews of the PM NAAQS should include evaluation of alternative forms and averaging times of the current primary 24-hour $PM_{2.5}$ standard.

The EPA disagrees with commenters that the current primary 24-hour $PM_{2.5}$ standard, with its 24-hour averaging time, does not adequately protect against short-term peaks and disagrees that that there is sufficient information to conclude that a subdaily averaging time would be more appropriate than a 24-hour averaging time. The EPA has reviewed the currently available scientific evidence and finds that it does not indicate that alternative averaging times would be more appropriate for the primary $PM_{2.5}$ standards. Accordingly, the EPA concludes that it is appropriate to retain both the annual and 24-hour averaging times for standards meant to protect against long- and short-term $PM_{2.5}$.

As noted in the proposal, the 2019 ISA and ISA Supplement found that the scientific evidence continues to provide strong support for health effect associations with both long-term (*e.g.,* annual or multi-year) and short-term (*e.g.,* mostly 24-hour) exposures to $PM_{2.5}$. Epidemiologic studies continue to provide strong support for health effects associated with short-term $PM_{2.5}$ exposures based on 24-hour $PM_{2.5}$ averaging periods, and we note that subdaily effect estimates are less consistent and, in some cases, smaller in magnitude (88 FR 5618, January 27, 2023). Controlled human exposure and panel-based studies of subdaily exposures typically examine subclinical effects rather than the more serious population-level effects that have been reported to be associated with 24-hour exposures (*e.g.,* mortality, hospitalizations). Collectively, the 2019 ISA concludes that epidemiologic studies do not indicate that subdaily averaging periods are more closely associated with health effects than the 24-hour average exposure metric (U.S. EPA, 2019a, section 1.5.2.1). Additionally, the EPA notes that while recent controlled human exposure studies provide consistent evidence for cardiovascular effects following $PM_{2.5}$ exposures for less than 24 hours (*i.e.,* <30 minutes to 5 hours), exposure concentrations in these studies are well-above the ambient concentrations typically measured in locations meeting the current standards (U.S. EPA, 2022a, section 3.3.3.1). Therefore, this information does not indicate that a revision to the averaging time is needed to provide additional protection against subdaily $PM_{2.5}$ exposures, beyond that provided by the current primary standards. This conclusion is also supported by the advice given to EPA by the CASAC in their review of the 2021 draft PA, which reached consensus that averaging times for the standards should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[94] For all of these reasons, the Administrator concludes that the currently available evidence does not support considering alternatives to the annual and 24-hour averaging times for standards meant to protect against long- and short-term $PM_{2.5}$ exposures.

Multiple commenters, primarily from public health and environmental organizations, recommend revising the form of the primary 24-hour $PM_{2.5}$ standard to a 99th percentile to provide increased public health protection against peak $PM_{2.5}$ exposures, particularly for at-risk populations. These commenters express concern that the current 98th percentile form allows 7 exceedances per year and contend that a 99th percentile form that would allow half that number is more appropriate. Commenters also cite to the CASAC's advice in their review of the 2021 draft PA, which recommended that the EPA consider alternative percentiles for the form of the primary 24-hour $PM_{2.5}$ standard in the future.

The EPA disagrees that the current 98th percentile form does not provide the requisite public health protection against peak $PM_{2.5}$ exposures and concludes that the 98th percentile, averaged over three years, remains appropriate for the primary 24-hour $PM_{2.5}$ standard. As noted in previous reviews and in the proposal, the EPA has set both an annual standard and a 24-hour standard to provide protection from health effects associated with both long- and short-term exposures to $PM_{2.5}$ (62 FR 38667, July 18, 1997; 88 FR 5620, January 27, 2023). With respect to the form of the 24-hour standard, as described just above, the epidemiologic studies continue to provide strong support for health effect associations with short-term (*e.g.,* mostly 24-hour) $PM_{2.5}$ exposures and controlled human exposure studies provide evidence for health effects following single short-term ''peak'' $PM_{2.5}$ exposures (88 FR 5619, January 27, 2023). Both the 98th and the 99th percentile form provide a very high degree of control of peak concentrations. As the commenters point out, a 99th percentile would reduce the number of allowable exceedances to four days per year. The EPA anticipates, however, that such a revision to the form would make the attainment status of an area more subject to change from unpredictable nonanthropogenic factors, such as meteorological events. The EPA has often noted that frequent shifts in attainment status that are unrelated to long-term air quality trends is inconsistent with providing a stable target for air quality planning and risk management programs, which in turn provides for the most effective public health protection in the long run (78 FR 3127, January 15, 2013; 80 FR 65351, October 26, 2015). Thus, the EPA's interest in an appropriate degree of stability is to ensure that the State air quality programs are effective in controlling pollution and that the public health protections of the standard are achieved. As discussed above, while recent controlled human exposure studies provide consistent evidence for cardiovascular effects following $PM_{2.5}$

[94] In providing advice on the 2019 draft PA, the CASAC did not weigh in specifically on the averaging time of the primary 24-hour $PM_{2.5}$ standard but did recommend that the standard be retained because the available evidence does not call into question its adequacy (Cox, 2019b, p. 3 of consensus letter).

exposures for less than 24 hours (*i.e.,* < 30 minutes to 5 hours), exposure concentrations in these studies are well-above the ambient concentrations typically measured in locations meeting the current standards (U.S. EPA, 2022a, section 3.3.3.1), and the 98th percentile form is very effective at limiting occurrences of exposures of concern. Taking into consideration the available scientific information and quantitative information, the EPA therefore concludes that the 98th percentile form provides an appropriate balance between limiting the occurrence of peak 24-hour $PM_{2.5}$ concentrations and identifying a stable target for risk management programs. This conclusion is also supported by the advice given to the EPA by the CASAC in their review of the 2021 draft PA, where they reached consensus that the form for the standards should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[95]

Additionally, the EPA recognizes the CASAC's advice in their review of the 2021 draft PA, where they recommended ''that in future reviews, the EPA provide a more comprehensive assessment of the 24-hour standard that includes the form as well as the level'' (Sheppard, 2022a, p. 4 of consensus letter). This advice is reflected in the proposal by the EPA, which noted ''that it would be appropriate to gather additional air quality and scientific information and further consider these issues in future reviews'' (88 FR 5619, January 27, 2023). The EPA will consider the information provided by the commenters regarding the form of the 24-hour $PM_{2.5}$ standard in the next review of the PM NAAQS.

A number of commenters who support revising the level of the primary annual $PM_{2.5}$ standard, particularly those who support a revised level of 8 $\mu g/m^3$, disagree with how the EPA has emphasized the mean $PM_{2.5}$ concentrations reported in key epidemiologic studies to inform conclusions on the level of the primary $PM_{2.5}$ standard. These commenters argue that, in this reconsideration, the EPA is arbitrarily emphasizing uncertainties in key epidemiologic studies in the focus on mean concentrations. Many of these commenters recommend that the EPA consider the full distribution of $PM_{2.5}$ concentrations from the key epidemiologic studies in reaching conclusions on the appropriate level for the primary annual $PM_{2.5}$ standards, in particular concentrations below the mean, such as the 25th percentile. In supporting this view, commenters point to the CASAC's advice in their review of the 2021 draft PA, where the majority of the CASAC stated that the ''use of the mean to define where the data provide the most evidence is conservative since robust data clearly indicate effects below the mean in concentration-response functions'' (Sheppard, 2022a, p. 16 of consensus responses), and that ''[e]pidemiologic studies require consideration of distribution around the mean of exposure to identify effects and thus lower levels than the mean must be considered as part of the range where the data provide higher confidence'' (Sheppard, 2022a, p. 13 of consensus responses).

As an initial matter, consistent with some previous approaches and as detailed by the Administrator in reaching conclusions on the level of the primary annual $PM_{2.5}$ standard in section II.B.4 below, the EPA considers the long-term study-reported mean $PM_{2.5}$ concentrations from key epidemiologic studies and sets the level of the standard to somewhat below the lowest long-term mean $PM_{2.5}$ concentration. Additionally, as discussed further below, the EPA also considers the available information from a subset of epidemiologic studies that report exposure estimates or health events at the 25th and 10th percentiles of $PM_{2.5}$ concentrations. The Administrator gives some weight to the 25th percentile data, although he recognizes that his confidence in the magnitude and significance in the reported concentrations, and their ability to inform decisions on the appropriate level of the annual standard, decreases with reduced data (below the mean) and diminishes further at percentiles that are even further below the mean and the 25th percentile. Therefore, the Administrator places weight on the reported 25th percentiles concentrations, rather than the reported 10th percentile concentrations, for the subset of studies that report lower percentile $PM_{2.5}$ concentrations in reaching his conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard.

In considering the available scientific evidence to reach decisions on the adequacy of the suite of primary $PM_{2.5}$ standards, the EPA notes that in previous PM NAAQS reviews (including the 1997, 2006 and 2012 reviews), evidence-based approaches were used that focused on identifying standard levels near or somewhat below long-term mean concentrations reported in key epidemiologic studies. These approaches were supported by the CASAC in previous reviews and were supported in this reconsideration by the CASAC in their review of the 2021 draft PA.[96]

In considering the available scientific evidence, the EPA notes the strength of the epidemiologic evidence which includes multiple studies that consistently report positive associations for short- and long-term $PM_{2.5}$ exposures and mortality and cardiovascular effects. Some available studies also use a variety of statistical methods to control for confounding bias and report similar associations, which further supports the broader body of epidemiologic evidence for both mortality and cardiovascular effects. Additionally, the EPA notes that recent epidemiologic studies strengthen support for health effect associations at $PM_{2.5}$ concentrations lower than in those evaluated in epidemiologic studies available at the time of previous reviews.

While these epidemiologic studies evaluate associations between distributions of ambient $PM_{2.5}$ concentrations and health outcomes, they do not identify the specific exposures that led to the reported effects. As such, there is no specific point in the air quality distribution of any epidemiologic study that represents a ''bright line'' at and above which effects have been observed and below which effects have not been observed.

Studies of daily $PM_{2.5}$ exposures examine associations between day-to-day variation in $PM_{2.5}$ concentrations and health outcomes, often over several years. While there can be considerable variability in daily exposures over a multi-year study period, most of the estimated exposures reflect days with

[95] The CASAC did not provide advice or recommendations regarding the forms of the primary $PM_{2.5}$ standards in their review of the 2019 draft PA (Cox, 2019b).

[96] The Administrator notes that, in their review of the 2021 draft PA, a majority of members of the CASAC noted that there are some limitations for this approach ''for the purpose of informing the adequacy of the standards'' (Sheppard, 2022a, p. 8 of consensus responses) and advised that future reviews should include evaluation of other metrics, including the distribution of concentrations reported in epidemiologic studies and in analyses restricting concentrations to below the current standard level. The Administrator also notes that, in their review of the 2019 draft PA, the CASAC lacked consensus on the inferences to be drawn from the epidemiologic evidence, with a majority of CASAC having concerns about confounding, error and bias and concluding that newer studies did not provide a basis for revising the current standards, while a minority concluded that the evidence, including more recent studies showing associations in areas with average long-term $PM_{2.5}$ concentrations below the current annual standard, supported their conclusion that the current standards are inadequate (Cox, 2019b, pp. 8–9 of consensus responses).

ambient $PM_{2.5}$ concentrations around the middle of the air quality distributions examined (*i.e.,* ''typical'' days rather than days with extremely high or extremely low concentrations). Similarly, for studies of annual $PM_{2.5}$ exposures, most of the health events occur at estimated exposures that reflect annual average $PM_{2.5}$ concentrations around the middle of the air quality distributions examined. In both cases, epidemiologic studies provide the strongest support for reported health effect associations for this middle portion of the $PM_{2.5}$ air quality distribution, which corresponds to the bulk of the underlying data, rather than the extreme upper or lower ends of the distribution. Therefore, in the absence of discernible thresholds, long-term study-reported means—that is, the study-reported ambient $PM_{2.5}$ concentrations in the epidemiologic studies that reflect estimated exposures with a focus around the middle portion of the $PM_{2.5}$ air quality distribution where the bulk of the observed data reside—provide the strongest support for reported health effect associations in epidemiologic studies.

Based on the air quality criteria for this reconsideration, as described in the 2019 ISA, ISA Supplement, 2022 PA and the proposal, the EPA believes it is appropriate to continue to use the mean $PM_{2.5}$ concentrations from the key epidemiologic studies to inform conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard.

There are a large number of key epidemiologic studies available in this reconsideration to inform conclusions regarding the level of the primary annual $PM_{2.5}$ standard. For the key U.S. epidemiologic studies, the study-reported mean $PM_{2.5}$ concentrations range from 9.9–16.5 $\mu g/m^3$ for monitor-based studies (Figure 1 above) and range from 9.3–12.2 $\mu g/m^3$ for hybrid modeling-based studies (Figure 2 above).

In addition to the study-reported mean $PM_{2.5}$ concentrations, the EPA agrees with the CASAC's advice in their review of the 2021 draft PA and public comments that information on other percentiles below the mean can also be informative, and the EPA notes that the CASAC advised that for the purpose of informing the adequacy of the standards, future reviews should include an evaluation of other metrics, including the distribution of concentrations reported in epidemiologic studies (Sheppard, 2022a, p. 9 of consensus responses). As such, in reaching conclusions in this reconsideration, the EPA takes note of the additional study-reported $PM_{2.5}$ concentrations below the means (*e.g.,* 25th and 10th percentiles) that are available from a limited subset of key U.S. epidemiologic studies. As shown in Figures 1 and 2 above, six key U.S. epidemiologic studies report information on other percentiles (*e.g.,* 10th and 25th percentiles of $PM_{2.5}$ concentrations or 10th and 25th percentiles of $PM_{2.5}$ concentrations associated with health events) that are below the mean.[97] Three of the studies are monitor-based and three are hybrid model-based.

The key U.S. epidemiologic studies that report percentiles below the mean that are monitor based are older studies. These studies included smaller numbers of people than the newer hybrid model-based studies. For the three older, monitor-based studies, because the cohorts were smaller in size, a relatively smaller portion of the health events were observed in the lower part of the air quality distribution. As such, our confidence in the magnitude and significance of the associations begins to decrease in the lower part of the air quality distribution of those older, monitor-based studies.

The three newer, hybrid model-based studies have larger cohort sizes than the older, monitor-based studies and, as noted by commenters, have more health events in the lower part of the air quality distribution. For these reasons, the EPA notes that we have more confidence in the reported association at concentrations lower than the reported mean in these more recent hybrid model-based studies, particularly at the 25th percentile compared to the 10th percentile. While the cohort sizes in the more recent, hybrid model-based studies are larger than the older, monitor-based studies, the EPA notes that the 10th percentiles are well below the middle portion of the air quality distribution for which we have the greatest confidence, and as noted above, our confidence in the magnitude and significance of associations in the lower parts of the air quality distribution begins to decrease. While we have more confidence in the lower percentiles because of the larger cohort sizes in the more recent hybrid model-based studies, we also have more confidence in the 25th percentiles than in the 10th percentiles, which are further from the means and closer to the lower end of the air quality distribution.

In considering how the six studies that report percentiles lower than the mean can be used to inform conclusions regarding the level of the primary annual $PM_{2.5}$ standard, the EPA first notes that the three monitor-based epidemiologic studies (Bell et al., 2008; Franklin et al., 2007; Zanobetti and Schwartz, 2009) report 25th percentile concentrations that are at or above 11.5 $\mu g/m^3$. For two of the more recent hybrid model-based studies (Di et al., 2017b; Wang et al., 2017), the 25th percentile of estimated $PM_{2.5}$ concentrations are just above 9 $\mu g/m^3$, while one study (Di et al., 2017a) reports a $PM_{2.5}$ concentrations corresponding to 25th percentiles of health events of just below 7 $\mu g/m^3$. For the Di et al. (2017a) study, the 25th percentile $PM_{2.5}$ concentration (6.7 $\mu g/m^3$) is based on the $PM_{2.5}$ concentration at which the 25th percentile of deaths occur in the study, while the reported mean (11.6 $\mu g/m^3$) is based on estimated $PM_{2.5}$ exposure concentrations. Additionally, the 25th percentiles of the other two recently available hybrid model-based studies (Di et al., 2017b; Wang et al., 2017) are based on estimated $PM_{2.5}$ concentrations. As such, the $PM_{2.5}$ concentration at which the 25th percentile of health events occur may be different from the estimated 25th percentile $PM_{2.5}$ concentration in this study (Di et al., 2017a), creating an uncertain basis for comparison with the studies by Di et al. (2017b) and Wang et al. (2017). The 25th percentiles from these studies, in particular those that are more recently available, help to inform the Administrator's judgments regarding the appropriate level for the primary annual $PM_{2.5}$ standard.

Some commenters disagree with the EPA's consideration of the relationship between mean $PM_{2.5}$ concentrations reported in the key epidemiologic studies and design values to inform conclusions on the appropriate level for the primary annual $PM_{2.5}$ standards. Commenters contend that setting the level of the primary annual standard below the design values in the epidemiologic studies, rather than below the study-reported mean concentrations, might keep overall mean $PM_{2.5}$ concentrations throughout an area below the study-reported means but allow $PM_{2.5}$ concentrations in some parts of the area, including near the ''design value monitor'' to remain above the study-reported mean $PM_{2.5}$ concentrations, which are the concentrations where the evidence of health effects is strongest. Commenters contend that such a decision framework would not result in a standard that would provide requisite protection with an adequate margin of safety,

[97] The Wang et al. (2017) study only reports the 25th percentile of the estimated $PM_{2.5}$ concentrations, not the 10th percentile.

particularly for at-risk populations. These commenters further support this view by citing the CASAC's advice in their review of the 2021 draft PA, where the majority of CASAC stated that ''even if a design value is somewhat higher than the area average, it reflects actual exposure levels and thus any portion of the population living near the design value monitor does experience exposures at that level and consequent health effects of exposure to that higher concentration'' (Sheppard, 2022a, p. 14 of consensus responses). Additionally, these commenters suggest that the EPA should not deviate from the approach taken in the 2012 review, which was to set the standard at a level ''somewhat below'' the lowest mean $PM_{2.5}$ concentration in the key epidemiologic studies.

To the extent that commenters are suggesting that the EPA is setting the level of the primary annual $PM_{2.5}$ standard below the design values in the epidemiologic studies, rather than below the study-reported mean $PM_{2.5}$ concentrations, we disagree with the commenters. In reaching conclusions on the level of the primary annual $PM_{2.5}$ standard, the EPA considers the long-term study-reported mean $PM_{2.5}$ concentrations from key epidemiologic studies and sets the level of the standard to somewhat below the lowest long-term mean $PM_{2.5}$ concentration, not below the design values in the epidemiologic studies. Additionally, the EPA also considers the available information from a subset of epidemiologic studies that report exposure estimates or health events at the 25th and 10th percentiles of $PM_{2.5}$ concentrations. The EPA particularly considers the 25th percentile data, while recognizing that our confidence in the magnitude and significance in the reported concentrations, and the ability of the lower percentile $PM_{2.5}$ concentrations to inform decisions on the appropriate level of the annual standard, decreases with reduced data (below the mean) and diminishes further at percentiles that are even further below the mean and the 25th percentile.

However, the EPA notes that it is important to understand, and to not ignore, the relationship between the study-reported mean $PM_{2.5}$ concentrations reported in key epidemiologic studies and the area design value. As an initial matter, the NAAQS consists of all four elements of the standard (indicator, averaging time, form, and level) and setting a standard that is requisite to protect public health includes consideration of all four elements together. Following implementation of the NAAQS, the design value is the metric used to determine compliance with the standard and is the statistic that describes the air quality status of a given location relative to the level of the primary annual $PM_{2.5}$ NAAQS. The design value is different from the study-reported mean $PM_{2.5}$ concentrations. This is because the study-reported mean $PM_{2.5}$ concentrations are an annual average $PM_{2.5}$ concentration, similar to the level of the standard, but the epidemiologic studies do not report statistics that take into account the other elements of the standard (*i.e.,* averaging time and form). Therefore, when considering the appropriate revisions to the annual $PM_{2.5}$ standard, the EPA must consider the protection provided by a revised standard taking into account all of the elements of the standard, not just the annual average $PM_{2.5}$ concentration alone.

In considering the annual standard, and in assessing the range of study-reported exposure concentrations for which we have the strongest support for adverse health effects observed in epidemiologic studies, the EPA focuses on whether the current primary annual $PM_{2.5}$ standard provides adequate protection against these exposure concentrations or if the level of the standard should be revised to provide the appropriate public health protection. This means that, as in some previous reviews, it is important to consider how the study means were computed and how these concentrations compare to the annual standard metric (including the level, averaging time and form) which must be met at the monitor with the highest $PM_{2.5}$ design value in an area for compliance with the NAAQS. This approach is based on the application of a decision framework based on assessing means (as well as the lower distribution of reported $PM_{2.5}$ concentration, as noted above) reported in key epidemiologic studies. In the 2012 review, the available key epidemiologic studies computed the mean $PM_{2.5}$ concentrations using an average across monitor-based $PM_{2.5}$ concentrations. As such, at that time, the decision framework used an approach based on maximum monitor concentrations to determine compliance with the standard, while selecting the standard level based on consideration of composite monitor concentrations (*i.e.,* selecting the standard level of 12.0 μg/m^3 was just below the long-term study-reported mean $PM_{2.5}$ concentrations in key epidemiologic studies). Further, the EPA conducted analyses that examined the differences in these two metrics (*i.e.,* maximum monitor concentrations, which is how compliance with the standard is assessed and composite monitor concentrations, which is how key epidemiologic studies report their mean concentrations) across the U.S. and in areas included in the key epidemiologic studies and found that the maximum design value in an area was generally higher than the monitor average across that area, with the amount of difference between the two metrics varying based on location and concentration (Hassett-Sipple et al., 2010; Frank, 2012). This information was taken into account by the then-Administrator's final decision in selecting a level of 12.0 μg/m^3 for the primary annual $PM_{2.5}$ standard in the 2012 review and discussed more specifically in her considerations on adequate margin of safety.

The relationship between the mean $PM_{2.5}$ concentrations and the area design value continues to be an important consideration in evaluating the adequacy of the current or potential alternative annual standard levels in this reconsideration. Again, in a given area, the area design value is based on the monitor in an area with the highest $PM_{2.5}$ concentrations and is used to determine compliance with the standard, including the averaging time and form of the standard (*i.e.,* an annual average over 3-years must not exceed the level of the of the annual $PM_{2.5}$ standard). The highest $PM_{2.5}$ concentrations spatially distributed in the area would generally occur at or near the area design value monitor and the distribution of $PM_{2.5}$ concentrations would generally be lower in other locations and at monitors in that area. As such, when an area is meeting a specific annual standard level (*e.g.,* 9.0 μg/m^3), we would expect the annual average exposures (*i.e.,* a metric similar to the study-reported mean values) in that area to be at concentrations lower than that level (*e.g.,* lower than 9.0 μg/m^3).

However, as described in section II.A.2.c.ii, we note that there are a substantial number of different types of epidemiologic studies available since the 2012 review, as assessed in both the 2019 ISA and the ISA Supplement, that make understanding the relationship between the mean $PM_{2.5}$ concentrations and the area design value an even more important consideration in this reconsideration (U.S. EPA, 2019a; U.S. EPA, 2022a). While the key epidemiologic studies in the 2012 review were all monitor-based studies, the recent epidemiologic studies in this reconsideration include hybrid modeling approaches that have emerged in the epidemiologic literature as an

alternative to approaches that only use ground-based monitors to estimate $PM_{2.5}$ exposure. As assessed in the 2019 ISA and ISA Supplement, a substantial number of epidemiologic studies used hybrid model-based methods in evaluating associations between $PM_{2.5}$ exposure and health effects. Hybrid model-based studies employ various fusion techniques that combine ground-based monitored data with air quality modeled estimates and/or information from satellites to estimate $PM_{2.5}$ exposures. While these studies provide a broader estimation of $PM_{2.5}$ exposures compared to monitor-based studies (*i.e.,* $PM_{2.5}$ concentrations are estimated in areas without monitors), the hybrid modeling approaches result in study-reported means that are more difficult to relate to the annual standard metric and to the maximum monitor design values used to assess compliance. In addition, to further complicate the comparison, when looking across these studies, we find variations in how exposure is estimated between such studies, and thus, how the study means are calculated. Two important variations across studies include: (1) Variability in spatial scale used (*i.e.,* averages computed across the national (or large portions of the country) versus a focus on only CBSAs); and (2) variability in exposure assignment methods (*i.e.,* averaging across all grid cells, averaging across a scaled-up area like a ZIP code, and population weighting). The differences in these approaches can result in studies reporting different study means, even though the association between $PM_{2.5}$ exposure and health effects outcomes are similar.

To emphasize the importance of the differences between the studies, we revisit the simplified example in the State of Georgia from the 2022 PA that evaluates monitors and hybrid modeling approaches, noting that this example is useful to exhibit how the differences in the methods used to estimate exposure can lead to differences in the reported mean concentrations (U.S. EPA, 2022b, p. 3–71). In this example, for all monitors within the Atlanta-Sandy Springs-Roswell CBSA, the average $PM_{2.5}$ concentration is 9.3 $\mu g/m^3$, while the area design value (based on the highest monitored $PM_{2.5}$ concentration in the area) is 10.4 $\mu g/m^3$. This comparison helps to illustrate the fact that composite monitor values tend to be somewhat lower than the highest area monitor values, consistent with the key points made in the 2012 review. This example also illustrates how monitors are sited to represent the higher concentrations within the area and that the area's annual design value, which is used for compliance with the standard, is calculated based on the highest monitor in the area. Next, in this example, mean $PM_{2.5}$ concentrations were calculated using similar approaches to those used in hybrid modeling-based epidemiologic studies to compute study-reported means, including (1) the average concentration across the entire State of Georgia; (2) the population-weighted average across the entire State; (3) the average concentration across the Atlanta-Sandy Springs-Roswell CBSA; and (4) the population-weighted average across the Atlanta-Sandy Springs-Roswell CBSA. At the urban level (*e.g.,* Atlanta-Sandy Springs-Roswell CBSA), the average $PM_{2.5}$ concentration when taking the mean of all grid cells is 9.2 $\mu g/m^3$, whereas the population-weighted mean is 9.6 $\mu g/m^3$. Across Georgia, the average $PM_{2.5}$ concentration using the hybrid approach and averaged across each grid cell is 8.3 $\mu g/m^3$, which is lower than the population-weighted statewide average of 9.1 $\mu g/m^3$. While this is a simple example completed in one State and one CBSA, it suggests that the lowest mean values tend to result from the approaches that use concentrations from all or most grid cells (*e.g.,* did not apply population weighting), both urban and rural, across the study area to compute the mean. Higher mean values are observed when the approach focuses on the urban areas alone or when the approach incorporates population weighting. Overall, this example suggests that the means from studies using hybrid modeling approaches are generally lower than the means from monitor-based approaches, and means from both approaches are lower than the annual design values for the same area. Population weighting tends to increase the calculated mean concentration, likely because more densely populated areas also tend to have higher $PM_{2.5}$ concentrations. In other words, this simplified example exhibits how not all reported mean $PM_{2.5}$ concentrations from key epidemiologic studies are the same; some reported means are from monitored studies and some reported means are from hybrid modeling studies, while some reported means include only urban areas, and other reported means include both urban and rural areas, and some reported means include aspects of population weighting while others do not.

As detailed above in section I.D.5, in the air quality analyses comparing composite monitored $PM_{2.5}$ concentrations with annual $PM_{2.5}$ design values in U.S. CBSAs, maximum annual $PM_{2.5}$ design values were approximately 10% to 20% higher than annual average composite monitor concentrations (*i.e.,* averaged across multiple monitors in the same CBSA). Based on these results, this analysis suggests that there will be a distribution of concentrations and the maximum annual average monitored concentration in an area (at the design value monitor, used for compliance with the standard), will generally be 10–20% higher than the average across the other monitors in the area. Thus, in considering how the annual standard levels would relate to the study-reported means from monitor-based studies, we can generally conclude that an annual standard level that is no more than 10–20% higher than monitor-based study-reported mean $PM_{2.5}$ concentrations would generally maintain air quality exposures to be below those associated with the study-reported mean $PM_{2.5}$ concentrations, exposures for which we have the strongest support for adverse health effects occurring.

Air quality analyses described in section I.D.5 above also consider information from the epidemiologic studies that utilized the hybrid modeling approaches. Analyses show that average maximum annual design values are 40–50% higher when compared to annual average $PM_{2.5}$ concentrations estimated without population weighting and are 15–18% higher when compared to average annual $PM_{2.5}$ concentrations with population weighting applied. Given these results, it is worth noting that for the studies using the hybrid modeling approaches, the choice of methodology employed in calculating the study-reported means (*i.e.,* using population weighting versus not applying aspects of population weighting), and not a difference in estimates of exposure in the study itself, can produce substantially different study-reported mean values, with the approach that does not employ population weighting producing a much lower reported mean $PM_{2.5}$ concentration. Therefore, the impact of the differences in methods is an important consideration when comparing mean concentrations across studies.

Because of the differences in the methods employed by the key epidemiologic studies, and as demonstrated by the example and air quality analyses above, the application of any decision framework that considers the study-reported mean $PM_{2.5}$ concentrations, and evaluates whether the current annual standard provides adequate protection against these reported exposure concentrations, is more complicated than the

approaches used in past reviews. As such, the EPA disagrees with commenters who argue that the EPA's consideration of the relationship between mean $PM_{2.5}$ concentrations reported in key epidemiologic studies and design values is not appropriate and should be ignored.

In considering the information from the epidemiologic studies, while the EPA does not dispute the reported associations of epidemiologic studies in hybrid modeling studies that report long-term mean concentrations and do not apply aspects of population weighting, using the reported long-term mean concentration from these studies in informing an appropriate level of the annual $PM_{2.5}$ standard is more uncertain. Given this, hybrid modeling studies that do not apply aspects of population weighting provide less information on conclusions regarding the appropriate level of the primary annual $PM_{2.5}$ standard. In support of this, some commenters also noted this consideration and suggested that the Administrator place lower weight on U.S. studies that did not use population weighting.

In considering the relationship between study-reported mean $PM_{2.5}$ concentrations and the design values, the EPA agrees with commenters that setting the level of the primary annual standard below the design values, rather than below the study-reported mean concentrations, might allow $PM_{2.5}$ concentrations in some part of the area near the design value monitor to remain above the study-reported mean $PM_{2.5}$concentration, where evidence of health effects is strongest. As discussed in the proposal and in section II.B.4 below, the Administrator specifically notes that that the highest $PM_{2.5}$ concentrations spatially distributed in the area would generally occur at or near the area design value monitor and that $PM_{2.5}$ concentrations will be equal to or lower at other monitors in the area. Furthermore, since monitoring strategies aim to site monitors in areas with higher $PM_{2.5}$ concentrations, monitored areas will generally have higher concentrations compared to areas without monitors. Therefore, by setting the level of the standard to 9.0 $\mu g/m^3$ and just below the lowest study-reported mean $PM_{2.5}$ concentration (*e.g.,* 9.3 $\mu g/m^3$), the highest possible design value in a given area would be just below the study-reported mean $PM_{2.5}$ concentration, the concentration where we have the most confidence in the reported health effect association, and we anticipate that, based on our assessment of air quality data, the distribution of $PM_{2.5}$ concentrations would decrease even further with distance from the highest monitor (*i.e.,* the ''design value monitor'') (see, for example, U.S. EPA, 2022a, section 2.3.3.2.4 and pp. 3–71 to 3–77). The Administrator further notes that when an epidemiologic study reports a mean $PM_{2.5}$ concentration that reflects the average of annual average monitor-based concentrations across an area, the area design value will generally be higher than the study-reported mean. Similarly, he observes that when a study reports a mean that reflects the average of annual average concentrations estimated at across an area using a hybrid modeling approach, the area design value will generally be higher. As such, by evaluating the difference between the study-reported mean $PM_{2.5}$ concentrations and design values, the Administrator seeks to set the level of the standard below the lowest study-reported mean, while ensuring that the primary annual $PM_{2.5}$ standard, including its averaging time and form, provides protection against the exposures associated with health effects observed in the key epidemiologic studies.

Additionally, the EPA disagrees with commenters who contend that the approach taken may allow $PM_{2.5}$ near the design value monitor to remain above the study-reported mean $PM_{2.5}$ concentrations. In following this approach of setting the annual standard level somewhat below the lowest reported mean $PM_{2.5}$ concentration, setting a standard level that requires the design value monitor (which is the highest monitor in an area) to be just below the lowest study-reported mean across key studies will generally result in distributions of even lower concentrations of $PM_{2.5}$ across the entire area, such that even those people living near an area design value monitor (where $PM_{2.5}$ concentrations are generally highest) will be exposed to $PM_{2.5}$ concentrations below the $PM_{2.5}$ concentrations reported in the epidemiologic studies where there is the highest confidence of an association. In their review of the 2021 draft PA, the majority of the CASAC had some concerns about the approach for comparing study means and design values, questioning whether such an approach would provide adequate protection for people who live in areas with higher concentrations, such as those living in areas with higher concentrations (*e.g.,* near the design value monitor) (Sheppard, 2022a, p. 8 of consensus responses). The minority of the CASAC, in considering the relationship between the study-reported mean $PM_{2.5}$ concentration and design values, stated that ''the form of the standard and the way attainment with the standard is determined (*i.e.,* highest design value in the CBSA) are important factors when determining the appropriate level for the standard'' and noted that that design values are generally higher than area average exposure levels (Sheppard, 2022a, p. 17 of consensus responses). For all of the reasons discussed above, and consistent with the minority of the CASAC's advice in their review of the 2021 draft PA, we disagree with the commenters that areas near the design value monitors would be expected to experience $PM_{2.5}$ concentrations above the study-reported mean concentrations.

Several commenters assert that epidemiologic studies that restrict $PM_{2.5}$ concentration to below 12 $\mu g/m^3$ provide additional support for revising the level of the primary annual $PM_{2.5}$ standard to 8 $\mu g/m^3$. Some commenters disagree with the EPA's assertion that the studies that employ restricted analyses do not provide enough information to understand how the studies were restricted to certain $PM_{2.5}$ concentrations, with commenters providing additional information on the methods for restricted analyses. The commenters state that for the long-term studies at issue here, the study authors simply examined their database that linked subjects to long-term $PM_{2.5}$ concentrations above 12 $\mu g/m^3$, removed those data from the analysis, and reran the analysis. Additionally, one commenter provided an explanation of how the restricted analyses were conducted in studies for which he was an author. The commenter notes that for each year a subject was in the study, annual $PM_{2.5}$ concentrations were assigned at the ZIP code level. If they moved, they were assigned the ZIP code level $PM_{2.5}$ concentration for the new ZIP code. The commenter notes that these restricted analyses only included subjects whose annual $PM_{2.5}$ exposure never exceeded that restricted concentration for any year of follow-up in the study. The commenter suggested that the EPA may be concerned as to how $PM_{2.5}$ concentrations in restricted analyses related to a design value since these are exposures for individuals who may have relocated during the study but argue that that is not the point. The commenters assert that while the analyses were restricted to people never exposed above certain concentrations over longer periods of time, the actual $PM_{2.5}$ exposure was one year of exposure in most of these studies. Commenters also suggest that, since the

EPA has deviated from its approach from the 2012 review for considering study-reported mean $PM_{2.5}$ concentrations, the EPA should dismiss its concerns regarding being able to relate the mean $PM_{2.5}$ concentrations from these studies to design values.

First, the EPA agrees with commenters that studies that employ restricted analyses can be used for informing conclusions regarding the appropriate level of the primary annual $PM_{2.5}$ standard. However, the EPA disagrees that the information provided by the commenters provides a sufficient basis for an annual standard level of 8 $\mu g/m^3$. Restricted analyses provide additional support for effects at lower concentrations, exhibiting associations for mean concentrations presumably below the mean concentrations for the main analyses. However, even though commenters note that any individual with exposures over the restricted analyses is excluded from restricted analyses, uncertainties remain with regard to how the mean $PM_{2.5}$ concentrations in restricted analyses compare to design values, particularly in light of the removal of entire ZIP codes from analyses. Design values are calculated based on all measured $PM_{2.5}$ concentrations. When an analysis is restricted below a certain level, some parts of the air quality distribution are removed, but comparing the restricted mean to a design value is not possible because these are two different metrics. For example, in a study that restricts concentrations below 12 $\mu g/m^3$, that represents only part of the air quality distribution, whereas a design value for that study area would include all $PM_{2.5}$ concentrations, not just the ones below 12 $\mu g/m^3$. Therefore, in contrast to means from the main (unrestricted) analysis, it is not possible to compare mean concentrations from restricted analyses to design values. Further, it is unclear how one could evaluate such a relationship between design values and mean $PM_{2.5}$ concentrations from studies that use restricted analyses because the standard is set based on all of its elements (indicator, averaging time, form, and level) and removing $PM_{2.5}$ concentrations from the calculation of the design value for such a comparison would result in a metric that is no longer a design value that would provide the intended protection of the standard. This leads to greater uncertainty in how to use the mean $PM_{2.5}$ concentrations from these studies that use restricted analyses in a similar decision framework as the epidemiologic studies that report long-term mean $PM_{2.5}$ concentrations for health effect associations for the full distribution of $PM_{2.5}$ concentrations.

As described in reaching his conclusions in the section below, the Administrator judges that, despite these uncertainties and limitations, studies that use restricted analyses can provide supplemental information for consideration in reaching conclusions regarding both the adequacy and level of the standard. He notes two studies (Di et al., 2017b and Dominici et al., 2019) are available in this reconsideration that report means in their restricted analyses (restricting annual average $PM_{2.5}$ exposure below 12 $\mu g/m^3$) and used population-weighted approaches to estimate $PM_{2.5}$ exposures and these studies report mean $PM_{2.5}$ concentrations of 9.6 $\mu g/m^3$. He recognizes that these studies are just one line of evidence for consideration and that along with the broader evidence base, including the key epidemiologic studies, these studies provide support that the level of the primary annual $PM_{2.5}$ standard should be set below 10 $\mu g/m^3$.

We disagree with the commenters that concerns about relating the mean $PM_{2.5}$ concentrations from restricted analyses to design values are not valid. As an initial matter, restricted analyses were not available and did not inform the 2012 decision to revise the annual $PM_{2.5}$ standard level to 12.0 $\mu g/m^3$. The approach in 2012 in revising the annual standard was to set the level to somewhat below the mean of key epidemiologic studies. As noted above, while the EPA believes that restricted analyses can help inform conclusions regarding the adequacy and the level of the primary annual $PM_{2.5}$ standard, in the context of placing the studies in a decision framework to inform the appropriate level of the annual $PM_{2.5}$ standard, the EPA has not deviated from its approach from the 2012 review. Given that restricted analyses are new since the 2012 review, the EPA disagrees with commenters that uncertainties associated with these studies should not be considered, and that these studies should be used in a similar manner to their main analyses in taking an approach to set a level of the standard somewhat below the lowest long-term reported mean $PM_{2.5}$ concentration. Specifically, as detailed above there are uncertainties and limitations associated with relating the mean $PM_{2.5}$ concentrations from these studies to design values for studies that use restricted analyses, and many of these studies did not expressly report a mean $PM_{2.5}$ concentration for the restricted analysis which makes it impossible to make such a comparison.

Several commenters contend that in considering the accountability studies, the EPA inappropriately reached conclusions regarding the level of the primary annual $PM_{2.5}$ standard based on the starting $PM_{2.5}$ concentrations of these studies, rather than the ending concentrations (*i.e.,* concentrations after a policy was implemented). The commenters assert that these studies provide support for revising the level of the primary annual $PM_{2.5}$ standard to below the proposed range of 9–10 $\mu g/m^3$ to protect public health with an adequate margin of safety.

Accountability studies examine the effect of a policy on reducing $PM_{2.5}$ concentrations in ambient air and evaluate whether such reductions were observed to also lead to reductions in $PM_{2.5}$- associated health outcomes (*e.g.,* mortality). Additionally, accountability studies can reduce uncertainties related to residual confounding of temporal and spatial factors (U.S. EPA, 2022a, p. 3–25). Prior to implementation of the policies, three accountability studies newly available in this reconsideration and assessed in the ISA Supplement, report mean $PM_{2.5}$ concentrations below the level of the current annual standard level (12.0 $\mu g/m^3$) and ranged from 10.0 $\mu g/m^3$ to 11.1 $\mu g/m^3$ (Sanders et al., 2020b; Corrigan et al., 2018; and Henneman et al., 2019). These studies suggest that public health improvements may occur following the implementation of a policy that reduces annual average $PM_{2.5}$ concentrations below the level of the current standard of 12.0 $\mu g/m^3$, and potentially below the lowest ''starting'' concentrations in these studies of 10.0 $\mu g/m^3$. However, while the small number of studies may provide limited information related to informing the adequacy and level of the annual $PM_{2.5}$ standard, we note that accountability studies are only one line of evidence, and that these studies provide supplemental information for consideration in addition to the full body of evidence. Further, the EPA does not believe it would be appropriate to determine the level of the standard by reference to ending concentrations in accountability studies. Accountability studies are most informative in demonstrating that public health improvements may occur following the implementation of a policy that reduces annual average $PM_{2.5}$ concentrations below the level of the current standard of 12.0 $\mu g/m^3$, and potentially below the lowest ''starting'' concentrations in these studies of 10.0 $\mu g/m^3$. However, the EPA finds the available information from accountability studies is too limited to support a conclusion that the

appropriate level at which to set the primary annual $PM_{2.5}$ standard would be equal to the ending concentrations of those studies, as the commenters suggest. These studies demonstrate that there are reductions in health outcomes when $PM_{2.5}$ concentrations are reduced in these studies from the starting concentration to the ending concentration, but do not provide support for health effect associations at or below the ending concentrations that would warrant a more stringent standard.

Commenters disagree with the Administrator placing less weight on the epidemiologic studies conducted in Canada when reaching conclusions regarding the level of the primary annual $PM_{2.5}$ standard. These commenters argue that the Canadian epidemiologic studies provide support for setting the level at the lowest end of the proposed range (*i.e.,* 8 $\mu g/m^3$) because they report mean $PM_{2.5}$ concentrations, in some cases, below 8 $\mu g/m^3$. Commenters disagree with the EPA's reasoning for placing less weight on the Canadian epidemiologic studies, suggesting it conflicts with the approaches in previous PM NAAQS reviews and arguing that the findings of the Canadian epidemiologic studies can be directly translated into a primary annual $PM_{2.5}$ standard. Additionally, while the commenters disagree with the EPA's approach for considering the study-reported mean $PM_{2.5}$ concentrations and design values in general, they note that the CASAC, in their review of the 2021 PA, noted that ''while there may be no design value in Canada, there are data that indicate what a U.S. design value would be if an area average like that found in the Canadian studies were to occur in the U.S.'' (Sheppard, 2022a, p. 13 of consensus responses). The commenters contend that the EPA failed to acknowledge this advice from the CASAC, specifically noting that the majority of the CASAC highlighted Canadian epidemiologic studies as a part of their rationale for revising the level of the primary annual $PM_{2.5}$ standard to within the range of 8–10 $\mu g/m^3$.

In considering the information from the epidemiologic studies in reaching his conclusions, the Administrator considered the full body of evidence, including studies conducted in the U.S. and Canada. However, as described in the proposal and in section II.B.4 below, the Administrator also recognizes that the exposure environments in the U.S. are different from those in Canada. In particular, the U.S. population density is approximately 43 people per square kilometer in the contiguous U.S.[98] compared to Canada, which has one of the lowest population densities on the Earth with 4.2 people per square kilometer (Statistics Canada, 2023). This difference in population density between the U.S. and Canada was not as apparent, and did not need to be highlighted, in the 2012 review given that the available Canadian epidemiologic studies used population-weighting and focused on urban areas where monitors were available and population densities were more comparable with those in the U.S. Given this, the study-reported mean concentrations from U.S. and Canadian studies in the 2012 review were very similar. The recent epidemiologic evidence available in this reconsideration, however, includes studies that utilize approaches that highlight the importance of considering the differences between the two exposure environments in the U.S. versus Canada. When focusing on the recently available Canadian monitor-based epidemiologic studies in this reconsideration, the information indicates that these studies, unlike the studies available in the 2012 review, do not apply population weighting (*e.g.,* Lavigne et al., 2018; Liu et al., 2019). As noted in responding to other public comments above, the absence of population weighting is an important consideration that limits the utility of these studies in informing the appropriate level of the primary annual $PM_{2.5}$ standard. In addition, there are recently available studies in the 2019 ISA and ISA Supplement that expand the geographical extent of the epidemiologic study areas by estimating exposure concentrations in areas where there are no monitors. To do this, these studies use either a statistical extrapolation of monitored values or use air quality modeling and other forms of data (*e.g.,* hybrid model-based approaches). For these Canadian studies, the EPA notes two important considerations in using the information to directly translate to policy decisions regarding the level of the annual standard in the U.S. The first is that in incorporating a larger portion of Canada into these recent studies, more rural areas are included, and as such, the population densities and exposure environment differences become more important. The second is that in analyses that evaluate and validate hybrid models, there is less certainty in $PM_{2.5}$ exposure estimates in more rural areas, which are further from air quality monitors and where $PM_{2.5}$ concentrations in the ambient air tend to be lower (U.S. EPA, 2022b, pp. 2–51 and 2–63). Additionally, it is unclear what portion of the $PM_{2.5}$ concentrations from rural areas are contributing to the study reported mean. Given this, studies that incorporate more rural areas into the epidemiologic studies highlight the importance of considering the differences between the population exposures in the studies themselves and in the U.S. versus Canadian study areas, as well as the influence these differences have on the interpretation of the epidemiologic study results. For these reasons, while the Canadian epidemiologic studies provide additional support for associations between $PM_{2.5}$ concentrations and health effects, the long-term means from Canadian epidemiologic studies are a less certain basis for informing the EPA's selection of the annual standard level, given that it is a U.S.-based standard.

With respect to the CASAC's advice in their review of the 2021 draft PA, the EPA recognizes that the majority of the CASAC pointed to the Canadian studies as supporting their recommendation to revise the annual standard level to within the range of 8–10 $\mu g/m^3$. However, the EPA also notes that the CASAC did not advise the EPA to revise the annual standard to a level that was below the study-reported means in the key Canadian epidemiologic studies. Indeed, the CASAC noted that some of the Canadian studies showed associations below 8 $\mu g/m^3$, but did not recommend that the Administrator consider levels below 8 $\mu g/m^3$ for the annual standard. Further, based on the CASAC's advice, the Administrator is not excluding Canadian studies from his consideration in this reconsideration, but he is considering them in light of the limitations and challenges presented and in the context of the full body of available scientific evidence.

Lastly, the EPA disagrees with commenters that the findings of the Canadian epidemiologic studies can be directly translated into a primary annual $PM_{2.5}$ standard based on the evaluation of the relationship between U.S. study-reported mean $PM_{2.5}$ concentrations and U.S. design values. It is unclear whether the relationship between U.S. study-reported mean $PM_{2.5}$ concentrations and U.S. design values (which, in the case of U.S. hybrid model-based studies, indicates that design values are 15–18% greater than area mean $PM_{2.5}$ concentrations) would apply to the Canadian epidemiologic studies and their reported mean $PM_{2.5}$

[98] All of the key U.S. epidemiologic studies considered in this reconsideration focus on all or subsections of the continental U.S.

concentrations, given that these studies generally report lower $PM_{2.5}$ concentrations than the U.S.-based studies. As such, interpreting the study-reported mean concentrations from the Canadian studies in the context of a U.S.-based standard may present challenges in directly and quantitatively informing decisions regarding potential alternative levels of the annual standard, particularly noting the different in exposure relationships in the U.S. versus Canada given the large difference in population densities between the two countries. Further, as mentioned above, while the CASAC advised the EPA to consider the Canadian studies as relevant evidence and found that placing weight on the Canadian studies supported their recommendation to revise the annual standard level to within the range of 8–10 μg/m³, the lower end of their recommended range for the level of the annual standard did not extend below the lower study-reported means from those studies.

Commenters who supported retaining and revising the primary annual $PM_{2.5}$ standard both raised concerns regarding how the EPA used the scientific evidence and quantitative risk assessment related to disparities in $PM_{2.5}$ exposure and risk in informing conclusions on the standard. Commenters who supported retaining the standard assert that the available scientific evidence that demonstrates disparities for minority populations do not support revising the standard, noting that these studies are in areas that tend to have large minority populations and more sources of PM. These commenters contend that because the studies conclude that minority populations experience more effects than others living in the same area that something other than $PM_{2.5}$ concentrations in ambient air is causing the disproportionate impact on minority populations, providing proximity to a source as an example. The commenters note that it is unclear how a national standard will reduce exposure disparities for population groups living in the same area, and further assert that studies of exposure disparities among minority populations were considered in reaching the 2020 final decision to retain the standards.

Conversely, commenters who support revising the standard assert that the at-risk analyses conducted in the 2022 PA provide support for revising the primary annual $PM_{2.5}$ standard to a level of 8 μg/m³. In particular, these commenters state that the at-risk analysis demonstrated that while disparities in mortality risk remain at a standard level of 9.0 μg/m³, disparities in exposure are significantly reduced for an alternative standard level of 8.0 μg/m³ (U.S. EPA, 2022b, p. 3–162).

As discussed in section I above, the primary (health-based) NAAQS are established at a level that is requisite to protect public health, including the health of sensitive or at-risk groups, with an adequate margin of safety.[99] In so doing, decisions on the NAAQS are based on an explicit and comprehensive assessment of the current scientific evidence and associated risk analyses. More specifically, the EPA expressly considers the available information regarding health effects among at-risk populations in decisions on the primary NAAQS. Where populations with disparities in exposure and risk are among the at-risk populations, the decision on the standards is based on providing requisite protection for these and other at-risk populations and lifestages.

The Administrator expressly considered the available information regarding health effects among at-risk populations in reaching the proposed decisions that the current primary annual $PM_{2.5}$ standard is not requisite to protect public health with an adequate margin of safety, and should be revised. The 2019 ISA and ISA Supplement identified children, older adults, people with pre-existing diseases (cardiovascular disease and respiratory disease), minority populations, and low SES populations as at-risk populations. The Administrator is thus, in his final decision, establishing primary $PM_{2.5}$ standards which, in his judgment, will provide protection for these at-risk populations, including minority populations, with an adequate margin of safety.

With respect to the risk assessment, while the EPA notes that the analyses support the conclusion that the primary $PM_{2.5}$ standards are not adequate, as detailed further in the proposal and above in section II.A.3, the EPA also cautions against an over-interpretation of the absolute results. The quantitative risk assessment provides estimates of $PM_{2.5}$-attributable mortality based on input data that include C–R functions from epidemiologic studies that do not quantitatively account for uncertainties in associations between $PM_{2.5}$ exposure and health effects at lower concentrations and are based on an air quality adjustment approach that incorporates proportional decreases in $PM_{2.5}$ concentrations to meet lower alternative standard levels. As a result, simulated air quality improvements used in the risk assessment will always lead to proportional decreases in risk (*i.e.,* each additional μg/m³ reduction produces additional benefits with no clear stopping point), without considering the substantially greater uncertainties associated with the relationship between $PM_{2.5}$ exposures and health effects at lower concentrations.

The same is true for the new at-risk analysis in the risk assessment presented in the 2022 PA that is based on a recent epidemiologic study that is available in this reconsideration that provides mortality risk coefficients for older adults (*i.e.,* 65 years and older) based on $PM_{2.5}$ exposure and stratified by racial and ethnic demographics. Generally, the results of at-risk analyses can vary greatly depending on the inputs to the analyses, including the representativeness of the populations and demographics captured by the study areas that are a part of the analyses, as well as the available C–R functions from epidemiologic studies that stratify by race and ethnicity and the air quality adjustment approaches that are used to simulate air quality at different standard levels. In fact, for this at-risk analysis, the results are even more uncertain than similar estimates from the overall risk assessment due to additional sources of uncertainty specific to the at-risk analysis, such as using C–R functions derived from smaller epidemiologic sample sizes along with the sources of uncertainty that apply to the overall risk assessment (U.S. EPA, 2022b, section 3.4.1.8). Additionally, in characterizing at-risk populations, the at-risk analysis only used one of the air quality adjustment approaches used in the overall risk assessment, which decreases the potential representativeness of the $PM_{2.5}$ concentrations across the study areas (U.S. EPA, 2022b, section 3.4.1.8). Lastly, this at-risk analysis relies on the stratified risk coefficients from only one epidemiologic study.[100] For these reasons, the Administrator places little

[99] The legislative history of section 109 indicates that a primary standard is to be set at ''the maximum permissible ambient air level . . . which will protect the health of any [sensitive] group of the population,'' and that for this purpose ''reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group.'' S. Rep. No. 91–1196, 91st Cong., 2d Sess. 10 (1970); see also, *e.g.,* Am. Lung Ass'n v. EPA, 134 F.3d 388, 389 (D.C. Cir. 1998) (''If a pollutant adversely affects the health of these sensitive individuals, EPA must strengthen the entire national standard'').

[100] Additional information on all available at-risk epidemiologic studies in this reconsideration are available in section 3.4 and Appendix C of the 2022 PA (U.S. EPA, 2022b, section 3.4, Figure 3–17, and Appendix C, section C.3.2).

weight on the absolute results of the risk assessment, including the at-risk analysis, for purposes of selecting the level of the annual standard that is requisite.

While there are substantial uncertainties in the absolute results of the quantitative risk assessment, the EPA also notes that recent scientific evidence evaluated in the ISA Supplement, which built upon the 2019 PM ISA conclusions, found that the evidence ''[c]ontinue[s] to support disparities in $PM_{2.5}$ exposure and health risks by race and ethnicity'' while studies of SES ''provide additional support indicating there may be disparities in $PM_{2.5}$ exposure and health risk by SES'' (U.S. EPA, 2022a, p. 5–4). Thus, in light of the statutory requirement to provide protection for at-risk populations, it is not surprising that the stratified population results of the risk assessment suggest that meeting a revised standard would result in higher risk reductions for minority and low SES populations.

In conclusion, the EPA recognizes that the at-risk analysis was based on one epidemiologic study that stratified by race/ethnicity for older adults (*e.g.,* 65+ years old) and that there is increasing uncertainty in quantitative estimates of stratified risk estimates at the lower end of the range of standard levels assessed. Moreover, the EPA finds that the goal of the NAAQS is to provide the requisite protection to at-risk groups, and where minority populations are included among the at-risk groups, providing requisite protection to minority populations will also result in protecting the public health of other populations. Thus, in setting the NAAQS to protect the health of at-risk groups with an adequate margin of safety, the Administrator is selecting the standard that will provide requisite protection, including for minority populations and other at-risk populations, which also generally results in protecting the public health of other populations and reducing risk disparities.

A number of commenters, primarily from industries and industry groups and some States, support the EPA's proposed decision to retain the primary 24-hour $PM_{2.5}$ standard. Many of these commenters contend that the available scientific evidence and quantitative information has not significantly changed since the 2020 final decision and note that important uncertainties remain. The commenters agree with the EPA's conclusions regarding the controlled human exposure studies and their relationship to short-term peak $PM_{2.5}$ concentrations in ambient air. These commenters also noted the primary annual and 24-hour $PM_{2.5}$ standards work together to provide public health protection, with the 98th percentile form of the 24-hour standard effectively limiting peak daily concentrations. The commenters agree with the EPA that the current suite of standards maintain subdaily concentrations below the higher concentrations in controlled human exposure studies where more consistent health effects are observed. Commenters also agree with the EPA's conclusions that the epidemiologic studies are not useful for informing decisions on the level of the primary 24-hour $PM_{2.5}$ standard because the standard focuses on reducing peak exposures with its 98th percentile form, while the epidemiologic studies often focus on the mean or median as the percentile for which associations with short-term exposures are observed. These commenters also agree with the EPA's focus on U.S.-based studies because of differences compared to Canadian studies. The commenters also generally agree with the Administrator's judgment that it was appropriate to place less weight on the risk assessment, noting that the annual standard is controlling in most areas of the country and revising the annual standard would have the most potential to reduce risk related to $PM_{2.5}$ exposures and would reduce both average (annual) and peak (daily) $PM_{2.5}$ concentrations. Finally, these commenters note that the CASAC did not reach consensus on whether the current primary 24-hour $PM_{2.5}$ standard should be revised, and they agree with the minority of the CASAC's recommendation in their review of the 2021 draft PA that the primary 24-hour primary $PM_{2.5}$ standard should be retained. These commenters also note the CASAC's support in their review of the 2019 draft PA for retaining the primary 24-hour $PM_{2.5}$ standard.

A number of commenters, primarily from public health and environmental organizations and some States, oppose the EPA's proposed decision to retain the primary 24-hour $PM_{2.5}$ standard. These commenters support revising the level of the primary 24-hour $PM_{2.5}$ standard, contending that a more stringent standard is necessary to provide requisite public health protection with an adequate margin of safety, particularly for at-risk groups. In so doing, these commenters place weight on the same aspects of the available scientific evidence as the majority of the CASAC in their review of the 2021 draft PA, and generally advocate for revising the level of the standard to within the range of 25–30 $\mu g/m^3$ as recommended by the majority of the CASAC. Some of these commenters support a level no higher than 25 $\mu g/m^3$ and others support a level of 20 $\mu g/m^3$. These commenters generally cite to the available scientific evidence, including evidence of disproportionate exposures and risks for certain at-risk groups, and the CASAC's advice in support for their recommendation. Some of these commenters also suggest that decisions regarding the primary 24-hour $PM_{2.5}$ standard should not be related to decisions on the primary annual $PM_{2.5}$ standard.

As an initial matter, the EPA disagrees with commenters who suggest that decisions regarding the primary 24-hour $PM_{2.5}$ standard should not be related to decisions on the primary annual $PM_{2.5}$ standard. In reviewing the adequacy of the public health protection afforded by the primary $PM_{2.5}$ standards, the Administrator's consistent past practice has been to evaluate the combination of the annual and 24-hour standards together. In 2012, the then-Administrator concluded that the most effective and efficient way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures was to set a generally controlling annual standard, and to provide supplemental protection by means of a 24-hour standard set at the appropriate level. In so doing, the then-Administrator explicitly recognized that potential air quality changes associated with meeting a revised annual standard (with a level of 12 $\mu g/m^3$) would result in lowering risks associated with both long- and short-term $PM_{2.5}$ exposures by lowering the overall distribution of air quality concentrations, and that retaining a 24-hour standard at the appropriate level would ensure an adequate margin of safety against short-term effects in areas with high peak-to-mean ratios (78 FR 3163, January 15, 2013). In this reconsideration, also, the Administrator considers it appropriate to rely on the annual standard (arithmetic mean, averaged over three years) for targeting protection against both long- and short-term $PM_{2.5}$ exposures, noting that the annual standard is typically controlling, while the 24-hour standard (98th percentile, averaged over three years) can provide supplemental protection against the occurrence of peak 24-hour $PM_{2.5}$ concentrations (U.S. EPA, 2022b, section 3.6.3). Further, the Administrator notes that, as in the 2012 review, changes in $PM_{2.5}$ air quality to meet a revised annual standard would

affect the entire distribution of long- and short-term concentrations, thus likely resulting not only in lower short- and long-term $PM_{2.5}$ concentrations near the middle of the air quality distribution, but also in fewer and lower short-term peak $PM_{2.5}$ concentrations.[101] Thus, the Administrator continues to conclude it is appropriate to consider whether the annual and 24-hour standards together provide requisite protection of public health, rather than considering each standard in isolation.

Regarding the appropriate basis for determining the level of the 24-hour standard, a number of commenters who support revising the primary 24-hour $PM_{2.5}$ standard to a lower level contend that the EPA should not rely on the controlled human exposure studies in evaluating the adequacy of the public health protection afforded by the primary 24-hour $PM_{2.5}$ standard. These commenters support this view by citing the CASAC comments in their review of the 2019 draft PA which advised that controlled human exposure studies have limitations that may impact their ability to inform conclusions on the adequacy of the public health protection afforded by the primary 24-hour $PM_{2.5}$ standard. Commenters noted that these studies do not include the most vulnerable populations and often involve exposure to only one pollutant to elicit a response, and therefore are not representative of real-world exposures.

Other commenters support the EPA's use of the controlled human exposure studies to inform the adequacy of the public health protection and note that the 24-hour standard must at least provide protection against the health effects observed in controlled human exposure studies. Some of the commenters cite the Wyatt et al. (2020) study that demonstrated cardiovascular effects following 2-hour exposures to 120 $\mu g/m^3$ and 4-hour exposures to 37.8 $\mu g/m^3$. Some of these commenters contend that the current primary 24-hour $PM_{2.5}$ standard allows $PM_{2.5}$ exposures comparable to those observed to elicit effects in the controlled human exposure studies, and therefore, the EPA must revise the level of the current standard to protect public health. To support this view, some commenters submitted an analysis of monitoring data from 2017–2020, which compares the number of days per year where maximum daily $PM_{2.5}$ concentrations exceed 120 $\mu g/m^3$ and 37.8 $\mu g/m^3$.

Additionally, other commenters assert that the EPA should focus less on peak $PM_{2.5}$ concentrations ''typically measured'' in areas meeting the current primary $PM_{2.5}$ standards even if they do not exceed the concentrations in the controlled human exposure studies because, in their view, the standard needs to protect against atypical exposures to atypical peak $PM_{2.5}$ concentrations. These commenters conclude that, when considered together, the controlled human exposure studies and the epidemiologic studies warrant strengthening the level of the primary 24-hour $PM_{2.5}$ standard.

The EPA generally disagrees with commenters who contend that it is inappropriate to rely on the controlled human exposures studies in evaluating the adequacy of the public health protection afforded by the primary 24-hour $PM_{2.5}$ standard. The Agency considers these studies informative both for establishing biological plausibility and for determining an appropriate level for the 24-hour standard. When looking to the experimental studies, the EPA finds that the 2019 ISA and ISA Supplement included controlled human exposure studies that report statistically significant effects on one or more indicators of cardiovascular function following 2-hour exposures to $PM_{2.5}$ concentrations at and above 120 $\mu g/m^3$ (and at and above 149 $\mu g/m^3$ for vascular impairment, the effect shown to be most consistent across studies). As noted in the 2019 ISA, these studies are important in establishing biological plausibility for $PM_{2.5}$ exposures causing more serious health effects, such as those seen in short-term exposure epidemiologic studies, and they provide support that more adverse effects may be experienced following longer exposure durations and/or exposure to higher concentrations. Additionally, one controlled human exposure study assessed in the ISA Supplement reports evidence of some effects for cardiovascular markers at lower $PM_{2.5}$ concentrations, 4-hour exposures to 37.8 $\mu g/m^3$ (Wyatt et al., 2020). However, there is inconsistent evidence for inflammation in other controlled human exposure studies evaluated in the 2019 ISA. The EPA notes that although the controlled human exposure studies do not provide a threshold below which no effects occur, the observed effects in these controlled human exposures studies are ones that signal an intermediate effect in the body, likely due to short-term exposure to $PM_{2.5}$, and typically would not, by themselves, be judged as adverse (88 FR 5620, January 27, 2023) [102] [103]

The EPA notes that the majority of the CASAC, in their review of the 2021 draft PA, commented that these controlled human exposure studies generally do not include populations with substantially increased risk from exposure to $PM_{2.5}$, such as children, older adults, or those with more severe underlying illness, and often involve exposure to only one pollutant to elicit a response. However, both the majority and the minority of the CASAC explained that, even taking into consideration their limitations, the controlled human exposure studies provide some support for assessing the adequacy of the 24-hour standard.[104]

The EPA agrees with the CASAC that the controlled human exposure studies generally do not include populations with substantially increased risk from exposure to $PM_{2.5}$, like children, older adults, or those with pre-existing severe illness, like cardiovascular effects. As such, and as an initial note, these

[101] Similarly, the Administrator recognizes that changes in air quality to meet a 24-hour standard, would result not only in fewer and lower peak 24-hour $PM_{2.5}$ concentrations, but also in lower annual average $PM_{2.5}$ concentrations. However, as noted in 2012, an approach that relied on setting the level of the 24-hour standard such that the 24-hour standard was generally controlling would be less effective and result in less uniform protection across the U.S. than an approach that focuses on setting a generally controlling annual standard (78 FR 3163, January 15, 2013).

[102] Judgments regarding adversity or health significance of measurable physiological responses to air pollutants have been informed by guidance, criteria or interpretative statements developed within the public health community, including the American Thoracic Society (ATS) and the European Respiratory Society (ERS), which cooperatively updated the ATS 2000 statement *What Constitutes an Adverse Health Effect of Air Pollution* (ATS, 2000) with new scientific findings, including the evidence related to air pollution and the cardiovascular system (Thurston et al., 2017).

[103] The ATS/ERS described its 2017 statement as one ''intended to provide guidance to policymakers, clinicians and public health professionals, as well as others who interpret the scientific evidence on the health effects of air pollution for risk management purposes'' and further notes that ''considerations as to what constitutes an adverse health effect, in order to provide guidance to researchers and policymakers when new health effects markers or health outcome associations might be reported in future.'' The most recent policy statement by the ATS, which once again broadens its discussion of effects, responses and biomarkers to reflect the expansion of scientific research in these areas, reiterates that concept, conveying that it does not offer ''strict rules or numerical criteria, but rather proposes considerations to be weighed in setting boundaries between adverse and nonadverse health effects,'' providing a general framework for interpreting evidence that proposes a ''set of considerations that can be applied in forming judgments'' for this context (Thurston et al., 2017).

[104] In their review of the 2021 draft PA, the majority of the CASAC advised that ''evidence of effects from controlled human exposure studies with exposures close to the current standard support epidemiologic evidence for lowering the standard'' (Sheppard, 2022a, p. 4 of consensus letter). The minority of the CASAC also advised that it was appropriate to place ''more emphasis on the controlled human exposure studies, showing effects at $PM_{2.5}$ concentrations well above those typically measured in areas meeting the current standards'' (Sheppard, 2022a, p. 4 of consensus letter), in evaluating adequacy of the 24-hour standard.

studies are therefore somewhat limited in their ability to inform at what concentrations effects may be elicited in at-risk populations. In spite of this limitation, the EPA also agrees with the CASAC, that even taking into consideration the limitations of the controlled human exposure studies, these studies can provide some support for evaluating the adequacy of the 24-hour standard. However, the EPA further notes that while the controlled human exposure studies are important in establishing biological plausibility, the health outcomes observed in these controlled human exposure studies are often ''intermediate'' outcomes (*i.e.,* not always clearly adverse) and therefore it is unclear how the importance of the effects observed in the studies should be interpreted with respect to adversity to public health. The EPA finds that it is appropriate to consider these study limitations in assessing the information provided by controlled human exposure studies in evaluating the adequacy of the primary 24-hour $PM_{2.5}$ standard.

The EPA agrees with commenters that the primary 24-hour $PM_{2.5}$ standard must at least provide protection against the health effects consistently observed in controlled human exposure studies. As discussed in the proposal, the EPA looks at whether the exposures that elicit a response following exposure to $PM_{2.5}$ in the controlled human exposure studies occur under recent air quality conditions in areas meeting the current standards. Based on these air quality analyses, the EPA concludes that these types of exposures very rarely occur when the current standards are being met.

The EPA did receive multiple comments questioning these results and the approach in the EPA's analyses. For example, some commenters submitted an analysis of monitoring data from 2017–2020, which compares the number of days per year where maximum daily $PM_{2.5}$ concentrations exceed 120 $\mu g/m^3$ and 37.8 $\mu g/m^3$ and evaluate the number of days subset by groups of monitors with 4-year average $PM_{2.5}$ concentrations close to the levels of combinations of current and proposed annual (+/− 0.2 $\mu g/m^3$) and 24-hour (+/−2 $\mu g/m^3$) $PM_{2.5}$ standards. To support their view that the primary $PM_{2.5}$ standards should be revised, the commenters describe decreases in days per monitor per year with 2-hour maximum concentrations greater than 120 $\mu g/m^3$ and 4-hour maximum concentrations greater than 37.8 $\mu g/m^3$ when comparing monitors that achieve close to 10 and 30 $\mu g/m^3$ versus monitors that meet close to 8 $\mu g/m^3$ and 25 $\mu g/m^3$. The commenters noted decreases in the number of days per monitor per year with 2-hour maximum concentrations over 120 $\mu g/m^3$ and 4-hour max concentration over 37.8 $\mu g/m^3$ were also seen when comparing monitors close to achieving 24-hour standards with levels of 35 $\mu g/m^3$ versus 25 $\mu g/m^3$.

First, the EPA notes that this analysis submitted by commenters was limited to a very small number of monitors and did not include a national perspective. Second, the EPA notes that this analysis focused on number of days (rather than the number of times) where there was a 2-hour maximum concentration over 120 $\mu g/m^3$ or a 4-hour max concentration over 37.8 $\mu g/m^3$. In order to evaluate the protection provided by the current 24-hour standard against peak exposures, including exposures with 2-hour concentrations greater than 120 $\mu g/m^3$ and 4-hour concentrations greater than 37.8 $\mu g/m^3$, the EPA considers it more informative and appropriate from a public health perspective to assess the number of times a subdaily exposure of concern occurs in a year, rather than the number of days on which they occur because the former identifies more potential exposures of concern and provides more information about the scale and scope of the occurrences of those exposures. Lastly, the analyses allowed monitors somewhat above the standards to be included. Therefore, it is unclear whether the exceedances of the 2-hour or 4-hour benchmarks would still have occurred if the area had actually been meeting the current primary $PM_{2.5}$ standards. However, in considering the analyses submitted by the commenters, the EPA conducted new analyses [105] that looked at all individual monitors across the U.S. and evaluated the percentage of times the monitors experienced a 2-hour maximum concentration over 120 $\mu g/m^3$ or a 4-hour max concentration over 37.8 $\mu g/m^3$ when that monitor was meeting the current standards. Further, given that the Administrator concludes that the level of the current primary annual $PM_{2.5}$ is not adequate and that it should be revised to 9.0 $\mu g/m^3$, the new analysis evaluates the percentage of times during a recent 3-year period (*i.e.* 2019–2021) that individual monitors experienced a 2-hour maximum concentration over 120 $\mu g/m^3$ or a 4-hour max concentration over 37.8 $\mu g/m^3$ when that monitor was meeting the current primary 24-hour $PM_{2.5}$ standard with its level of 35 $\mu g/m^3$ and a revised primary annual $PM_{2.5}$ standard of 9.0 $\mu g/m^3$.

In evaluating the results from the new analyses, it is important to keep in mind that the 2019 ISA and ISA Supplement concluded that the most consistent evidence from the controlled human exposures studies is for impaired vascular function following 2-hour exposures to average $PM_{2.5}$ concentrations at and above about 120 $\mu g/m^3$, with less consistent evidence for effects following exposures to concentrations lower than 120 $\mu g/m^3$. The new analyses show that across all monitors, on average, only 0.029 percent of 2-hour observations reach $PM_{2.5}$ concentrations higher than 120 $\mu g/m^3$ in areas meeting the current 24-hour standard and a revised annual standard of 9.0 $\mu g/m^3$. Further, recognizing that one purpose of the 24-hour standard is to protect against exposure in areas with high peak-to-mean ratios, when assessing the monitors individually across the U.S. under these same conditions, the monitors reporting the highest $PM_{2.5}$ concentrations have only 0.47 percent of 2-hour observations reach $PM_{2.5}$ concentrations higher than 120 $\mu g/m^3$.

Additionally, the analyses also evaluated the frequency of reporting a 4-hour maximum concentration over 37.8 $\mu g/m^3$ when monitors were meeting the current 24-hour standard and a revised annual standard of 9.0 $\mu g/m^3$. For this part of the analysis, the EPA finds that across all monitors, on average, only 0.41 percent of 4-hour observations reach $PM_{2.5}$ concentrations higher than 37.8 $\mu g/m^3$ in areas meeting the current 24-hour standard and a revised annual standard of 9.0 $\mu g/m^3$. Further, when assessing the monitors individually across the U.S. under these same conditions, the monitors reporting the highest $PM_{2.5}$ concentrations have only 2.6 percent of 4-hour observations reach $PM_{2.5}$ concentrations higher than 37.8 $\mu g/m^3$. Thus, the EPA disagrees with commenters that the current primary 24-hour $PM_{2.5}$ standard typically allows $PM_{2.5}$ exposures at or above those observed to cause health effects in controlled human exposure studies. Furthermore, the EPA notes that in light of the small number of occurrences and the intermediate nature of the effects observed in Wyatt et al. (2020) at concentrations of 37.8 $\mu g/m^3$ (*i.e.,* effects that typically would not, by themselves, be judged as adverse), there is substantial basis to doubt whether further improvements in public health

[105] Jones et al. (2023). Comparison of Occurrence of Scientifically Relevant Air Quality Observations Between Design Value Groups. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

would be achieved by further reducing these exposures. In drawing this conclusion, the EPA notes the lack of evidence of effects from controlled human exposure studies at levels below the current 24-hour standard and the fact that the results of Wyatt et al. (2020) are inconsistent with other currently available studies, and this study only observes intermediate effects.

In response to commenters that cited the majority of the CASAC's view that, in general, ''[t]here is . . . less confidence that the annual standard could adequately protect against health effects of short-term exposures'' (Sheppard, 2022a, p. 4 of consensus letter), the EPA disagrees with the majority of CASAC, noting that the results of the EPA's analysis suggest that high peak concentrations are extremely infrequent in areas meeting an annual standard of 9.0 μg/m^3, occurring less than 0.029–0.41 percent of the time (for 2-hour concentrations >120 μg/m^3 and 4-hour concentrations >37.8 μg/m^3, respectively). This suggests that in most locations, even the upper tail of the distribution would be controlled quite well under a revised annual standard. With regard to the likelihood that the current standards would allow peak concentrations that are clearly of concern from a health perspective, therefore, the EPA concludes that such occurrences are extremely infrequent—and will be even less frequent under the improved air quality conditions associated with meeting a revised annual $PM_{2.5}$ standard of 9.0 μg/m^3.

A number of commenters who support revising the primary 24-hour $PM_{2.5}$ standard to a lower level suggest that the available epidemiologic evidence provides support for such a revision. To support their view, the commenters note that the currently available evidence, including a number of epidemiologic studies that demonstrate associations between short-term $PM_{2.5}$ exposures and health effects, provides support for causal relationships for short-term $PM_{2.5}$ exposures and health effects as described in the 2019 ISA and ISA Supplement. The commenters further note that the available epidemiologic studies include diverse populations that are broadly representative of the U.S. population, including at-risk populations, which they assert is an advantage over the controlled human exposure studies and the risk assessment, which are not as broadly representative.

These commenters highlight a number of specific epidemiologic studies that they suggest provide support for revising the level of the 24-hour standard. Additionally, commenters contend that there are epidemiologic studies using restricted analyses that show that positive and statistically significant associations between short-term $PM_{2.5}$ exposure and mortality persist at daily mean concentrations below 25 μg/m^3. The commenters also cite several studies that provide no evidence of a threshold. These commenters also point to the CASAC advice in their review of the 2021 draft PA, where the majority of the CASAC cited epidemiologic studies using restricted analyses as offering support for revision. The commenters argue that the EPA cannot base discretion on uncertainties related to the methods used in restricted analyses in the epidemiologic studies. In so doing, these commenters disagree with the EPA that it is important to take into consideration that these studies do not consider the form or averaging time of the 24-hour standard. Finally, the commenters claim that while the EPA stated that the study-reported means from epidemiologic studies that use restricted analyses are more useful for identifying impacts from typical 24-hour exposures than for peak 24-hour exposures, the commenters assert that the studies also indicate that there are health risks at relatively high concentrations below the current level of the primary 24-hour $PM_{2.5}$ standard that must be addressed.

As noted by the commenters, epidemiologic studies that show positive and statistically significant associations between short-term $PM_{2.5}$ exposure and mortality provide support for the causal determination in the 2019 ISA. The EPA also agrees that the available epidemiologic studies include diverse populations that are broadly representative of the U.S. population, including at-risk populations. Further, the EPA agrees that studies evaluated in the 2019 ISA and the ISA Supplement continue to provide evidence of linear, no-threshold concentration-response relationships, but with less certainty in the shape of the curve at lower concentrations (*i.e.,* below about 8 μg/m^3), with some recent studies providing evidence for either a sublinear, linear, or supralinear relationship at these lower concentrations (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 2.2.3.2).

However, findings of positive, significant associations in short-term epidemiologic studies do not directly indicate that short-term effects would occur in areas meeting the 24-hour standard and therefore, do not directly address the question of whether the current 24-hour standard is adequate. While short-term epidemiologic studies evaluate associations between distributions of ambient $PM_{2.5}$ and health outcomes, they do not identify the specific exposures (*i.e.,* a specific 24-hour concentration) that can lead to the reported effects. Short-term epidemiologic studies evaluate the association between day-to-day variation in daily (24-hour) $PM_{2.5}$ exposure and health endpoints (*e.g.,* mortality) to understand how these changes in air pollution concentrations are associated with changes in health outcomes. But these studies do not report daily concentrations; rather, they report the long-term mean concentration of the 24-hour $PM_{2.5}$ concentrations over the entire multi-year period of the study, and typically report their results as a relative risk (*e.g.,* for each 10 μg/m^3 increase in $PM_{2.5}$, the risk of mortality or cardiovascular hospital admissions increases by a certain percentage, across the full range of the 24-hour $PM_{2.5}$ concentrations in the study). This means that there is no specific point in the air quality distribution of any epidemiologic study that represents a ''bright line'' at and above which effects have been observed and below which effects have not been observed. Nor, as noted above, do these studies allow for any direct inferences about health impacts associated with the short-term ''peak'' exposures that the primary 24-hour standard is designed to protect against. While there can be considerable variability in daily exposures over a multi-year study period, most of the estimated exposures in these epidemiologic studies reflect days with ambient $PM_{2.5}$ concentrations around the mean or middle of the air quality distributions examined (*i.e.,* ''typical'' days rather than days with extremely high or extremely low concentrations). This is true of long-term epidemiologic studies as well. The difference between epidemiologic studies examining associations with long-term exposures and short-term exposures is comparing different levels of exposure over different exposure durations (*i.e.,* long-term studies exposures are defined as those that are annual or multi-year, while short-term exposures are defined as those that are mostly 24-hour) (U.S. EPA, 2019a, section P.3.1). Thus, in both cases, and in the absence of a discernible threshold, epidemiologic studies of short-term and long-term exposures provide the strongest support and confidence for reported health effect associations around the middle portion of the $PM_{2.5}$ air quality distribution (*e.g.,* the study-reported mean $PM_{2.5}$

concentration), which corresponds to the bulk of the underlying data, rather than at the extreme upper or lower ends of the distribution. However, the difference between the annual standard and the 24-hour standard, aside from averaging times, is that the form of the annual standard is a mean $PM_{2.5}$ concentration, which is based on the bulk of the air quality data, while the form of the 24-hour standard is a 98th percentile form, which is based on peak concentrations. Both long-term and short-term epidemiologic studies are informative for determining the appropriate level of the annual $PM_{2.5}$ standard, which is designed to control ''typical'' daily exposures and risks, because these studies most often report long-term mean (or median) $PM_{2.5}$ concentrations that are representative of ''typical'' exposures that are associated with health effects. In contrast, while the short-term epidemiologic studies examine health effects associated with shorter exposure durations (*e.g.,* mostly 24-hour exposures), these studies are less informative for determining the appropriate level of the 24-hour $PM_{2.5}$ standard because these studies do not report the 98th percentile $PM_{2.5}$ concentrations,[106] which is more directly comparable to the form of the 24-hour standard. Additionally, if the 98th percentile of data were reported, the EPA would consider the peak concentrations observed in these studies (which by definition rarely occur) in conjunction with other supporting evidence. However, as already noted, there is an absence of new information in this reconsideration (either from controlled human exposure studies or epidemiologic studies) suggesting that peak concentrations just below the level of the current 24-hour standard (with its level of 35 $\mu g/m^3$) are associated with adverse effects. Instead, the evidence links risk to more typical daily exposures near the middle of the air quality distribution—exposures most effectively controlled through a strengthening of the annual standard. As noted in the 2012 final rule, ''reducing the annual standard is the most efficient way to reduce the risks from short-term exposures . . . as the bulk of the risk comes from the large number of days across the bulk of the air quality distribution, not the relatively small number of days with peak concentrations'' (78 FR 3156, January 15, 2013).

As noted above, in evaluating the adequacy of the current standards, the EPA has consistently considered the annual standard (based on arithmetic mean concentrations) and 24-hour standard (based on 98th percentile concentrations) together in evaluating the public health protection provided by the standards against the full distribution of short- and long-term $PM_{2.5}$ exposures. Moreover, the EPA has previously noted that the annual standard is generally controlling in most parts of the country, providing an effective and efficient way to reduce total population risk to both long- and short-term $PM_{2.5}$ exposures, while the 24-hour standard, with its 98th percentile form, provides supplemental protection, particularly for areas with high peak-to-mean ratios of 24-hour $PM_{2.5}$ concentrations (78 FR 3158, January 15, 2013). In such areas, annual average $PM_{2.5}$ concentrations could be quite low, and the 24-hour standard provides a means of ensuring control of episodic peaks possibly associated with strong local or seasonal sources, or $PM_{2.5}$-related effects that may be associated with shorter-than daily exposure periods. The approach taken in evaluating the adequacy and alternative levels of the annual standard has been to evaluate the long-term mean $PM_{2.5}$ concentrations of both long-term and short-term key epidemiologic studies, where we have the most confidence in the reported health effects association, while also giving some consideration to lower percentiles of the air quality distribution (*e.g.,* 25th percentiles). However, using a similar approach to evaluate the adequacy of the current and any potential alternative levels of the 24-hour standard with short-term epidemiologic studies, as the majority of CASAC and some commenters are suggesting, presents challenges.

Short-term epidemiologic studies, including those that use restricted analyses, often report metrics that include mean $PM_{2.5}$ concentrations, with some studies also reporting lower percentiles, such as the 25th percentile. As previously noted above, for studies of daily $PM_{2.5}$ exposure, which examine associations between day-to-day variation in $PM_{2.5}$ concentrations and health outcomes, often over several years, most of the estimated exposures reflect days with ambient $PM_{2.5}$ concentrations around the middle of the air quality distributions examined (*i.e.,* the mean or median). However, there is not a metric or statistic reported in short-term epidemiologic studies that allows for a direct comparison to the current 24-hour $PM_{2.5}$ standard and its 98th percentile form. While a 98th percentile of $PM_{2.5}$ concentrations is a metric that might be more closely compared to the 24-hour standard level, 98th percentile $PM_{2.5}$ concentrations were not reported in key epidemiologic studies. Consistent with the Administrator's final decision in 2012, the EPA notes that even if 98th percentile values were reported, it would be inappropriate to focus on these concentrations without also considering the impact of a revised annual standard on short-term concentrations, since many areas would be expected to experience decreasing short- and long-term $PM_{2.5}$ concentrations in response to a revised annual standard (78 FR 3156, January 15, 2013). Furthermore, in light of the scarcity of days at the very upper end of the distribution, and to avoid placing undue reliance on the peak concentrations observed in these studies (which by definition rarely occur), the EPA finds that such values would need to be considered in conjunction with other supporting evidence. In addition, as described above, the other lines of evidence available for consideration by the EPA do not indicate that the current primary 24-hour standard requires revision to protect public health with an adequate margin of safety. The EPA notes again the lack of corroborating evidence from controlled human exposure studies. While the EPA agrees with the CASAC that the controlled human exposure studies are limited in their ability to speak to the concentrations at which effects may be elicited in at-risk populations, as discussed above the lowest concentration associated with effects is 37.8 $\mu g/m^3$ and the effects observed were ''intermediate'' outcomes that are not by themselves considered adverse. We also note that, as detailed in section II.A.2.a above, the study that observed intermediate effects at concentrations of 37.8 $\mu g/m^3$ was evaluated in the ISA Supplement and the results of this study were inconsistent with the controlled human exposure studies evaluated in the 2019 ISA. Additionally, as noted above, the EPA finds that across all monitors, on average, only 0.41 percent of 4-hour observations reach $PM_{2.5}$ concentrations higher than 38 $\mu g/m^3$ in areas meeting the current 24-hour

[106] In the 2022 PA, the EPA has identified a number of key areas for additional research and data collection for $PM_{2.5}$, based on the uncertainties and limitations that remain in the scientific evidence and technical information. In addition to research and data collection, the EPA specifically highlights additional information that could be reported in the epidemiologic studies that may help inform future reviews of the primary $PM_{2.5}$ standards, including additional descriptive statistics in the upper percentiles of the air quality distribution (*i.e.,* from the 95th to the 99th percentile), as well as the number of days of concentrations and/or health events within each of these percentiles (U.S. EPA, 2022a, section 3.7).

standard and a revised annual standard of 9.0 μg/m^3. Given the rarity of these occurrences and the fact that the effects associated with exposures to this $PM_{2.5}$ concentration have not been found to be adverse in and of themselves, the EPA finds it reasonable to conclude that this pattern of air quality will protect at-risk populations, even though such populations were not in the study groups. The EPA concludes that further evidence would be needed at specific short-term (*i.e.,* hourly or daily) concentrations below the level of the current 24-hour standard to support any revision to the current 24-hour standard.

With regard to the data that are available from the short-term epidemiologic studies (which, as noted, do not include 98th percentile values), the EPA considers it inappropriate to utilize the study-reported means from the short-term epidemiologic evidence to assess the adequacy of the 24-hour standard, with its 98th percentile form, considering that the study-reported mean concentrations do not provide meaningful insight regarding the frequency or health significance of peak concentrations occurring during the study period. As indicated in the 2022 PA, the study-reported means of short-term epidemiologic studies do not serve a purpose in determining a level at which we can confidently attribute effects to the impact of ''peak'' exposures. The 24-hour standard is intended to provide supplemental protection against short-term peak exposures and while there is a general relationship between mean concentrations and 98th percentile concentrations in individual locations, such relationships vary by location and there is not an established relationship that can be relied upon to predict 98th percentile concentrations based on mean $PM_{2.5}$ concentrations reported in multi-city epidemiologic studies. Instead, mean concentrations from short-term epidemiologic studies are more useful in addressing questions regarding the effects of ''typical'' or average 24-hour exposures, which are addressed through the annual standard. For this reason, the EPA does consider the mean concentrations of short-term studies (as well as the means from the long-term studies) in evaluating the level of the annual standard, which the EPA recognizes as the generally controlling standard for both long- and short-term exposures. However, the EPA does not agree with commenters that it is appropriate to use means from short-term epidemiologic studies as the basis for a decision-making framework to determine the adequacy of the current 24-hour standard, with its 98th percentile form.

As described in the proposal (88 FR 5613, January 27, 2023), the 2022 PA also noted the epidemiologic studies that restrict 24-hour average $PM_{2.5}$ concentrations to values of less than 35 μg/m^3, and in some cases less than 25 μg/m^3, and annual average $PM_{2.5}$ concentrations less than 12 μg/m^3. Restricted analyses use a subset of data from their main analyses and conduct an epidemiologic study with health events that occur at concentrations below a certain concentration (*e.g.,* 25 μg/m^3). While some of these studies do not report the mean $PM_{2.5}$ concentration for the restricted analysis, the mean of the restricted analysis is presumably less than the mean $PM_{2.5}$ concentration in the main analysis. Restricted analyses from long-term and short-term exposure epidemiologic studies are informative in providing support that the health effects associations are not driven by just the upper peaks of the $PM_{2.5}$ air quality distributions and provide support for revision to the level of the annual $PM_{2.5}$ standard. Short-term restricted analyses also report positive associations between short-term $PM_{2.5}$ exposure and morbidity and mortality. As an example, in a restricted analysis evaluating the association between short-term exposures and $PM_{2.5}$ concentrations less than 25 μg/m^3, Di et al. (2017a) removed 6.3 percent of the data from their main analyses, (*i.e.,* all $PM_{2.5}$ concentrations greater than 25 μg/m^3), and still found a positive and significant association between short-term $PM_{2.5}$ exposure and mortality. This study provides additional support that the association between short-term exposure to $PM_{2.5}$ and mortality in the main epidemiologic analysis is not driven by the upper peaks of the $PM_{2.5}$ air quality distribution, which in turn supports the conclusion that lowering the entire distribution of air quality concentrations through a revised annual standard is an appropriate means of protecting against adverse effects from short-term exposure, as discussed further below.

In their review of the 2021 draft PA, the majority of the CASAC highlighted three U.S.-based epidemiologic studies that restricted 24-hour average $PM_{2.5}$ concentrations below 25 μg/m^3 as a part of their rationale for recommending that the EPA revise the level of the primary 24-hour $PM_{2.5}$ standard. Similarly, in evaluating positive associations in restricted analyses, some commenters also suggest that because an association exists at 24-hour concentrations below 25 μg/m^3, the 24-hour standard level should be set at the concentration at which the analysis was restricted (*e.g.,* 25 μg/m^3). However, the EPA notes that neither the CASAC nor public commenters provided any detail regarding, how, in their view, these studies demonstrate that the level of the current 24-hour standard is not adequate, and/or how these studies demonstrate what revised level of the 24-hour standard would provide requisite public health protection with an adequate margin of safety. The EPA considers that such an approach would have several important limitations. First, the approach assumes that a specific point on the air quality distribution (*e.g.,* the point at which the analysis was restricted) is where health effects are exhibited and where we have the most confidence in the reported association. However, in addition to the limitations associated with the short-term epidemiologic studies outlined above, the EPA does not agree that it would be appropriate to identify the requisite level of the primary 24-hour $PM_{2.5}$ standard based on the specific concentration at which the analyses restrict their studies. The choice to restrict the data at a particular concentration is in effect arbitrary, and does not establish that any particular effects are attributable to that concentration as opposed to other concentrations within the restricted analysis.

Further, these restricted analyses do not report the $PM_{2.5}$ concentration at the 98th percentile of data or other metrics relating to the upper end of the distribution that could provide information about health risks associated with peak exposures. For example, the CASAC does not provide a discussion of what the comparable 98th percentile concentration is in the distribution of remaining 24-hour $PM_{2.5}$ concentrations of restricted analyses (because such data is not reported by the study authors) and what degree of confidence the Administrator should place on those upper percentile values (*e.g.,* 98th percentile values). In order to identify a level of the 24-hour standard based on associations between the ''upper end'' of exposures, either in the unrestricted or the restricted analyses, and adverse health effects, it would be necessary to have both greater detail on the distribution of air quality in the study and greater confidence in the reported association at the peak concentrations such as the 98th percentile—in other words, a better understanding of how specific 24-hour concentrations correspond to the frequency and total number of observed health events in the study.

Further, the EPA notes that when resulting analyses based on the

restricted dataset continue to find positive associations between the remaining air quality distribution and health effects, it suggests that the relationship was in fact not driven primarily by the upper tail (now removed from the dataset) but rather by lower portions of the distribution of air quality. In other words, we have no confidence that the remaining upper end of the air quality distribution is driving the remaining associations reported in the restricted analyses, as opposed to the vast array of health events at and around the mean $PM_{2.5}$ concentration. In fact, it is reasonable to conclude that to effectively address the health effects observed in the study, it is necessary to control not just the peak concentrations but to reduce the bulk of the exposures (occurring near the mean), a task more effectively achieved, as noted above through a tightening of the annual standard, which has the effect of shifting the entire distribution of $PM_{2.5}$ concentrations downward (both peaks and means). Therefore, while the EPA agrees that both short- and long-term epidemiologic studies that completed restricted analyses and reported the resulting study means could be used to inform conclusions regarding the adequacy of the annual standard, given that the resulting study means (when reported) could be evaluated in the context of the decision framework described above for informing decisions on the level of the annual standard, the EPA considers that current short-term epidemiologic studies that restrict analyses are subject to the same limitations outlined above for current short-term epidemiologic studies in how they can be used in a decision-making framework to inform the adequacy and alternative level of the primary 24-hour $PM_{2.5}$ standard. As such, while the available short-term epidemiologic studies that restrict their analyses are useful for informing conclusions regarding the strength of the associations for health outcomes, they are not, as currently designed, as useful for informing conclusions regarding the adequacy of the current primary 24-hour $PM_{2.5}$ standard. In reaching this conclusion, the EPA notes that the majority of the CASAC did not address the limitations of these studies outlined in the 2021 draft PA, particularly in the context of the 24-hour standard with its 98th percentile form. Among the future research needs identified by the EPA in the 2022 final PA, the Agency noted a number of gaps in the currently available information reported in the epidemiologic studies of short-term exposure, including ''descriptive statistics of $PM_{2.5}$ concentrations at individual percentiles from the 95th percentile to the 99th percentile, as well as the number of days of concentrations and/or health events within each of these percentiles'' and other descriptive statistics and details regarding analytical design in studies employing restricted analyses (U.S. EPA, 2022b, pp. 3–225 to 3–226). Such information could significantly improve the EPA's ability to draw conclusions from these studies with regard to the adequacy of the current primary 24-hour $PM_{2.5}$ standard.

Due to the limitations and uncertainties outlined above, in reaching his decision on the primary 24-hour $PM_{2.5}$ standard, the Administrator judges that the information from currently available short-term epidemiologic studies, including those that use restricted analyses, is inadequate to inform decisions regarding the adequacy of the current 24-hour standard. Additionally, consistent with the final decision in 2012, the EPA continues to view an approach that focuses on setting a generally controlling annual standard as the most effective and efficient way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures. Potential air quality changes associated with meeting an annual standard level of 9.0 $\mu g/m^3$ will result in lowering risk associated with both long- and short-term $PM_{2.5}$ exposure by lowering the overall air quality distribution. As discussed above, reducing the annual standard is the most efficient way to reduce the risks from short-term exposures identified in the epidemiologic studies, as the available evidence suggests the bulk of the risk comes from the large number of days across the bulk of the air quality distribution, not the relatively small number of days with peak concentrations. However, as in the 2012 review, the Administrator recognizes that an annual standard alone would not be expected to offer sufficient protection with an adequate margin of safety against the effects of short-term $PM_{2.5}$ exposures in all parts of the country, particularly in areas with high peak-to-mean ratios, and concludes that it is appropriate to continue to provide supplemental protection by means of a 24-hour standard. In so doing, the Administrator concludes that retaining the level of the primary 24-hour $PM_{2.5}$ standard of 35 $\mu g/m^3$ will provide requisite protection against short-term peak $PM_{2.5}$ concentrations, in conjunction with a revised annual standard level of 9.0 $\mu g/m^3$.

4. Administrator's Conclusions

This section summarizes the Administrator's considerations and conclusions related to the adequacy of the current primary $PM_{2.5}$ standards and presents his decision to revise the primary annual $PM_{2.5}$ standard to a level of 9.0 $\mu g/m^3$ and retain the primary 24-hour $PM_{2.5}$ standard. In establishing primary standards under the Act that are ''requisite'' to protect public health with an adequate margin of safety, the Administrator is seeking to establish standards that are neither more nor less stringent than necessary for this purpose. He recognizes that the requirement to provide an adequate margin of safety was intended to address uncertainties associated with inconclusive scientific and technical information and to provide a reasonable degree of protection against hazards that research has not yet identified. However, the Act does not require that primary standards be set at a zero-risk level; rather, the NAAQS must be sufficiently protective, but not more stringent than necessary.

Given these requirements, the Administrator's final decision in this reconsideration is a public health policy judgment drawing upon scientific and technical information examining the health effects of $PM_{2.5}$ exposures, including how to consider the range and magnitude of uncertainties inherent in that information. This public health policy judgment is based on an interpretation of the scientific and technical information that neither overstates nor understates its strengths and limitations, nor the appropriate inferences to be drawn, and is informed by the Administrator's consideration of advice from the CASAC and public comments received on the proposal.

The initial issue to be addressed in the reconsideration of the primary $PM_{2.5}$ standards is whether, in view of the advances in scientific knowledge and other information reflected in the 2019 ISA, ISA Supplement, and 2022 PA, the current standards are requisite to protect public health with an adequate margin of safety. In considering the adequacy of the current suite of primary $PM_{2.5}$ standards, the Administrator has considered the large body of evidence presented and assessed in the 2019 ISA and ISA Supplement, the conclusions presented in the 2022 PA, the views expressed by the CASAC, and public comments. The Administrator has taken into account both evidence- and risk-based considerations in developing final conclusions on the adequacy of the current primary $PM_{2.5}$ standards. The Administrator has additionally

considered the associated public health policy judgments and judgments about the uncertainties inherent in the scientific evidence and quantitative analyses that are integral to the conclusions on the adequacy of the current primary $PM_{2.5}$ standards.

In evaluating the adequacy of the current standards, the Administrator first recognizes the longstanding body of health evidence supporting relationships between $PM_{2.5}$ exposures (short- and long-term) and mortality and serious morbidity effects. The evidence available in this reconsideration (*i.e.,* that assessed in the 2019 ISA and ISA Supplement) and summarized above in section II.A.2.a reaffirms, and in some cases strengthens, the conclusions from the 2009 ISA regarding the health effects of $PM_{2.5}$ exposures. Recent epidemiologic studies demonstrate generally positive and often statistically significant associations between $PM_{2.5}$ exposures and a number of health effects, including non-accidental, cardiovascular, or respiratory mortality; cardiovascular or respiratory hospitalizations or emergency room visits; and other mortality/morbidity outcomes (*e.g.,* lung cancer mortality or incidence, asthma development). Recent controlled human exposure and animal toxicological studies, as well as evidence from epidemiologic panel studies, strengthens support for potential biological pathways through which $PM_{2.5}$ exposures could lead to the serious effects reported in many population-level epidemiologic studies, including support for pathways that could lead to cardiovascular, respiratory, nervous system, and cancer-related effects. In considering the available scientific evidence, and consistent with approaches employed in past NAAQS reviews, the Administrator places the most weight on evidence supporting ''causal'' or ''likely to be causal'' relationship with long or short-term $PM_{2.5}$ exposures. In addition, the Administrator also takes note of those populations identified to be at greater risk of $PM_{2.5}$-related health effects, as characterized in the 2019 ISA and ISA Supplement, and the potential public health implications.

In evaluating what existing or revised standards may be requisite to protect public health, as described above in section II.A.2, the Administrator's approach recognizes that the current annual standard (based on arithmetic mean concentrations) and 24-hour standard (based on 98th percentile concentrations), together, are intended to provide public health protection against the full distribution of short- and long-term $PM_{2.5}$ exposures. This approach recognizes that changes in $PM_{2.5}$ air quality designed to meet either the annual or the 24-hour standard would likely result in changes to both long-term average and short-term peak $PM_{2.5}$ concentrations.

Further, consistent with the approach adopted in 2012, the Administrator concludes that the most effective and efficient way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures is to set a generally controlling annual standard, and to provide supplemental protection against the occurrence of peak 24-hour $PM_{2.5}$ concentrations by means of a 24-hour standard set at the appropriate level. In reaching this conclusion, the Administrator explicitly recognizes that air quality changes associated with meeting a revised annual standard would result in lowering risks associated with both long- and short-term $PM_{2.5}$ exposures by lowering the overall distribution of air quality concentrations, leading to not only in lower short- and long-term $PM_{2.5}$ concentrations near the middle of the air quality distribution, but also in fewer and lower short-term peak $PM_{2.5}$ concentrations. Similarly, the Administrator recognizes that changes in air quality to meet a 24-hour standard, would result not only in fewer and lower peak 24-hour $PM_{2.5}$ concentrations, but also in lower annual average $PM_{2.5}$ concentrations. However, as noted in 2012, he also recognizes that an approach that relies on setting the level of the 24-hour standard such that the 24-hour standard is generally controlling would be less effective and result in less uniform protection across the U.S. than an approach that focuses on setting a generally controlling annual standard. Thus, he concludes that relying on a revised annual standard as the controlling standard will reduce aggregate risks associated with both long- and short-term exposures more consistently than a generally controlling 24-hour standard. He further concludes that retaining a 24-hour standard at the appropriate level will ensure an adequate margin of safety against short-term effects in areas with high peak-to-mean ratios.

In light of his focus on the annual standard as the generally controlling standard, in considering whether the primary $PM_{2.5}$ standards are adequate, the Administrator first considers information available to inform his final conclusions regarding the primary annual $PM_{2.5}$ standard. In so doing, he notes that in this reconsideration, a large number of key U.S. epidemiologic studies report positive and statistically significant associations for air quality distributions with overall mean $PM_{2.5}$ concentrations that are well below the current level of the annual standard of 12.0 $\mu g/m^3$. He further recognizes that there is additional scientific evidence assessed in the 2019 ISA and newly assessed in this reconsideration in the ISA Supplement that can provide supplemental information to inform his decisions. In addition to the key U.S. epidemiologic studies, the Administrator also recognizes that key Canadian epidemiologic studies also demonstrate positive and statistically significant associations at concentrations below 12 $\mu g/m^3$. He also recognizes that epidemiologic studies that restrict annual average $PM_{2.5}$ concentrations to below 12 $\mu g/m^3$ also provide support for positive and statistically significant associations at lower mean $PM_{2.5}$ concentrations, as do accountability studies that also suggest public health improvements may occur at concentrations below 12 $\mu g/m^3$.

With regard to the available scientific evidence to inform his final decisions on the adequacy of the current 24-hour standard, the Administrator finds that there is less information available to support decisions on the 24-hour standard than that summarized above for the annual standard. The Administrator first notes that controlled human exposure studies, including those newly available in this reconsideration, demonstrate effects following short-term $PM_{2.5}$ exposures at concentrations higher than the current 24-hour standard. The Administrator also considers air quality analyses conducted in the 2022 PA and in responding to public comments, as described above in section II.B.3, that evaluate $PM_{2.5}$ concentrations in ambient air for similar durations to the controlled human exposure studies. As noted above, these air quality analyses indicate that the current 24-hour standard, particularly in conjunction with the revised level of the annual standard, provides a high degree of protection against subdaily $PM_{2.5}$ concentrations that have been shown to elicit effects in controlled human exposure studies. The Administrator considers a limited number of available epidemiologic studies that report associations with health effects when the analyses are restricted to daily $PM_{2.5}$ concentrations below 35 $\mu g/m^3$. As described above, although these studies are useful in demonstrating that health effects are associated with exposure to daily $PM_{2.5}$ concentrations in the lower part of the air quality distribution, they do not provide information about health effects associated with the short-term

''peak'' exposures that the 24-hour standard is designed to protect against. Accordingly, these studies have limited relevance in informing a decision about the appropriate level of the 24-hour standard.

In addition to the scientific evidence, the Administrator also considers the information from the risk assessment. In so doing, he notes that the risk assessment estimates that the current primary annual $PM_{2.5}$ standard could allow a substantial number of deaths in the U.S. With respect to the 24-hour standard, the Administrator recognizes that there are only a small number of study areas where the 24-hour standard is controlling and changes in the 24-hour standard level are estimated to have a much smaller impact on public health. The Administrator recognizes that while the risk estimates can help to place the evidence for specific health effects into a broader public health context, they should be considered along with the inherent uncertainties and limitations of such analyses when informing judgments about the potential for additional public health protection associated with $PM_{2.5}$ exposure and related health effects. While the Administrator recognizes that these uncertainties are important, he also notes that the general magnitude of the risk estimates provide support for significant public health impacts, particularly for lower alternative annual standard levels.

In reaching his final conclusions regarding the adequacy of the primary $PM_{2.5}$ standards, the Administrator also considers the CASAC's advice and recommendations, as well as public comments. With respect to the CASAC's advice, the Administrator recognizes that, in their review of the 2021 draft PA, the CASAC reached consensus that the current primary annual $PM_{2.5}$ standard is not adequate and that it is not sufficiently protective of public health. The Administrator also takes note of the CASAC's advice in their review of the 2019 draft PA, where the CASAC did not reach consensus on the adequacy of the primary annual $PM_{2.5}$ standard, with the minority recommending revision and the majority recommending the standard be retained. Furthermore, he recognizes that in reviewing the 2019 draft PA, the CASAC reached consensus regarding the adequacy of the primary 24-hour $PM_{2.5}$ standard, concluding that the standard should be retained. Conversely, in their review of the 2021 draft PA, the majority of the CASAC advised that the current primary 24-hour $PM_{2.5}$ standard is not adequate and recommended revising the level of the standard, while the minority of the CASAC concluded that the standard was adequate and should be retained. However, in considering the advice of the CASAC collectively in the context of this reconsideration, the Administrator recognizes that the 2021 draft PA included scientific evidence and quantitative risk information that was not available in the 2019 draft PA, and therefore, the advice and recommendations of the CASAC in their review of the 2021 draft PA are based on consideration of the full body of scientific evidence available in this reconsideration, including the evidence evaluated in the 2019 ISA and the ISA Supplement.

The Administrator recognizes that much of the scientific evidence available in this reconsideration was also available in the 2019 ISA and was considered by the then-Administrator when he decided that the current primary $PM_{2.5}$ standards are requisite to protect public health with an adequate margin of safety. However, as described in section I.C.5.b above, in reaching his decision to reconsider the 2020 final decision, the Administrator also recognized that there were a number of studies published since the literature cutoff date of the 2019 ISA that were raised by some members of the CASAC in their review of the 2019 draft PA, in public comments on the 2020 proposal, and in the petitions for reconsideration. As such, the expansion of the air quality criteria in this reconsideration to encompass both the 2019 ISA and the additional scientific evidence evaluated in the ISA Supplement, along with evidence and updated quantitative analyses in the 2022 PA also provided an expanded record for the CASAC's review and public comments as a part of this reconsideration. Taken together, the 2019 ISA, ISA Supplement, and 2022 PA, along with the CASAC's advice and recommendations and public comments, provide the Administrator with additional information for consideration in reaching his final conclusions in this reconsideration. As a result, the record before him notably expands upon and strengthens the basis for the conclusions of the 2019 ISA while reducing some uncertainties that were identified in the 2020 final action.

In considering the available information in this reconsideration, the current Administrator reached different conclusions regarding the appropriate weight to place on certain aspects of the evidence than the then-Administrator in the 2020 final decision. For example, in reaching his conclusions on the primary annual $PM_{2.5}$ standard in 2020, the then-Administrator concluded that it was appropriate to place more weight on epidemiologic studies that used ground-based monitors and to place less weight on the studies that used hybrid model-based approaches, citing to increased uncertainties associated with this new and emerging approach to estimating exposure. In placing more weight on the key U.S. monitor-based studies, the then-Administrator noted that the majority of these studies had mean concentrations at or above the level of the annual standard (12.0 $\mu g/m^3$). However, unlike the approach for considering such studies in the 2012 review, the then-Administrator concluded that it was appropriate to consider the study-reported means collectively, and in so doing, he placed weight on the average of the study-reported means (or medians) across the U.S. monitor-based studies of 13.5 $\mu g/m^3$, and noted that this concentration was above the level of the standard (85 FR 82717, December 18, 2020). In contrast, in this reconsideration, the current Administrator judges that it is appropriate to consider the individual study-reported mean $PM_{2.5}$ concentrations from not only the U.S. monitor-based epidemiologic studies, but also the U.S. hybrid model-based epidemiologic studies, which are an advancement in the available science since the completion of the 2009 ISA. The current Administrator also adopts an approach similar to some previous approaches for the PM NAAQS in which he judges it most appropriate to set the level of the standard to somewhat below the lowest long-term study-reported mean $PM_{2.5}$ concentration reported in key U.S. epidemiologic studies, which is 9.3 $\mu g/m^3$. The study that reports the long-term mean $PM_{2.5}$ concentration of 9.3 $\mu g/m^3$ is newly available in this reconsideration and is evaluated in the ISA Supplement. In the 2019 ISA, the lowest long-term study-reported mean $PM_{2.5}$ concentrations for U.S.-based studies that use ground-based monitors and hybrid model-based approaches are 9.9 $\mu g/m^3$ and 10.7 $\mu g/m^3$, respectively. In judging that it is appropriate to consider both monitor- and hybrid model-based epidemiologic studies and that it is appropriate to adopt an approach to set the level of the standard to somewhat below the lowest long-term mean $PM_{2.5}$ concentration, the current Administrator judges that the available scientific evidence—evaluated in both the 2019 ISA and in the ISA Supplement—provide support for his conclusion that that current primary

$PM_{2.5}$ standard is not adequate and should be revised.

In addition to adopting a different approach than the previous Administrator for considering the long-term mean $PM_{2.5}$ concentrations from key U.S. epidemiologic studies (one more consistent with the approach of the EPA in other prior reviews), the current Administrator both has information newly available in this reconsideration before him and is reaching different conclusions about how to weigh the evidence before him in reaching his final conclusions. For example, in reaching his final decision in 2020, the then-Administrator was concerned about placing too much weight on epidemiologic studies to inform his conclusions on the adequacy of the primary $PM_{2.5}$ standards, noting that the epidemiologic studies do not identify particular $PM_{2.5}$ concentrations that cause effects and cannot alone identify a specific level at which to set the standard. In so doing, the then-Administrator placed greater weight on the uncertainties and limitations associated with the epidemiologic studies, including exposure measurement error, potential confounding by copollutants, increased uncertainty of associations at lower $PM_{2.5}$ concentrations, and heterogeneity of effects across different cities or regions (85 FR 82716, December 18, 2020). The Administrator recognizes that in reaching these judgments, the then-Administrator took into consideration the views of some members of the CASAC, who, in their advice on the 2019 draft PA, expressed the view that the current PM NAAQS should be retained because reported associations between short- and long-term $PM_{2.5}$ exposures and adverse health outcomes ''can reasonably be explained in light of uncontrolled confounding and other potential sources of error and bias'' (Cox, 2019b, p. 8 of consensus responses).

In this reconsideration, the current Administrator notes that the ISA Supplement evaluates additional studies that employed statistical approaches that attempted to more extensively account for confounders and are more robust to model misspecification (*i.e.,* used alternative methods for confounder control, which are sometimes referred to as causal modeling or causal inference methods) that build upon those studies available and evaluated in the 2019 ISA (U.S. EPA, 2019, sections 11.1.2.1 and 11.2.2.4). These studies report consistent positive associations between long-term and short-term $PM_{2.5}$ exposure and total mortality and cardiovascular effects (U.S. EPA, 2022a, section 3.2.2.3). In considering the epidemiologic evidence evaluated in the 2019 ISA, along with the newly available studies evaluated in the ISA Supplement, the current Administrator also recognizes that there are uncertainties and limitations associated with the epidemiologic studies, but judges that it is appropriate to place less weight on these uncertainties than the then-Administrator placed on them in reaching his final decision in 2020, given the strength of the longstanding large body of epidemiologic evidence, employing a variety of study designs, that demonstrates associations between long- and short-term $PM_{2.5}$ exposures and health effects across multiple U.S. cities and in diverse populations, including in studies examining populations and lifestages that may be at comparatively higher risk of experiencing a $PM_{2.5}$-related health effect (*e.g.,* older adults, children).

In reaching this final decision, the Administrator recognizes he is differing not only with the prior Administrator but also with the advice some members of the CASAC provided during their review of the 2019 draft PA. Specifically, taking into consideration the strength of the evidence providing support for causality determinations, the advice of other members of the CASAC and the need to protect public health with an adequate margin of safety, the current Administrator disagrees with these members of CASAC regarding the weight to be given to epidemiologic evidence ''based on its methodological limitations'' (Cox, 2019b, p. 8 of consensus responses), such as the possibility ''that such associations could reasonably be explained by uncontrolled confounding and other potential sources of error and bias'' (Cox, 2019b, p. 8 of consensus responses).

As another example of information that was not available to the CASAC in providing advice to the Administrator in reaching his final decision in 2020, the then-Administrator noted in his final decision that, while some members of the CASAC and public commenters highlighted a number of accountability studies that examined past reductions in ambient $PM_{2.5}$ concentrations and the degree to which those reductions have resulted in public health improvements, the small number of available accountability studies did not examine air quality with starting concentrations meeting the primary annual $PM_{2.5}$ standard of 12.0 $\mu g/m^3$. The then-Administrator took into consideration the absence of such accountability studies, as part of his consideration of the full body of scientific evidence, in reaching his judgment that there was considerable uncertainty in the potential for increased public health protection from further reductions in ambient $PM_{2.5}$ concentrations beyond those achieved under the existing primary $PM_{2.5}$ NAAQS (85 FR 82717, December 18, 2020). However, there are several accountability studies available since the literature cutoff date of the 2019 ISA and evaluated in the ISA Supplement in this reconsideration that have starting concentrations (or concentrations prior to the policy or intervention) below 12.0 $\mu g/m^3$ (Corrigan et al, 2018; Henneman et al., 2019; Sanders et al., 2020a). The current Administrator concludes that, while the number of available accountability studies is limited, he recognizes that these studies provide supplemental information for consideration for informing decisions on the appropriate level of the primary annual $PM_{2.5}$ standard along with the full body of evidence.

As EPA has frequently noted throughout this document, the extent to which the current primary $PM_{2.5}$ standards are judged to be adequate depends in part on science policy and public health policy judgments to be made by the Administrator on the strength and uncertainties of the scientific evidence, such as how to consider epidemiologic evidence and the need for an adequate margin of safety in setting the standards. Thus, it would be pure speculation to guess whether the then-Administrator would have reached the same or different conclusions in the 2020 final decision had the record before him included the newly available information in this reconsideration.[107] However, the current Administrator concludes that, for the reasons explained herein that, in his judgment, based on the record before him in this reconsideration, it is necessary and appropriate to revise the primary annual $PM_{2.5}$ NAAQS to provide requisite protection of public health with an adequate margin of safety.

Based on the available scientific evidence and quantitative information, as well as consideration of the CASAC's advice and public comments, the Administrator concludes that the

[107] The EPA notes that, in considering the additional scientific evidence available in this reconsideration, one member of the CASAC who reviewed both the 2019 draft PA and the 2021 draft PA found that the available scientific and quantitative information available in this reconsideration supported revising the level of the primary annual $PM_{2.5}$ standard to within the range of 10–11 $\mu g/m^3$, whereas he recommended retaining the standard during the review of the 2019 draft PA.

current primary annual $PM_{2.5}$ standard is not adequate to protect public health with an adequate margin of safety. In addition, he finds the available information insufficient to call into question the adequacy of the public health protection afforded by the current primary 24-hour $PM_{2.5}$ standard.

In considering how to revise the current suite of primary $PM_{2.5}$ standards in order to achieve the requisite protection for public health, with an adequate margin of safety, against long- and short-term $PM_{2.5}$ exposures the Administrator considers the four basic elements of the NAAQS (indicator, averaging time, form, and level) collectively. With respect to indicator, the Administrator recognizes that the scientific evidence in this reconsideration, as in previous reviews, continues to provide strong support for health effects associated with $PM_{2.5}$ mass. He notes the 2022 PA conclusion that the available information continues to support the $PM_{2.5}$ mass-based indicator and remains too limited to support a distinct standard for any specific $PM_{2.5}$ component or group of components, and too limited to support a distinct standard for the ultrafine fraction of PM (U.S. EPA, 2022b, section 3.6.3.2.1). In its advice on the adequacy of the current primary $PM_{2.5}$ standards in their review of the 2021 draft PA, the CASAC reached consensus that the $PM_{2.5}$ mass-based indicator should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[108] Additionally, there was no information in the public comments that provided a rationale for an alternative indicator. For all of these reasons, the Administrator concludes that it is appropriate to retain $PM_{2.5}$ mass as the indicator for the primary standards for fine particles.

Consistent with his proposed conclusions regarding averaging time, the Administrator notes that the scientific evidence continues to provide strong support for health effect associations with both long- and short-term $PM_{2.5}$ exposures (88 FR 5618, January 27, 2023). Epidemiologic studies continue to provide strong support for health effects associated with short-term $PM_{2.5}$ exposures based on 24-hour averaging periods, and associations in epidemiologic studies with subdaily estimates are less consistent and, in some cases, smaller in magnitude (88 FR 5618, January 27, 2023). Taken together, the 2019 ISA concludes that epidemiologic studies do not indicate that subdaily averaging periods are more closely associated with health effects than the 24-hour average exposure metric (U.S. EPA, 2019a, section 1.5.2.1). In addition, controlled human exposure and panel-based studies of subdaily exposures typically examine subclinical effects rather than the more serious population-level effects that have been reported to be associated with 24-hour exposures (*e.g.,* mortality, hospitalizations). While recent controlled human exposure studies provide consistent evidence for cardiovascular effects following $PM_{2.5}$ exposures for less than 24 hours (*i.e.,* <30 minutes to 5 hours), air quality analyses have shown that the current averaging times can effectively protect against the exposure concentrations in these studies. This information does not indicate that a revision to the averaging time is necessary to provide additional protection against subdaily $PM_{2.5}$ exposures, beyond that provided by the current primary annual and 24-hour $PM_{2.5}$ standards. The Administrator also notes that this conclusion is also support by the CASAC's advice in their review of the 2021 draft PA where they reached consensus that averaging times for the primary $PM_{2.5}$ standards should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[109] The Administrator also considers the relatively few public comments received that support a subdaily averaging time, but concludes that the currently available information does not provide support for an alternate averaging time. Consistent with his proposed decision, the Administrator concludes that it is appropriate to retain the annual and 24-hour averaging times for the primary $PM_{2.5}$ standards to protect against long- and short-term $PM_{2.5}$ exposures.

With regard to form, the Administrator first notes that the EPA has set both an annual standard and a 24-hour standard to provide protection from health effects associated with both long- and short-term exposures to $PM_{2.5}$ (62 FR 38667, July 18, 1997; 88 FR 5620, January 27, 2023). With regard to the form of the annual standard, the Administrator recognizes that a large majority of the recently available epidemiologic studies continue to report associations between health effects and annual average $PM_{2.5}$ concentrations. These studies of annual average $PM_{2.5}$ concentrations provide support for retaining the current form of the annual standard to provide protection against long- and short-term $PM_{2.5}$ exposures. In its review of the 2021 draft PA, the CASAC reached consensus that the form of the annual standard (*i.e.,* annual mean, averaged over 3 years) should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[110] The Administrator also notes that there were no public comments that recommended an alternative form for the primary annual $PM_{2.5}$ standard.

With regard to the form of the 24-hour standard (98th percentile, averaged over three years), epidemiologic studies continue to provide strong support for health effect associations with short-term (*e.g.,* mostly 24-hour) $PM_{2.5}$ exposures, and controlled human exposure studies provide evidence for health effects following single short-term ''peak'' $PM_{2.5}$ exposures (88 FR 5618, January 27, 2023). Therefore, the Administrator concludes that the evidence supports retaining a standard focused on providing supplemental protection against short-term peak exposures and supports a 98th percentile form for a 24-hour standard, in combination with a primary annual $PM_{2.5}$ standard with its annual mean averaged over three years form. As described in the proposal and in responding to comments in section II.B.3 above, the Administrator further notes that the 98th percentile, averaged over three years, form also provides an appropriate balance between limiting the occurrence of peak 24-hour $PM_{2.5}$ concentrations and identifying a stable target for risk management programs (U.S. EPA, 2022b, section 3.6.3.2.3). Furthermore, the Administrator notes that the multi-year percentile form (*i.e.,* averaged over three years) offers greater stability to the air quality management process by reducing the possibility that statistically unusual indicator values will lead to transient violations of the standard. This conclusion is also supported by the CASAC's advice in their review of the 2021 draft PA, where they reached consensus that the form for the primary $PM_{2.5}$ standards should be retained, without revision (Sheppard, 2022a, p. 2 of consensus letter).[111]

The Administrator also recognizes that the CASAC recommended that in future reviews, the EPA also consider alternative forms for the primary 24-hour $PM_{2.5}$ standard (Sheppard, 2022a,

[108] The CASAC did not provide advice or recommendations regarding the indicator of the primary $PM_{2.5}$ standards in their review of the 2019 draft PA (Cox, 2019b).

[109] The CASAC did not provide advice or recommendations regarding the averaging times of the primary $PM_{2.5}$ standards in their review of the 2019 draft PA (Cox, 2019b).

[110] The CASAC did not provide advice or recommendations regarding the forms of the primary $PM_{2.5}$ standards in their review of the 2019 draft PA (Cox, 2019b).

[111] The CASAC did not provide advice or recommendations regarding the forms of the primary $PM_{2.5}$ standards in their review of the 2019 draft PA (Cox, 2019b).

p. 18 of consensus responses). Based on the CASAC's advice, the proposal solicited comment on alternatives to the current form for consideration in future reviews (88 FR 5619, January 27, 2023). The Administrator recognizes that there were a limited number of public comments related to the form of the primary $PM_{2.5}$ standards as discussed in section II.D.3 above and in the Response to Comments document, and notes that, the EPA will consider the information provided by the commenters regarding the form of the 24-hour $PM_{2.5}$ standard in the next review of the PM NAAQS. Consistent with his proposed decision, in considering the information summarized above, the Administrator concludes that it is appropriate to retain the forms of the current annual and 24-hour $PM_{2.5}$ standards.

In considering how to revise the current suite of $PM_{2.5}$ standards to provide the requisite public health protection with an adequate margin of safety, the Administrator next evaluates the appropriate levels of the primary $PM_{2.5}$ standards, beginning with the annual $PM_{2.5}$ standard. In having carefully considered public comments related to the primary annual $PM_{2.5}$ standard, the Administrator believes that the fundamental conclusions regarding the scientific evidence and quantitative information that supported his proposed conclusions (as described in the 2019 ISA, ISA Supplement, 2022 PA, and the proposal) remain valid. In considering the level at which the primary annual $PM_{2.5}$ standard should be set, the Administrator considers the entire body of evidence and information, giving appropriate weight to each part of that body of evidence and information. He continues to place the greatest weight in this reconsideration on the available scientific evidence that provides support for associations between health effects and long- and short-term $PM_{2.5}$ exposures. In conjunction with his decisions to retain the current indicator, averaging time, and form as described above, the Administrator is revising the level of the primary annual $PM_{2.5}$ standard to 9.0 $\mu g/m^3$. In so doing, he is selecting a primary annual $PM_{2.5}$ standard that, together with the primary 24-hour $PM_{2.5}$ standard, provides requisite public health protection with an adequate margin of safety, based on his judgments about and interpretation of the scientific evidence and quantitative risk information.

The Administrator's decision to revise the level of the primary annual $PM_{2.5}$ standard to 9.0 $\mu g/m^3$ builds upon his conclusion that the overall body of scientific evidence and quantitative risk information calls into question the adequacy of public health protection afforded by the current standard, particularly for at-risk populations. Consistent with his consideration of the available information in reaching his proposed decisions, the Administrator's final decision on the level of the primary annual $PM_{2.5}$ standard places the greatest emphasis on key U.S. epidemiologic studies that report associations between long- and short-term $PM_{2.5}$ exposures and mortality and morbidity. As in the proposal, and as discussed further below, he views additional epidemiologic studies (*i.e.,* studies that employ alternative methods for confounding control, studies that employ restricted analyses, and accountability studies), the controlled human exposure studies, and the risk assessment as providing supplemental information in support of his decision to revise the current annual standard, but recognizes that some of these lines of evidence and information provide a more limited basis for selecting a particular standard level among a range of options. See *Mississippi,* 744 F. 3d at 1351–52 (studies can legitimately support a decision to revise the standard, but not provide sufficient information to justify their use in setting the level of a revised standard).

Given his consideration of the scientific evidence, quantitative risk information, advice from the CASAC, and public comments, the Administrator judges that a primary annual $PM_{2.5}$ standard with a level of 9.0 $\mu g/m^3$ is requisite to protect public health with an adequate margin of safety. He notes that the determination of what constitutes an adequate margin of safety is expressly left to the judgment of the EPA Administrator. See *Lead Industries Association* v. *EPA,* 647 F.2d at 1161–62; *Mississippi,* 744 F.3d at 1353. He further notes that in evaluating how particular standards address the requirement to provide an adequate margin of safety, it is appropriate to consider such factors as the nature and severity of the health effects, the size of the at-risk populations, and the kind and degree of the uncertainties present. In considering the need for an adequate margin of safety, the Administrator notes that a primary annual $PM_{2.5}$ standard with a level of 9.0 $\mu g/m^3$ would be expected to provide substantial improvements in public health compared to the current annual standard, including for at-risk groups such as children, older adults, people with preexisting conditions, minority populations, and low SES populations.

Consistent with his conclusions on the need for revision of the current annual standard, in reaching a decision on level, the Administrator places the most weight on information from epidemiologic studies. In so doing, the Administrator notes that these studies provide consistent evidence of positive and statistically significant associations between long- and short-term exposure to $PM_{2.5}$ and mortality and morbidity (88 FR 5624, January 27, 2023). The Administrator recognizes that placing weight on the information from the epidemiologic studies allows for examination of the entire population, including those that may be at comparatively higher risk of experiencing a $PM_{2.5}$-related health effects (*e.g.,* children, older adults, minority populations) (88 FR 5624, January 27, 2023). The Administrator also recognizes that recent epidemiologic studies continue to support a no-threshold relationship, meaning that there is no ''bright line'' below which no effects have been found. These studies also support a linear relationship between health effects and $PM_{2.5}$ exposures at $PM_{2.5}$ concentrations greater than 8 $\mu g/m^3$, though uncertainties remain about the shape of the C–R curve at $PM_{2.5}$ concentrations less than 8 $\mu g/m^3$, with some recent studies providing evidence for either a sublinear, linear, or supralinear relationship at these lower concentrations (U.S. EPA, 2019a, section 11.2.4; U.S. EPA, 2022a, section 2.2.3.2; 88 FR 5625, January 27, 2023).

As at the time of proposal, the Administrator notes that some recent epidemiologic studies have adopted a broad range of approaches to examine confounding and the results of those examinations support the robustness of reported associations seen in epidemiologic studies. These include studies that employ alternative methods for confounder control and studies that evaluate the uncertainty related to exposure measurement error, both of which continue to support associations between $PM_{2.5}$ exposures and health effects while taking approaches to address uncertainties.

In considering the epidemiologic evidence, the Administrator judges that, in reaching his decision on an appropriate level for the annual standard that will protect public health with an adequate margin of safety, in the absence of any discernible population-level thresholds, and in recognizing the need to weigh uncertainties associated with the epidemiologic evidence, it is most appropriate to examine where the evidence of associations observed in the

epidemiologic studies is strongest and, conversely, to place less weight where he has less confidence in the associations observed in the epidemiologic studies. As at the time of proposal, the Administrator notes that in previous reviews, evidence-based approaches noted that the evidence of an association in any epidemiologic study is ''strongest at and around the long-term average where the data in the study are most concentrated'' (78 FR 3140, January 15, 2013). Given this, these approaches focused on identifying standard levels near or somewhat below long-term mean concentrations reported in key epidemiologic studies. These approaches were supported by previous CASAC advice as well as the CASAC's advice in their review of the 2021 draft PA as a part of this reconsideration.

Additionally, the Administrator acknowledges that in the 2020 final action, the then-Administrator decided to retain the standard based in part on concerns about placing reliance on the epidemiologic studies and his judgment that even if he did rely on them, the majority of the studies had means or medians, as well as the mean of all of the key study-reported means or medians, above the level of the current annual standard. However, after considering the evidence, the advice of CASAC, and public comments the Administrator judges that this approach is insufficient to protect public health with an adequate margin of safety. The Administrator's decision to reach a different judgment about the appropriate level of the annual standard reflects the updated and expanded scientific record available to the Administrator in this reconsideration, as well as the additional advice from the CASAC and the public comments based on this newly available information. In addition, the Administrator observes the decision in this action to place weight on the epidemiologic studies, and to revise the annual primary standard to a level below the lowest long-term mean in the U.S.-based epidemiologic studies, is consistent with the EPA's past practice in PM NAAQS reviews.

In this reconsideration, the Administrator is considering the scientific record which has been expanded and updated since the 2020 final action, as well as the additional advice from the CASAC and the public comments that are based on the newly available information that expands upon the information previously available. In addition, the Administrator is exercising his judgment about how to interpret and weigh the expanded evidence in a way that is more consistent with the approaches used in prior PM NAAQS reviews. As a result, the Administrator has concluded on reconsideration that the level of the primary annual standard is not adequate and should be revised to protect public health with an adequate margin of safety.

Consistent with his proposed decisions, in reaching conclusions on the level of the primary annual $PM_{2.5}$ standard, the Administrator considers the long-term [112] study-reported mean $PM_{2.5}$ concentrations from key long- and short-term epidemiologic studies and sets the level of the standard to somewhat below the lowest long-term mean $PM_{2.5}$ concentration.[113] He notes that in previous PM NAAQS reviews (including the 1997, 2006 and 2012 reviews), evidence-based approaches focused on identifying standard levels near or somewhat below long-term mean concentrations reported in key long- and short-term epidemiologic studies. These approaches were supported by the CASAC in previous reviews and were supported in this reconsideration by the CASAC in their review of the 2021 draft PA. In considering the available scientific evidence to inform such an approach, the Administrator notes the strength of the epidemiologic evidence which includes multiple studies that consistently report positive associations for short- and long-term $PM_{2.5}$ exposure and mortality and cardiovascular effects. Some available studies also use a variety of statistical methods to control for confounding bias and report similar associations, which further supports the broader body of epidemiologic evidence for both mortality and cardiovascular effects. Additionally, he notes that recent epidemiologic studies available for consideration in reaching his final decision strengthen support for health effect associations at $PM_{2.5}$ concentrations lower than in those evaluated in epidemiologic studies available at the time of previous reviews. The Administrator does recognize, however, that while these epidemiologic studies evaluate associations between distributions of ambient $PM_{2.5}$ concentrations and health outcomes, they do not identify the specific exposures that led to the reported effects. As such, he notes that there is no specific point in the air quality distribution of any epidemiologic study that represents a ''bright line'' at and above which effects have been observed and below which effects have not been observed. The Administrator further notes that the epidemiologic studies provide the strongest support for reported health effect associations for this middle portion of the $PM_{2.5}$ air quality distribution, which corresponds to the bulk of the underlying data, rather than the extreme upper or lower ends of the distribution, and concludes that the long-term study-reported means from both long- and short-term studies provide the strongest support for reported health effect associations in epidemiologic studies. For these reasons, as described in the proposal and in responding to public comments in section II.B.3 above, the Administrator concludes that it is appropriate to continue to employ an approach that focuses on the mean $PM_{2.5}$ concentrations from the key epidemiologic studies to inform his conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard.

In adopting such an approach, the Administrator considers the long-term mean concentrations reported in two types of key epidemiologic studies: (1) Monitor-based studies [114] (epidemiologic studies that used ground-based monitors to estimate exposure, similar to approaches used in past reviews), and (2) hybrid modeling-based studies [115] (epidemiologic studies that used hybrid modeling approaches and apply aspects of population weighting to estimate exposures). In reaching conclusions regarding the level of a standard that would provide requisite protection with an adequate margin of safety, the Administrator recognizes that he must use his judgment regarding the appropriate weight to place on the available evidence and technical information, including uncertainties. As shown in Figures 1 and 2 above, for the key U.S. monitor-based epidemiologic studies,

[112] ''Long-term'' represents $PM_{2.5}$ exposures and concentrations that are annual or multi-year.

[113] As described in section II.A.2.c above, key epidemiologic studies are those that report overall mean (or median) $PM_{2.5}$ concentrations and for which the years of $PM_{2.5}$ air quality data used to estimate exposures overlap entirely with the years during which health events are reported.

[114] Reported mean $PM_{2.5}$ concentrations in monitor-based studies are averaged across monitors in each study area with multiple monitors, referred to as a composite monitor concentration, in contrast to the highest concentration monitored in the study area, referred to as a maximum monitor concentration (*i.e.,* the ''design value'' concentration), which is used to determine whether an area meets a given standard.

[115] Studies that use hybrid modeling approaches employ methods to estimate ambient $PM_{2.5}$ concentrations across large geographical areas, including areas without monitors, and thus, when compared to monitor-based studies, require additional information to inform the relationship between the estimated $PM_{2.5}$ concentrations across an area and the maximum monitor design values used to assess compliance.

the study-reported mean concentrations range from 9.9–16.5 μg/m^3, and for the key U.S. hybrid modeling-based epidemiologic studies, the mean concentrations range from 9.3–12.2 μg/m^3. The Administrator also recognizes that, in their review of the 2021 draft PA, both the majority and minority of the CASAC emphasized the epidemiologic studies in support of their recommendations for the level of the annual standard, but they weighed the studies in different ways (Sheppard, 2022a, p. 16–17 of consensus responses).

Based on this information, and in considering the CASAC's advice in their review of the 2021 draft PA, the Administrator judges that it is appropriate to set the level of the primary $PM_{2.5}$ standard at least as low as the lowest mean $PM_{2.5}$ concentration from these key U.S.-based epidemiologic studies, which is 9.3 μg/m^3. The Administrator additionally notes that setting the annual standard level at 9.0 μg/m^3, which is below the lowest study-reported mean $PM_{2.5}$ concentration of 9.3 μg/m^3, would be expected to shift the distribution of $PM_{2.5}$ concentrations in an area such that the area's highest monitor would generally be at or below 9.0 μg/m^3 annually, when meeting the annual standard. In this situation, the resulting average or mean $PM_{2.5}$ concentration for the entire area (measured across a number of monitors) would be even further below the study-reported means,[116] and will provide adequate protection not only in areas where the highest allowable concentrations would be expected (*i.e.,* near design value monitors) but also in other parts of the area where $PM_{2.5}$ concentrations would be expected to be maintained even lower.

As noted above, however, the Administrator must exercise his judgment regarding the appropriate weight to place on the available scientific evidence and quantitative information, including uncertainties, in determining what level of the annual standard is sufficient to protect public health with an adequate margin of safety. In so doing, he considers other information available in this reconsideration to inform his judgments, including study-reported $PM_{2.5}$ concentrations at lower percentiles in key epidemiologic studies, supplemental information from other types of epidemiologic studies, study-reported $PM_{2.5}$ concentrations from key Canadian epidemiologic studies, and the results from the quantitative risk assessment.

In weighing the evidence in considering the requisite level of the annual standard, the Administrator also takes into account additional information from the key long- and short-term U.S. epidemiologic studies available that provide study-reported $PM_{2.5}$ concentrations below the mean and, in particular, the subset of epidemiologic studies that report 25th and 10th percentile concentrations. Consistent with his proposed conclusions, as well as the CASAC's advice in their review of the 2021 draft PA and public comments, the Administrator judges that it is appropriate to place some weight on these lower percentiles in reaching his conclusions on the level of the primary annual standard. There are six key U.S. epidemiologic studies that report information on other percentiles (*e.g.,* 10th and 25th percentiles of $PM_{2.5}$ concentrations or 10th and 25th percentiles of $PM_{2.5}$ concentrations associated with health events) that are below the mean.[117] In considering the information from these studies, the Administrator first notes that the three older, monitor-based studies that report lower percentiles of $PM_{2.5}$ concentrations have smaller cohort sizes than the three hybrid model-based studies. Thus, the Administrator recognizes that the older, monitor-based studies had a relatively smaller portion of the health events that were observed in the lower part of the air quality distribution because of the generally smaller size of the cohorts. He further notes that the recent hybrid model-based studies have larger cohort sizes than the older, monitor-based studies, and therefore, have more health events in the lower part of the air quality distribution. Because of the larger cohort sizes and having a larger portion of health events that are observed across the air quality distribution, the Administrator has more confidence in the magnitude and significance of the associations in the lower parts of the air quality distribution for the recent, hybrid model-based studies compared to the older, monitor-based studies. Given this, the Administrator judges that it is appropriate to place weight on the 25th percentile concentrations reported in the recently available hybrid model-based studies in reaching his conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard. However, the Administrator also recognizes that his confidence in the magnitude and significance in the reported concentrations, and their ability to inform decisions on the appropriate level of the annual standard, starts to diminish at percentiles that are even further below the mean and the 25th percentile. For these reasons, the Administrator places weight on the reported 25th percentiles concentrations in the recent hybrid model-based studies, rather than the reported 10th percentile concentrations, in reaching his conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard.

In considering the information from these studies, as described in section II.A.2.c and in responding to public comments in section II.B.3 above, the Administrator notes that there are two hybrid model-based studies with large cohort sizes that apply population weighting and report lower percentile values. These studies are Di et al. (2017b) and Wang et al. (2017) and the reported 25th percentile concentration is 9.1 μg/m^3 for both studies.[118] In considering these studies, the Administrator concludes that it is appropriate to place weight on the 25th percentile concentrations of these newer hybrid model-based studies (of 9.1 μg/m^3) such that setting the level of the standard near these 25th percentile concentrations would provide requisite protection. The Administrator observes that an annual standard level of 9.0 μg/m^3 would be near the reported 25th percentile concentrations in these studies.

As at the time of proposal, the Administrator also takes note of the study-reported long-term mean $PM_{2.5}$ concentrations in long- and short-term Canadian epidemiologic studies, which ranged from 6.9 to 13.3 μg/m^3 for monitor-based studies and 5.9 to 9.8 μg/m^3 for hybrid model-based studies. While the Administrator notes that these studies provide additional support for associations between $PM_{2.5}$ concentrations and health effects, he is also mindful that there are important differences between the exposure environments in the U.S. and Canada and that interpreting the data (*e.g.,* study-reported mean concentrations)

[116] Analyses in the 2022 PA suggest that the highest monitored value would be expected to be greater than the study-reported mean values by 10–20% for monitor-based studies and 15–18% for hybrid modeling studies that apply aspects of population weighting.

[117] The Wang et al. (2017) study only reports the 25th percentile of the estimated $PM_{2.5}$ concentrations, not the 10th percentile.

[118] There is a third hybrid model-based study, as described in the 2022 PA and in section II.B.3 above in responding to public comments, but it is not referenced here because it reports a 25th percentile $PM_{2.5}$ concentration based on the 25th percentile of health events that occur in the study (Di et al., 2017a) rather than report the 25th percentile based on air quality concentrations.

from the Canadian studies in the context of a U.S.-based standard may present challenges in directly and quantitatively informing decisions regarding potential alternative levels of the annual standard. For example, in terms of people per square kilometer, the U.S. population density is nearly 10 times in the contiguous U.S. compared to Canada. As described in more detail in responding to public comments in section II.B.3 above, in this reconsideration, the Administrator recognizes that this difference in population density between the U.S. and Canada is more apparent than in previous reviews because the studies available in this reconsideration use different approaches than those previously available. In the 2012 review, the available Canadian epidemiologic studies used population-weighting and focused on urban areas where monitors were available and population densities were more comparable with those in the U.S., and at that time, the U.S. and Canadian studies reported similar mean $PM_{2.5}$ concentrations. However, in this reconsideration, the Administrator takes note that for the new Canadian epidemiologic studies: (1) The Canadian monitor-based studies available in this reconsideration do not apply population weighting as the previously available studies did; and (2) some of the studies now use hybrid modeling approaches for estimating exposure. The Administrator recognizes that these differences are important to consider in reaching conclusions on how these Canadian epidemiologic studies should be interpreted regarding decisions on the requisite level of the primary annual $PM_{2.5}$ standard. Specifically, the Administrator notes that the more recent Canadian studies that use hybrid modeling incorporate larger portions of the country, and therefore include more rural areas. The more rural areas that are included in the study using the hybrid modeling approaches, the more important it is to consider how the population densities and exposure environments differ between the U.S. and Canada. Additionally, the Administrator notes that for hybrid modeling-based studies there is less certainty in $PM_{2.5}$ exposure estimates in more rural areas, which are further from air quality monitors and where $PM_{2.5}$ concentrations in the ambient air tend to be lower. For these hybrid model-based studies, the portion of the rural areas that are contributing to the study-reported mean $PM_{2.5}$ concentrations in these studies is unclear. For these reasons, the Administrator concludes that it is important to consider the differences between the population exposures in the U.S. and Canadian study areas and how these differences influence the interpretation of the epidemiologic study results.

Thus, the Administrator considers the Canadian studies to inform his judgments on what level for the annual standard is requisite in light of the limitations and challenges presented. The Administrator also recognizes that the majority of the CASAC in their review of the 2021 draft PA, as well as a number of public commenters, place weight on the Canadian epidemiologic studies in recommending that the level of the primary annual $PM_{2.5}$ standard be revised to 8–10 $\mu g/m^3$. The Administrator further notes while the majority of the CASAC advised the EPA to consider the Canadian studies in revising the annual standard level to within the range of 8.0–10.0 $\mu g/m^3$, they did not advise the EPA to set the annual standard level below the study-reported means from those studies. Given these considerations, the Administrator judges that it is appropriate to set the level of annual standard within the range of 8–10 $\mu g/m^3$ to be consistent with the majority of the CASAC's advice in their consideration of these studies.

The Administrator also recognizes that information from epidemiologic studies that included analyses that restrict annual average $PM_{2.5}$ concentrations to concentrations below the level of the current annual standard can be useful for informing conclusions regarding the appropriate level of the primary annual $PM_{2.5}$ standard. In so doing, he particularly notes the two key U.S. epidemiologic studies (Di et al., 2017b and Dominici et al., 2019) that restrict annual average $PM_{2.5}$ concentrations to less than 12 $\mu g/m^3$ and report positive and statistically significant associations with all-cause mortality and mean $PM_{2.5}$ concentrations of 9.6 $\mu g/m^3$. He also considers these results along with the uncertainties and limitations associated with studies that restricted analyses below certain $PM_{2.5}$ concentrations. As described in responding to comments in section II.B.3 above, uncertainties associated with how the studies exclude $PM_{2.5}$ concentrations from the analyses (*e.g.,* at what spatial resolution are concentrations being excluded), make it difficult to understand how to interpret the results of the restricted analyses in the context of the approach employed in this reconsideration, which takes into consideration the relationship between mean $PM_{2.5}$ concentrations and design values.

The Administrator also recognizes that, in their review of the 2021 draft PA, the CASAC noted that epidemiologic studies that restrict analyses below certain $PM_{2.5}$ concentrations represent one area for which the evidence has expanded in this reconsideration, stating that these studies provide support for mortality effects at concentrations below the current PM NAAQS (Sheppard, 2022a, p. 5 of consensus responses). In their recommendations on alternative levels for the primary annual $PM_{2.5}$ standard, the majority of the CASAC cited to studies that restrict $PM_{2.5}$ concentrations to below 12 $\mu g/m^3$ as a part of their rationale for supporting a level within the range of 8–10 $\mu g/m^3$ (Sheppard, 2022a p. 16 of consensus responses). Additionally, the Administrator notes that some members of the CASAC, in their review of the 2019 draft PA, concluded that the epidemiologic studies that restrict analyses below 12 $\mu g/m^3$ and show positive associations with health effects, along with other aspects of the scientific evidence, provide support for their conclusion that the primary annual $PM_{2.5}$ standard is not adequate (Cox, 2019b, p. 9 of consensus responses). Furthermore, the Administrator takes note of public commenters who also noted that the epidemiologic studies that restrict $PM_{2.5}$ concentrations to below the current standard provide support, along with the other available information, for lowering the level of the primary annual $PM_{2.5}$ standard. In considering the studies that include restricted analyses, along with the CASAC's advice and public comments on these types of studies, the Administrator concludes that, although there are inherent uncertainties associated with this limited body of evidence, these studies that apply restricted analyses provide support for serious effects (*e.g.,* mortality) at concentrations below 10.0 $\mu g/m^3$. Given this, the Administrator concludes that it is appropriate to place some weight on these studies, and in doing so, notes that a standard level of 9.0 $\mu g/m^3$ would be below the reported mean $PM_{2.5}$ concentrations of 9.6 $\mu g/m^3$ in these studies and would, thus, be expected to provide protection against exposures related to these reported mean concentrations.

The Administrator also takes into consideration recent U.S. accountability studies, which assess the health effects associated with actions that improve air quality (*e.g.,* air quality policies or implementation of an intervention). These types of studies can also reduce uncertainties related to residual confounding of temporal and spatial factors (U.S. EPA, 2022a, p. 3–25). The

Administrator notes that in the 2020 review, the available accountability studies had ''starting'' annual average $PM_{2.5}$ concentrations (*i.e.,* mean concentration prior to reductions being evaluated) from 13.2–31.5 μg/m³, and the then-Administrator cited the lack of accountability studies in areas where the ''starting'' concentration met the current primary $PM_{2.5}$ standards as part of his rationale for retaining the standards. As at the time of proposal, the current Administrator notes that in three studies newly available in this reconsideration and assessed in the ISA Supplement, prior to implementation of the policies, mean $PM_{2.5}$ concentrations in these studies were below the level of the current annual standard level (12.0 μg/m³) and ranged from 10.0 μg/m³ to 11.1 μg/m³. These studies report positive and significant associations between mortality and cardiovascular morbidity and reductions in ambient $PM_{2.5}$ following the implementation of a policy (Henneman et al., 2019; Corrigan et al., 2018; Sanders et al., 2020a; 88 FR 5627, January 27, 2023). These studies suggest that public health improvements may occur following the implementation of a policy that reduces annual average $PM_{2.5}$ concentrations below the level of the current standard of 12.0 μg/m³. The Administrator recognizes that in their review of the 2021 draft PA, the CASAC noted that the availability of recent accountability studies was one area where the evidence had been strengthened and that the studies assessed in the ISA Supplement provide evidence of mortality effects at annual average $PM_{2.5}$ concentrations below the current NAAQS (Sheppard, 2022a, p. 5 of consensus responses). The Administrator recognizes that the CASAC also concluded that, along with other lines of evidence, the accountability studies with starting concentrations below the levels of the current standards are appropriate to consider for informing conclusions on alternative standard levels (Sheppard, 2022a, p. 13 of consensus responses). The Administrator also notes the advice of the CASAC in their review of the 2019 draft ISA, where they suggested that accountability studies be taken into account and such studies provide potentially crucial information about whether and how much decreasing $PM_{2.5}$ causes decreases in future health effects, which reflects the primary purpose of the NAAQS (Cox, 2019b, p. 8 and 10 of consensus responses). The Administrator also notes that in their review of the 2019 draft ISA, some members of the CASAC cautioned against placing more weight on the data from accountability studies based on the methodological limitations of the studies (Cox, 2019b, p. 8 of consensus responses). The Administrator notes that the CASAC did not explicitly cite to accountability studies in their reviews of the 2019 draft PA or 2021 draft PA as support for their recommendations on the adequacy of the primary annual $PM_{2.5}$ standard or potential alternative standard levels. A number of public commenters who support revising the level of the standard to 8 μg/m³ cite these accountability studies, along with the broader evidence base, as support for a more protective standard. The Administrator, in considering the evidence, the advice from the CASAC, and public comment, first recognizes that accountability studies are just one line of evidence to be considered in the broader evaluations of the information available to inform conclusions on the level of the standard. In so doing, he notes that public health improvements may occur following the implementation of a policy that reduces annual average $PM_{2.5}$ concentrations below the level of the current standard of 12.0 μg/m³, and potentially below the lowest ''starting'' concentrations in these studies of 10.0 μg/m³. However, the Administrator concludes that the limited number of accountability studies provide limited information for informing decisions on the appropriate level of the primary annual $PM_{2.5}$ standard but recognizes that these studies provide supplemental information for consideration along with the full body of evidence. Taken together, the Administrator notes a revised annual standard level of 9.0 μg/m³ is at or below the lowest starting concentration of these accountability studies (*i.e.,* 10.0 μg/m³), and judges that it is appropriate to place some weight on these studies, particularly for informing his public policy judgments regarding an adequate margin of safety.

In addition to his consideration of and conclusions regarding the available scientific evidence, the Administrator also considers the results of the quantitative risk assessment to inform his conclusions regarding the appropriate level for the primary annual $PM_{2.5}$ standard. The Administrator recognizes that the risk estimates can help to place the evidence for specific health effects into a broader public health context, but should be considered along with the inherent uncertainties and limitations of such analyses when informing judgments about the potential for additional public health protection associated with $PM_{2.5}$ exposure and related health effects. The Administrator recognizes that the overall risk assessment estimates suggest that the current primary annual $PM_{2.5}$ standard could allow a substantial number of $PM_{2.5}$-associated deaths in the U.S. The Administrator also recognizes that the CASAC concurred with the 2021 draft PA's assessment that meaningful risk reductions will result from lowering the annual $PM_{2.5}$ standard (Sheppard, 2022a, p. 16 of consensus responses).

Additionally, with respect to the results of the quantitative risk assessment, the Administrator recognizes that the 2022 PA also provides information on the distribution of concentrations associated with the estimated mortality risk at each alternative standard level assessed (U.S. EPA, 2022b, sections 3.4.2.2 and 3.6.2.2, Figure 3–18 and 3–19). When meeting an annual standard of 9.0 μg/m³ at the design value monitor, the exposure concentrations within an area are estimated to be below 9 μg/m³, with the majority of those exposures being at concentrations of below 8 μg/m³. The Administrator notes that this range of concentrations is below the lowest means in the key long- and short-term epidemiologic studies (concentrations at which the evidence is the strongest in supporting an association between exposure to $PM_{2.5}$ and adverse health effects observed in the key epidemiologic studies available in this reconsideration). Thus, the Administrator concludes that the results of the quantitative risk assessment suggest that a revised annual standard level of 9.0 μg/m³ is estimated to reduce $PM_{2.5}$ exposures to fall within the range of concentrations in which there is the most confidence in the associations and thus, confidence that estimated risk reductions will actually occur.

The Administrator also notes the information provided by the quantitative risk assessment on the distribution of concentrations associated with the estimated mortality risk for a higher annual standard level of 10.0 μg/m³ and a lower standard level of 8.0 μg/m³ (U.S. EPA, 2022b, sections 3.4.2.2 and 3.6.2.2, Figure 3–18 and 3–19). The Administrator finds that, for an annual standard level of 10.0 μg/m³, the quantitative risk assessment estimates that the standard would allow multiple exposures at concentrations above the lowest means in the key epidemiologic studies, and therefore, calls into question whether a standard level of 10.0 μg/m³ would provide enough public health protection. Additionally, the Administrator also finds that, for a lower annual standard level of 8.0 μg/

m^3, the quantitative risk assessment estimates the exposure concentrations to be below 8 $\mu g/m^3$, with the majority of those exposures being at concentrations of below 7 $\mu g/m^3$. The Administrator observes that the majority of exposure concentrations under this air quality scenario are estimated to fall outside of the range of concentrations in which he has the most confidence in the associations and that the additional risk reductions will actually occur.

Recognizing and building upon the above considerations and judgments, and with consideration of advice from the CASAC and public comment, the Administrator concludes that the current body of scientific evidence and quantitative risk assessment support his judgment that the level of the primary annual $PM_{2.5}$ standard should be revised to a level of 9.0 $\mu g/m^3$. Revising the level of the primary annual $PM_{2.5}$ standard will, in the Administrator's judgment, provide requisite public health protection with an adequate margin of safety.

The Administrator recognizes that placing weight on the information from the epidemiologic studies allows for examination of the entire population, including those that may be at comparatively higher risk of experiencing a $PM_{2.5}$-related health effects (*e.g.,* children, older adults, minority populations) (88 FR 5624, January 27, 2023). In considering the epidemiologic evidence, the Administrator judges that, in reaching his decision on an appropriate level for the annual standard that will protect public health with an adequate margin of safety, in the absence of any discernible population-level thresholds, and in recognizing the need to weigh uncertainties associated with the epidemiologic evidence, it is most appropriate to examine where the evidence of associations observed in the epidemiologic studies is strongest and, conversely, to place less weight where he has less confidence in the associations observed in the epidemiologic studies. The Administrator notes that in previous reviews, evidence-based approaches noted that the evidence of an association in any epidemiologic study is ''strongest at and around the long-term average where the data in the study are most concentrated'' (78 FR 3140, January 15, 2013). These approaches were supported by previous CASAC advice as well as the CASAC's advice in their review of the 2021 draft PA as a part of this reconsideration. Given this, the Administrator notes that in revising the annual $PM_{2.5}$ standard to a level of 9.0 $\mu g/m^3$, he is setting the standard at a level below the long-term mean $PM_{2.5}$ concentrations in the key long- and short-term epidemiologic studies, including the lowest study reported mean of 9.3 $\mu g/m^3$, following an approach that is consistent with previous PM NAAQS reviews. The Administrator additionally notes that air quality analyses in the 2022 PA demonstrate that areas meeting a revised annual standard of 9.0 $\mu g/m^3$ would be expected to shift the distribution of $PM_{2.5}$ exposure concentrations in an area such that the area's highest monitor would generally be at or below 9.0 $\mu g/m^3$ annually, and most of the resulting $PM_{2.5}$ concentrations across the area would be even further below the study-reported means.[119] [120] Thus, a standard level of 9.0 $\mu g/m^3$ is expected to provide sufficient protection not only in areas where the highest allowable concentration would be located (*i.e.,* near design value monitors) but also in other parts of the area where $PM_{2.5}$ concentrations would be expected to be maintained even lower.

Furthermore, the Administrator recognizes the CASAC's advice in their review of the 2021 draft PA, as well as public comments, that weight should be placed on study-reported $PM_{2.5}$ concentrations that are somewhat below the mean, particularly for some of the newer epidemiologic studies with larger cohort sizes. In weighing uncertainties associated with using these data to inform a revised annual standard level, as well as noting the limited studies for which this information is available, the Administrator judges that some weight should be placed on these data, but they should not receive the same weight as the study-reported mean concentrations. Thus, the Administrator concludes that it would be appropriate to set the annual standard level near the 25th percentile $PM_{2.5}$ concentrations in the two newer key epidemiologic studies for which these values were reported. In doing so, the Administrator notes that a decision to revise the annual standard to 9.0 $\mu g/m^3$ would set a level of the standard near and somewhat below the reported 25th percentile $PM_{2.5}$ concentrations of 9.1 $\mu g/m^3$ in these two more recent hybrid model-based studies.

The Administrator also takes note of the study-reported long-term mean $PM_{2.5}$ concentrations in the key Canadian epidemiologic studies. While the Administrator notes that these studies provide additional support for associations between $PM_{2.5}$ concentrations and health effects, he is also mindful that there are important differences between the exposure environments in the U.S. and Canada that affect interpretation of the data in the context of informing decisions regarding potential alternative levels of the annual standard. The Administrator also recognizes that the majority of the CASAC in their review of the 2021 draft PA, as well as a number of public commenters, placed weight on the Canadian epidemiologic studies in recommending that the level of the primary annual $PM_{2.5}$ standard be revised to 8–10 $\mu g/m^3$. The Administrator notes that a decision to revise the annual standard to 9.0 $\mu g/m^3$ would set the level of the standard within the range of levels recommended by the majority of CASAC in their consideration of these studies.

Additionally, the Administrator also considers the information provided by epidemiologic studies that use restricted analyses, as well as accountability studies. With respect to the restricted analyses, the Administrator, in considering the CASAC's advice in their review of the 2021 draft PA and many public comments on these types of studies, concludes that, although there are inherent uncertainties associated with this limited body of evidence, the studies that apply restricted analyses provide support for serious effects (*e.g.,* mortality) at concentrations below 10.0 $\mu g/m^3$. Additionally, in considering accountability studies, the Administrator concludes that while the small number of these studies provide limited information for informing decisions on the appropriate level of the primary annual $PM_{2.5}$ standard, these studies provide supplemental information for consideration along with the full body of evidence. The Administrator further notes that these studies suggest that public health improvements may occur following the implementation of a policy that reduces annual average $PM_{2.5}$ concentrations below the level of the current standard of 12.0 $\mu g/m^3$, and potentially below the lowest ''starting'' concentrations in these studies of 10.0 $\mu g/m^3$. Taken together, the Administrator judges that it is appropriate to place some weight on these types of studies, particularly for informing his public policy judgments regarding an adequate margin

[119] Analyses in the 2022 PA suggest that the highest monitored value would be expected to be greater than the study-reported mean values by 10–20% for monitor-based studies and 15–18% for hybrid modeling studies that apply aspects of population weighting (U.S. EPA, 2022b, section 2.3.3.2.4).

[120] The risk assessment in the 2022 PA used air quality adjustments to simulate just meeting the current primary $PM_{2.5}$ standards, as well as alternative standard levels (U.S. EPA, 2022b, section 3.4.1.4 and Appendix C, section C.1.4).

of safety, and notes that a revised annual standard level of 9.0 μg/m³ is below the lowest starting concentration of the accountability studies (*i.e.,* 10.0 μg/m³), and below the concentration at which studies that apply restricted analyses provide support for serious effects (*i.e.,* 9.6 μg/m³).

The Administrator also judges that the results of the quantitative risk assessment provide support for a primary annual $PM_{2.5}$ standard with a level of 9.0 μg/m³. The results of the risk assessment suggest that when meeting an annual standard of 9.0 μg/m³, $PM_{2.5}$ exposures are maintained below 9 μg/m³ at the design value monitor, with the majority of those exposures being at concentrations below 8 μg/m³. Thus, the Administrator notes that an annual standard level of 9.0 μg/m³ would be expected to provide protection from exposures where he has the greatest confidence in the associations between health effects and $PM_{2.5}$ exposures (*i.e.* the long-term mean $PM_{2.5}$ concentrations in the key U.S. epidemiologic studies, of which the lowest is 9.3 μg/m³) and would provide an adequate margin of safety by maintaining most $PM_{2.5}$ exposures even further below 9.0 μg/m³.

When considering adequate margin of safety, the Administrator notes that in his decision to revise the annual standard level to 9.0 μg/m³, he is placing weight on the information from the epidemiologic studies which allows for examination of the entire population, including those that may be at comparatively higher risk of experiencing a $PM_{2.5}$-related health effects (*e.g.,* children, older adults, minority populations). Additionally, as discussed above, the Administrator also recognizes that setting the annual standard level at 9.0 μg/m³, which is below concentrations at which the evidence is the strongest in supporting an association between exposure to $PM_{2.5}$ and adverse health effects observed in the key epidemiologic studies available in this reconsideration, would be expected to shift the distribution of $PM_{2.5}$ exposure concentrations in an area such that the area's highest monitor would generally be at or below 9.0 μg/m³ annually, and most of the resulting $PM_{2.5}$ concentrations across the area would be even lower. In considering these air quality relationships, the Administrator judges that a revised annual standard level of 9.0 μg/m³ would provide requisite protection with adequate margin of safety, for all populations, including those most at-risk.

In reaching this conclusion, the Administrator recognizes that in establishing primary standards under the Act that are requisite to protect public health with an adequate margin of safety, he is seeking to establish standards that are neither more nor less stringent than necessary for this purpose. The Act does not require that primary standards be set at a zero-risk level or to protect the most sensitive individual, but rather at a level that avoids unacceptable risks to public health. In this context, the Administrator's conclusion is that revised primary annual standard, in conjunction with the 24-hour standard, provides the appropriate degree of protection, and that more or less stringent standards would not be requisite.

In considering the requirement for an adequate margin of safety, the Administrator notes that the determination of what constitutes an adequate margin of safety is expressly left to the judgment of the EPA Administrator. *See Lead Industries Association* v. *EPA,* 647 F.2d at 1161–62; *Mississippi,* 744 F.3d at 1353. He further notes that in evaluating how particular standards address the requirement to provide an adequate margin of safety, it is appropriate to consider such factors as the nature and severity of the health effects, the size of sensitive population(s) at risk, and the kind and degree of the uncertainties present. Consistent with past practice and long-standing judicial precedent, and as described in this section, the Administrator takes the need for an adequate margin of safety into account as an integral part of his decision making on a standard. *See, e.g., NRDC* v. *EPA,* 902 F. 2d 962, 973–74 (D.C. Cir. 1990).

Given all of the evidence and information discussed above, the Administrator judges that a standard with a level of 9.0 μg/m³ is requisite to protect public health with an adequate margin of safety. In so doing, he first recognizes that a less stringent standard would allow the occurrence of higher long- and short-term $PM_{2.5}$ concentrations at a level at or above the mean $PM_{2.5}$ concentrations in key U.S. epidemiologic studies. That is, a less stringent standard would be expected to allow more $PM_{2.5}$ exposures at concentrations at or above which the key U.S. epidemiologic studies have reported associations between mean $PM_{2.5}$ concentrations and serious health effects and would deviate from some past approaches for selecting the appropriate level of the annual standard. A less stringent standard would also not provide requisite protection with an adequate margin of safety against $PM_{2.5}$ exposures in the lower percentiles of the air quality distribution (*i.e.,* 25th percentile) for which associations with health effects have been observed in a limited number of epidemiologic studies. Furthermore, the Administrator notes that the primary annual and 24-hour $PM_{2.5}$ standards, together, are intended to provide public health protection against the full distribution of long- and short-term $PM_{2.5}$ exposures. As noted above, the Administrator recognizes that the changes in $PM_{2.5}$ air quality designed to meet a less stringent annual standard would likely result in higher exposures across the distribution of air quality, including both higher average (or typical) concentrations as well as higher short-term peak $PM_{2.5}$ concentrations. Taking into consideration both the full evidence base for associations of $PM_{2.5}$ with mortality and other adverse health effects, including the reported mean $PM_{2.5}$ concentrations from key long- and short-term U.S. epidemiologic studies, information from epidemiologic studies that report 25th percentile $PM_{2.5}$ concentrations, supplemental information from other epidemiologic studies (*i.e.,* epidemiologic studies that use restricted analyses, accountability studies, and Canadian epidemiologic studies), and the results of the risk assessment, as well as the advice from the CASAC and public comments, the Administrator concludes that a less stringent standard would allow risks of mortality and other adverse health effects that are too great, and thus would not provide sufficient protection for public health as required by the CAA.

Additionally, in considering a less stringent standard, the Administrator recognizes that through its control of long- and short-term $PM_{2.5}$ concentrations, the annual standard provides a margin of safety for less well-studied exposure levels and population groups for which the evidence is limited or lacking. In so doing, he recognizes that our understanding of the relationships between the presence of a pollutant in ambient air and associated health effects is based on a broad body of information encompassing not only more established aspects of the evidence, such as the conclusion that long- and short-term exposures to $PM_{2.5}$ are causally related to mortality and cardiovascular effects and likely to be causally related to respiratory effects, but also aspects with which there may be substantial uncertainty. In particular, the Administrator notes that there are other categories of effects with causality determinations that are suggestive of, but not sufficient to infer, a causal

relationship between $PM_{2.5}$ exposure and health outcomes. These include, but are not limited t,o short-term exposure and nervous system effects, as well as long- and short-term exposure and pregnancy and birth outcomes, where the evidence is less certain but which represent potentially substantial additional risk to public health from exposure to $PM_{2.5}$. He recognizes the CAA requirement that requires primary standards to provide an adequate margin of safety was intended to address uncertainties associated with inconclusive scientific and technical information as well as to provide a reasonable degree of protection against hazards that research has not yet identified and in his judgment, the primary NAAQS must be set at a level that is adequately protective against these and other effects which research has not yet identified. Thus, even if the Administrator had somewhat greater concerns about the possibility of confounding, error and bias in the epidemiologic studies, which reduced his confidence in finding that $PM_{2.5}$ is causally related to mortality and cardiovascular effects, he would still find it appropriate to set the primary NAAQS below the means of key U.S. epidemiologic studies given the strength of the evidence providing support for the association, as well as additional evidence linking $PM_{2.5}$ to other endpoints of substantial public health concern, and the need to protect public health with an adequate margin of safety. In considering the uncertainties in both the epidemiologic evidence and the controlled human exposures studies, the Administrator recognizes that collectively, the health effects evidence generally reflects a continuum, consisting of levels at which scientists generally agree that health effects are likely to occur, through lower levels at which the likelihood and magnitude of the response become increasingly uncertain. In light of these uncertainties, the Administrator recognizes that the CAA requirement that primary standards provide an adequate margin of safety, as summarized in section I.A above, is intended to address uncertainties associated with inconclusive scientific and technical information, as well as to provide a reasonable degree of protection against hazards that research has not yet identified. The Administrator has taken the need to provide for an adequate margin of safety into account as an integral part of his decision-making on the appropriate standards in setting the standard at a level below the level where available epidemiologic studies, which include diverse populations that are broadly representative of the U.S. population including at-risk populations, have provided the strongest evidence supporting effects, and in other ways as well. For example, consideration of a margin of safety is reflected in the approach of setting the level of the annual standard near and somewhat below the 25th percentile $PM_{2.5}$ concentrations from key U.S. epidemiologic studies (*i.e.,* 9.1 $\mu g/m^3$), as well as recognition that attaining a design value will generally result in significantly broader and greater improvements of air quality across an area (including but certainly not limited to areas near the design value monitor) (U.S. EPA, 2022a, sections 2.3.3.2.4 and 3.3.3.2.1, Table 3–5). Based on all of the considerations noted here, and considering the current body of evidence, including the associated limitations and uncertainties, in combination with the exposure/risk information, the Administrator concludes that a less stringent standard than the current standard would not provide the requisite protection of public health, including an adequate margin of safety.

Having concluded that a less stringent standard would not provide the requisite protection of public health, the Administrator next considers whether a more stringent standard would be appropriate. In so doing, he notes that a decision to set the level of the annual standard to below 9.0 $\mu g/m^3$ would place a large amount of the emphasis on potential public health importance of further reducing the occurrence of $PM_{2.5}$ concentrations of concern, though the exposures about which he is most concerned are well controlled with an annual standard level of 9.0 $\mu g/m^3$, as demonstrated by the quantitative risk assessment. Such a decision would also place greater weight on (1) further reducing ambient $PM_{2.5}$ concentrations relative to those observed in long-and short-term epidemiologic studies, including those that he had judged to have significant uncertainties, including Canadian studies, studies using restricted analyses, and accountability studies; (2) shifting the air quality distribution in areas such that the highest exposure concentrations are reduced to below $PM_{2.5}$ concentrations observed in epidemiologic studies to be in the 25th or lower percentile, for which the evidence is limited; and (3) further shifting exposure concentrations to those shown at the lower end of the distribution in the quantitative risk assessment, despite the important uncertainties in the overall risk assessment. As discussed in this section and in responses to significant comments above and in the Response to Comments document, the Administrator has concluded that placing a large emphasis on these factors and revising the standard to a level below 9.0 $\mu g/m^3$ would result in a standard that is more stringent than the evidence indicates to be sufficient to protect public health with an adequate margin of safety. Compared to a primary annual $PM_{2.5}$ standard set at a level of 9.0 $\mu g/m^3$, the Administrator concludes that the extent to which lower standard levels could result in further public health improvements becomes notably less certain.

Thus, having carefully considered the scientific evidence, quantitative information, CASAC advice, and public comments relevant to his decision on the level of the primary annual $PM_{2.5}$ standard, as discussed above and in the Response to Comments document, the Administrator is revising the level of the primary annual $PM_{2.5}$ standard to 9.0 $\mu g/m^3$. In the Administrator's judgment, based on the currently available evidence and information, an annual standard set at this level and using the specified indicator, averaging time, and form, in conjunction with the other primary PM standards, would be requisite to protect public health with an adequate margin of safety. The Administrator judges that such a standard would protect, with an adequate margin of safety, the health of at-risk populations, including children, older adults, those with pre-existing cardiovascular and respiratory diseases, minority populations, and low SES populations. The Administrator believes that a standard set at 9.0 $\mu g/m^3$ would be sufficient to protect public health with a margin of safety, and believes that a lower standard would be more than what is necessary to provide this degree of protection. This judgment by the Administrator appropriately considers the degree of protection that is neither more nor less stringent than necessary for this purpose and recognizes that the CAA does not require that primary standards be set at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect public health with an adequate margin of safety.

In reaching his conclusions on adequacy of the current suite of primary $PM_{2.5}$ standards, based on consideration of the available scientific evidence and quantitative information, the CASAC's advice and public comments, the Administrator finds that the available information is insufficient to call into question the adequacy of the public

health protection afforded by the current primary 24-hour $PM_{2.5}$ standard. As described earlier in this section, the Administrator concludes that it is appropriate to retain the current indicator ($PM_{2.5}$), averaging time (24-hour), and form (98th percentile, averaged over three years) for the primary 24-hour $PM_{2.5}$ standard and below explains the basis for his final decision that is also appropriate to retain the current level of the primary 24-hour $PM_{2.5}$ standard.

In reaching his conclusion to retain the current primary 24-hour $PM_{2.5}$ standard the Administrator does so in light of the conclusion that the epidemiologic evidence supports associations between short- and long-term $PM_{2.5}$ exposures and adverse health effects, but that the epidemiologic evidence does not identify specific concentrations at which those effects occur and the Administrator has greatest confidence in effects where the bulk of the data is reported (*i.e.,* the mean $PM_{2.5}$ concentration, with some consideration for the 25th percentile of the air quality distribution). Thus, in considering the epidemiologic evidence, the Administrator concludes it is appropriate to focus on setting a generally controlling annual standard as the most effective and efficient way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures, and that it is appropriate to revise the level of the annual standard level to 9.0 $\mu g/m^3$. In addition to the epidemiologic evidence, the Administrator also considers the available controlled human exposure studies, which provide evidence for health effects following single, short-term $PM_{2.5}$ exposures to concentrations that typically correspond to upper end of the $PM_{2.5}$ air quality distribution in the U.S. (*i.e.,* ''peak'' concentrations). In so doing, the Administrator notes that these studies report statistically significant effects on one or more indicators of cardiovascular function following 2-hour exposures to $PM_{2.5}$ concentrations at and above 120 $\mu g/m^3$ and at and above 149 $\mu g/m^3$ for vascular impairment, the effect shown to be most consistent across studies. In particular, the Administrator notes that a single study is assessed in the ISA Supplement that reports effects following 4-hour exposures at 37.8 $\mu g/m^3$, although the results of this study are inconsistent with the results of the controlled human exposure studies assessed in the 2019 ISA. Along with the inconsistent results from the controlled human exposure studies, the Administrator also recognizes that effects observed in these studies are intermediate effects which are not typically considered adverse and that the study participants were healthy individuals. Taking into consideration the available scientific evidence, including the uncertainties and limitations, along with the CASAC's advice, the Administrator concludes that it is appropriate to maintain a primary 24-hour $PM_{2.5}$ standard to protect against peak exposures.

Thus, the Administrator considers what primary 24-hour $PM_{2.5}$ standard is requisite to provide supplemental protection against peak exposures. While having confidence that the revised annual standard will result in lowering risk associated with both long- and short-term $PM_{2.5}$ exposure by lowering the overall air quality distribution, as in the 2012 review, the Administrator recognizes that an annual standard alone would not be expected to offer sufficient protection with an adequate margin of safety against the effects of short-term $PM_{2.5}$ exposures in all parts of the country. Therefore, he continues to conclude that it is appropriate to continue to provide supplemental protection by means of a 24-hour standard, in conjunction with a revised annual standard level of 9.0 $\mu g/m^3$.

In considering the available scientific evidence assessed in the 2019 ISA and ISA Supplement, the Administrator first considers the controlled human exposure studies for informing his decisions on the primary 24-hour $PM_{2.5}$ standard. In so doing, he notes that in their review of the 2021 draft PA, the majority of CASAC members expressed the view that controlled human exposure studies are not the best evidence to use for justifying retaining the 24-hour standard without revision, in part because these studies preferentially recruit less susceptible individuals and have a typical exposure duration much shorter than 24 hours. Thus, in the view of the majority, ''the evidence of effects from controlled human exposure studies with exposures close to the current 24-hour standard supports epidemiological evidence for lowering the standard'' (Sheppard, 2022a, p. 3–4 of consensus letter). In reviewing the controlled human exposure studies, the Administrator agrees with the majority of CASAC that these controlled human exposure studies generally do not include populations with substantially increased risk from exposure to $PM_{2.5}$, such as children, older adults, or those with more severe underlying illness. However, he disagrees with any conclusion that they should not be used to inform a decision about the adequacy of the current standard. The Administrator finds the information available from these studies to be useful, noting that the recently available controlled human exposure studies provide evidence for health effects following single, short-term exposures to $PM_{2.5}$ concentrations that are greater than those allowed under the current standard. The results of the controlled human exposure studies are inconsistent, particularly at lower $PM_{2.5}$ concentrations, but some studies do report statistically significant effects on one or more indicators of cardiovascular function following 2-hour exposures to $PM_{2.5}$ concentrations at and above 120 $\mu g/m^3$ (and at and above 149 $\mu g/m^3$ for vascular impairment, the effect shown to be most consistent across studies). Additionally, one controlled human exposure study assessed in the ISA Supplement reports evidence of some effects for cardiovascular markers following 4-hour exposures to 37.8 $\mu g/m^3$ (Wyatt et al., 2020). However, there is inconsistent evidence for inflammation in other controlled human exposure studies evaluated in the 2019 ISA. The Administrator finds these studies are important in establishing biological plausibility for $PM_{2.5}$ exposures causing more serious health effects, such as those seen in short-term exposure epidemiologic studies, and they provide support that more adverse effects may be experienced following longer exposure durations and/or exposure to higher concentrations. As described in more detail in responding to public comments in section II.B.3 above, he notes that although the controlled human exposure studies do not provide a threshold below which no effects occur, the observed effects in these controlled human exposures studies are ones that signal an intermediate effect in the body, likely due to short-term exposure to $PM_{2.5}$, and typically would not, by themselves, be judged as adverse. As noted in sections II.A.2 and II.B.3 above, associated judgments regarding adversity or health significance of measurable physiological responses to air pollutants in previous NAAQS reviews have been informed by guidance, criteria or interpretative statements developed within the public health community. This type of information on adversity of effects is particularly informative to the Administrator's judgments regarding the adversity of the effects observed in the controlled human exposure studies which are short-term in nature (*i.e.,* generally ranging from 2- to 5-hours), including those studies that are

conducted at near-ambient $PM_{2.5}$ concentrations. Based on the observation that the effects observed in Wyatt et al. (2020) are not by themselves adverse, and the fact that the findings of this study are inconsistent with other currently available evidence regarding the level at which effects are observed, the Administrator disagrees with the view expressed by the majority of CASAC that this study supports epidemiologic evidence for lowering the 24-hour standard.

Consistent with his approach in reaching his proposed decision and taking into consideration these points as well as balancing these limitations (*i.e.,* that the health outcomes observed in these controlled human exposure studies are not clearly adverse and that the studies generally do not include those at increased risk from $PM_{2.5}$ exposure), the Administrator still considers it appropriate to ensure that the 24-hour $PM_{2.5}$ standard provides protection against health effects consistently observed in the controlled human exposure studies. He next examines the air quality analyses, described in more detail in section II.A.c.i above, to assess whether during recent air quality conditions, areas meeting the current standards would experience $PM_{2.5}$ concentrations reported in these controlled human exposure studies. He observes that air quality analyses demonstrate that the $PM_{2.5}$ exposures shown to cause consistent effects in the controlled human exposure studies are well above the ambient concentrations typically measured in locations meeting the current primary standards, and therefore suggest that the current primary $PM_{2.5}$ standards provide protection against these ''peak'' concentrations. In fact, at air quality monitoring sites meeting the current primary $PM_{2.5}$ standards (*i.e.,* the 24-hour standard of 35 $\mu g/m^3$ and the annual standard of 12 $\mu g/m^3$), the 2-hour concentrations generally remain below 10 $\mu g/m^3$, and rarely exceed 30 $\mu g/m^3$. Though two-hour concentrations are higher at monitoring sites violating the current standards, they generally remain below 16 $\mu g/m^3$ and rarely exceed 80 $\mu g/m^3$, still below concentrations in CHE studies where consistent effects are observed (*e.g.,* greater than 120 $\mu g/m^3$) (U.S. EPA, 2022b, section 2.3.2.2.3, Figure 2–19, and section 3.3.3.1). Additionally, and in response to public comments, the Administrator notes additional air quality analyses conducted by the EPA,[121] that provide a more refined analysis of whether areas that meet the current standards experience peak concentrations reported in controlled human exposure studies. He notes that 2-hour observations greater than 120 $\mu g/m^3$ and 4-hour observations greater than 38 $\mu g/m^3$ rarely occur (*e.g.,* 0.025% of rolling 2-hour observations are greater than 120 $\mu g/m^3$ and 0.78% of rolling 4-hour observations greater than 38 $\mu g/m^3$). Based on this information, the Administrator finds that the current suite of standards maintains subdaily concentrations of $PM_{2.5}$ in ambient air far below the exposure concentrations in controlled human exposure studies where consistent effects have been observed, and notes that while these studies generally do not include the most at-risk individuals, the exposure concentrations in these studies also do not elicit adverse effects.

Further, in light of the Administrator's emphasis on the annual standard as the controlling standard, with the 24-hour standard providing supplemental protection against peak concentrations, he next considers the potential impact of a revised annual standard of 9.0 $\mu g/m^3$ on the occurrence of peak sub-daily $PM_{2.5}$ concentrations. Specifically, the Administrator takes note of the new air quality analyses [122] where he observes that lower percentages of concentrations greater than 120 $\mu g/m^3$ and 38 $\mu g/m^3$ occur in areas meeting an annual standard of 9.0 $\mu g/m^3$ and a 24-hour standard of 35 $\mu g/m^3$, versus an annual standard of 12.0 $\mu g/m^3$ and a 24-hour standard of 35 $\mu g/m^3$. Thus, he concludes that an annual standard that is controlling across most areas of the country will continue to effectively limit peak daily concentrations in conjunction with the existing 24-hour standard, with its level of 35 $\mu g/m^3$ and 98th percentile form, which continues to provide supplemental protection against peak concentrations.

In addition, the Administrator also notes that the majority of the CASAC in their review of the 2021 draft PA, as well as a number of public commenters, support their recommendation to revise the current 24-hour standard by pointing to ''substantial epidemiologic evidence from both morbidity and mortality studies'' which ''includes three U.S. air pollution studies with analyses restricted to 24-hour concentrations below 25 $\mu g/m^3$'' (Sheppard, 2022a, p. 17 consensus responses). The Administrator notes that the epidemiologic evidence available in this reconsideration, including the studies that restrict short-term $PM_{2.5}$ exposures (*i.e.,* 24-hour $PM_{2.5}$ concentrations) to levels below 25 $\mu g/m^3$, provides support for positive and statistically significant associations between short-term exposure to $PM_{2.5}$ and all-cause mortality (Di et al., 2017a) and CVD hospital admissions (deSouza et al., 2021; Di et al., 2017a). He agrees that these studies help to provide additional support for reaching conclusions on causality in the 2019 ISA. He further agrees that the available epidemiologic studies provide important information that it is appropriate to consider in this reconsideration, including information on associations between health effects and $PM_{2.5}$ exposures in diverse populations that are broadly representative of the U.S. population, and include populations identified as at-risk (*e.g.,* older adults, minority populations), as well as evidence of linear, no-threshold concentration-response relationships in those associations, although with less certainty in the shape of the curve at long-term average concentrations below about 8 $\mu g/m^3$.

However, the Administrator also notes significant limitations in the currently available epidemiologic information that limit his ability to draw conclusions from the key short-term studies, including those that employ restricted analyses, to inform his decision regarding the level of the 24-hour $PM_{2.5}$ standard. As a result of these limitations, the Administrator does not find that the short-term epidemiologic studies, or the other evidence such as the controlled human exposure studies or the risk assessment, provide a sufficient justification for revising the 24-hour standard.

First, he notes that short-term epidemiologic studies examine associations between day-to-day variations in $PM_{2.5}$ concentrations and health outcomes, often over multi-year study periods. As such, these studies report long-term mean 24-hour $PM_{2.5}$ concentrations (*e.g.,* mean 24-hour $PM_{2.5}$ concentrations over multi-year study periods), rather than at specific points in the distribution (*i.e.,* 90th or 98th percentile 24-hour concentrations) at which effects occur. Further, he notes

[121] Jones et al. (2023). Comparison of Occurrence of Scientifically Relevant Air Quality Observations Between Design Value Groups. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

[122] Jones et al. (2023). Comparison of Occurrence of Scientifically Relevant Air Quality Observations Between Design Value Groups. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

that while there can be considerable variability in daily exposures over a multi-year study period, the bulk of the observations reflect days with ambient $PM_{2.5}$ concentrations in the middle of the air quality distribution (*i.e.,* ''typical'' days rather than days with extremely low or extremely high concentrations). As a result, the results of these studies are more directly applicable to decisions regarding the annual standard (which is based on the long-term mean of both short- and long-term epidemiologic studies), and the fact that they do not report other air quality statistics, such as the 98th percentile concentrations which might be more directly compared to the level of the 24-hour standard, makes them less useful for informing decisions on the 24-hour standard. As discussed in responding to comments above, the form of the annual standard is based on the annual mean $PM_{2.5}$ concentration averaged over three years,[123] which makes it better suited as a basis for controlling air quality to avoid effects observed in both long-term and short-term epidemiologic studies. By contrast, the form of the 24-hour standard is the 98th percentile averaged over three years, which makes it appropriate for controlling short-term peak concentrations. However, based on the available air quality information, including distribution statistics of $PM_{2.5}$ concentrations and health events reported in the short-term epidemiologic studies, these studies are too limited in their ability to identify health effects attributable to specific short-term peak concentrations that are necessary to evaluate whether the 24-hour standard with its 98th percentile form should be revised (*e.g.,* restricted epidemiologic studies do not report the number or the percentile of health events or the percentile of $PM_{2.5}$ concentrations across the highest part of the restricted air quality distribution, including the 98th percentile). Thus, the Administrator does not consider it appropriate to use the reported means from short-term studies to determine the appropriate level for a 24-hour standard with a 98th percentile form.

Similarly, the Administrator does not consider the results of the restricted analyses to be well suited to informing the choice of level for a 24-hour standard. Restricted analyses use a subset of data from their main analyses to evaluate health events that occur at concentrations below a certain concentration (*e.g.,* 25 $\mu g/m^3$). The Administrator notes that the associations between the health effects (*e.g.,* mortality and cardiovascular morbidity) and $PM_{2.5}$ concentrations remain even after excluding higher concentrations in the restricted analyses, and he also recognizes that the magnitude of the effect is generally greater in the restricted analyses compared to the associations reported in the main analysis. He considers such analyses to be informative in indicating that the health effects association reported in the main (unrestricted) analysis are not driven only by the upper peaks of the $PM_{2.5}$ air quality distribution, but rather persist at lower portions of the distribution (consistent with his emphasis on the annual standard, which is focused on exposures near the mean concentration, where the bulk of the exposure distribution is concentrated). Indeed, he notes that if peak concentrations were the principal driver of health effects associated with $PM_{2.5}$ exposure, one might expect the associations to become weaker as the upper portion of the data is excluded in the restricted analyses, which is not what is reported by the analyses (*e.g.,* the restricted analyses generally report associations that are greater in magnitude compared to the main analyses). However, he disagrees with the assertion by the CASAC in their review of the 2021 draft PA and some public commenters that it would be appropriate to focus on the specific $PM_{2.5}$ concentration (*e.g.,* 25 or 30 $\mu g/m^3$) at which the analysis was restricted as the basis for choosing a 24-hour standard level. The Administrator recognizes that in restricted analyses, while an association continues to persist across the full range of the air quality distribution, and that the cutpoint concentration at which the analysis was restricted (*e.g.,* 25 or 30 $\mu g/m^3$) becomes the maximum $PM_{2.5}$ concentration in the distribution, he also notes that these studies do not provide information related to the distribution of health events and $PM_{2.5}$ concentrations, and as such, he is more uncertain where the bulk of the data are and where he has confidence in the reported association.[124] He notes that no evidence exists to support a conclusion that the $PM_{2.5}$ concentration chosen as the cutpoint in a restricted analysis has any bearing on the concentration at which effects are likely to occur (or not occur). He notes that, as with long-term studies, the evidence does not suggest there is a specific point in the air quality distribution of these short-term studies that represents a ''bright line'' at and above which effects have been observed and below which effects have not been observed. In order to identify a level of the 24-hour standard based on associations between the ''upper end'' of exposures, either in the unrestricted or the restricted analyses, and adverse health effects, it would be necessary to have a better understanding of how specific 24-hour concentrations correspond to the frequency and total number of observed health events in the study. Currently, such information, including 98th percentile statistics, are not reported in the key short-term epidemiologic studies (and if they were reported, the Administrator would have to carefully consider how to weigh the data). As such, in reaching his decision on the primary 24-hour $PM_{2.5}$ standard, the Administrator judges that the currently available information from short-term epidemiologic studies, including those that employ restricted analyses, does not provide a sufficient basis to revise the current 24-hour standard, given that the 24-hour standard focuses on reducing ''peak'' exposures (with its 98th percentile form), but rather that such information supports his judgment that it is appropriate to focus on revising the annual standard for purposes of reducing all exposures, across the entire distribution of air quality, to increase public health protection.

In reaching final decisions regarding the adequacy of the primary 24-hour $PM_{2.5}$ standard, the Administrator continues to view an approach that focuses on setting a generally controlling annual standard as the most effective and efficient way to reduce total population risk associated with both long- and short-term $PM_{2.5}$ exposures. Additionally, he emphasizes that improvements in air quality associated with meeting an annual standard level of 9.0 $\mu g/m^3$ will result in lowering risk associated with both long- and short-term $PM_{2.5}$ exposure by lowering the overall air quality distribution. The Administrator concludes that reducing the annual standard is the most efficient way to reduce the risks from short-term exposures identified in the epidemiologic studies, as the available evidence suggests the bulk of the risk comes from the large number of days across the bulk of the air quality distribution, not the relatively small number of days with peak concentrations. However, as in the 2012

[123] The annual mean is calculated by averaging daily values in a calendar quarter and then averaging calendar quarters. See 40 CFR part 50 Appendix N, section 4.4.

[124] These studies do not report information about the distribution of the health events and $PM_{2.5}$ concentrations (*e.g.,* means, medians, other percentiles) in the restricted analyses.

review, the Administrator recognizes that an annual standard alone would not be expected to offer sufficient protection with an adequate margin of safety against the effects of short-term $PM_{2.5}$ exposures in all parts of the country and concludes that, in conjunction with a revised annual standard level of 9.0 μg/m³, it is appropriate to continue to provide supplemental protection by means of a 24-hour standard, particularly for areas with high peak-to-mean ratios possibly associated with strong local or seasonal sources.

In selecting the level of a 24-hour standard designed to provide supplemental protection against peak exposures (in conjunction with a revised annual standard of 9.0 μg/m³), the Administrator considers the information from the controlled human exposure studies and the EPA's analysis of peak concentrations observed in areas meeting the current standard of 35 μg/m³ in conjunction with a revised standard of 9.0 μg/m³ to be of particular relevance. He notes the controlled human exposure evidence includes studies reporting effects on one or more indicators of cardiovascular function following 2-hour exposures at and above 120 μg/m³, including effects reported at and above 149 μg/m³ for vascular impairment, the effect shown to be most consistent across studies, and less consistent effects at lower concentrations, including a single study at near ambient concentrations (Wyatt et al., 2020) reporting effects following 4-hour exposures at 37.8 μg/m³. He recognizes that the effects observed (in those studies that observed effects) are ones that signal an intermediate effect in the body, likely due to short-term exposure to $PM_{2.5}$, and typically would not, by themselves, be judged as adverse, and the study participants were healthy individuals.

He notes in particular that, in the EPA's analysis, in areas meeting the current 24-hour standard and the revised annual standard 0.029 percent of 2-hour observations and 0.41 percent of 4-hour observations reach $PM_{2.5}$ concentrations higher than 120 μg/m³ and 37.8 μg/m³, respectively. He also notes the lack of evidence of effects from controlled human exposure studies at levels below the current 24-hour standard and the fact that the results of Wyatt et al. (2020) are inconsistent with other available studies, as well as the intermediate nature of effects observed in this study. In his judgment, the small number of occurrences of peak exposures indicate that, in conjunction with a revised annual standard of 9.0 μg/m³, the current 24-hour standard of 35 μg/m³ remains requisite to protect public health with an adequate margin of safety, and that there is substantial basis to doubt whether further improvements in public health would be achieved by further reducing these exposures. Furthermore, the Administrator concludes that due to the limitations and uncertainties outlined above, the information from recent short-term epidemiologic studies, including those that use restricted analyses, is inadequate to inform decisions regarding the adequacy of the current 24-hour standard. Thus, in reaching his decision on the primary 24-hour $PM_{2.5}$ standard, the Administrator concludes that currently available evidence does not call into question the adequacy of the current standard.

In addition to the scientific evidence, the Administrator also considers the risk assessment in evaluating the appropriate level of the 24-hour $PM_{2.5}$ standard. The risk assessment indicates that the annual standard is the controlling standard across most of the urban study areas evaluated (*i.e.,* when air quality related to the annual average $PM_{2.5}$ concentrations decrease, daily average $PM_{2.5}$ concentrations are also expected to decrease). When air quality is adjusted to just meet an alternative 24-hour standard level of 30 μg/m³ in the areas where the 24-hour standard is controlling, the risk assessment estimates reductions in $PM_{2.5}$-associated risks across a more limited population and number of areas compared to when air quality is adjusted to simulate alternative levels for the annual standard (*i.e.,* where the annual standard is controlling), and these predictions are largely confined to areas located in the western U.S., several of which are also likely to experience risk reductions upon meeting a revised annual standard. With respect to the CASAC's advice in their review of the 2021 draft PA, the Administrator notes that the minority of CASAC advised that these results suggest that the annual standard can be used to limit both long- and short-term $PM_{2.5}$ concentrations and views these risk assessment results as supporting the conclusion that the current 24-hour standard is adequate (Sheppard, 2022a, p. 4 of consensus letter). In contrast, the majority of CASAC members in their review of the 2021 draft PA, as well as a number of public commenters that support revision of the 24-hour standard, placed greater weight on the evidence-based considerations (*e.g.* scientific evidence, like the restricted analyses) than on the values estimated by the risk assessment, noting the potential for uncertainties in how the risk assessment was able to ''capture areas with wintertime stagnation and residential wood-burning where the annual standard is less likely to be protective'' (Sheppard, 2022a, p. 4 of consensus letter).

In considering the application of the risk assessment to judgments about the adequacy of the current primary 24-hour $PM_{2.5}$ standard, the Administrator again notes that the risk assessment analyses of $PM_{2.5}$-attributable mortality use input data that include C–R functions from epidemiologic studies that have no threshold and a linear C–R relationship down to zero, as well an air quality adjustment approach that incorporates proportional decreases in $PM_{2.5}$ concentrations to meet lower standard levels. As such, the Administrator notes that this quantitative approach does not incorporate any elements of uncertainty in associations of health effects at lower concentrations and that simulated air quality improvements will always lead to proportional decreases in risk (*i.e.,* each additional μg/m³ reduction produces additional benefits with no clear stopping point at any $PM_{2.5}$ concentration). Therefore, the Administrator recognizes that while the risk estimates can help to place the evidence for specific health effects into a broader public health context, the results should be considered along with the inherent uncertainties and limitations of such analyses when informing judgments about the potential for additional public health protection associated with $PM_{2.5}$ exposure and related health effects. Further, the Administrator notes additionally that air quality analyses have also been considered in looking at the adequacy of the 24-hour standard in controlling peak $PM_{2.5}$ concentrations of potential concern,[125] and that those analyses included monitoring information from across the entire U.S., specifically highlighting areas with higher peak concentrations and including areas impacted by wintertime stagnation and residential wood-burning. Thus, while the risk assessment may have focused on a subset of areas across the U.S. based on the study area selection criteria, the Administrator is considering a broader set of information in reaching his conclusions regarding the appropriateness of the current 24-

[125] Jones et al. (2023). Comparison of Occurrence of Scientifically Relevant Air Quality Observations Between Design Value Groups. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

hour standard to control peak concentrations.

The Administrator also considers the advice from the CASAC in their reviews of the 2019 draft PA and 2021 draft PA. In their review of the 2019 draft PA, the CASAC ''agrees with the EPA and finds that the available evidence does not call into question the adequacy of public health protection afforded by the current 24-hour $PM_{2.5}$ standard and concurs that it be retained'' (Cox, 2019b, p. 3 of letter). He also notes that in their review of the 2021 draft PA, the CASAC did not reach consensus on whether the current 24-hour standard is adequate, with the majority of the CASAC recommending that the 24-hour standard be revised and the minority of the CASAC recommending that the standard be retained. The majority of the CASAC members further stated that ''[t]here is also less confidence that the annual standard could adequately protect against health effects of short-term exposures. A range of 25–30 μg/m^3 for the 24-hour $PM_{2.5}$ standard would be adequately protective'' (Sheppard, 2022a, p. 4 of consensus letter). The Administrator also acknowledges that some public commenters agreed with the majority of the CASAC in supporting a revision to the level of the 24-hour standard to a range between 25–30 μg/m^3. These commenters cite a number of reasons, including: (1) Results from controlled human exposure studies at near ambient concentrations; (2) aspects of the scientific evidence, including restricted analyses that report positive and significant associations below 35 μg/m^3; and (3) quantitative risk analyses that show decreasing risk with decreasing $PM_{2.5}$ concentrations. In responding to these comments, the Administrator recognizes that some commenters have different interpretations of the evidence, air quality information, and quantitative results from the risk assessment in this review and would make different judgments about the weight to place on the relative strength and limitations of the currently available scientific evidence and information and how such information could be used in making public health policy decisions on the 24-hour standard. However, as outlined above, the Administrator has carefully considered the information available from controlled human exposure studies and short-term epidemiologic studies, and weighed the strengths and limitations of this evidence in formulating his decisions. Furthermore, as discussed above the Administrator has noted significant uncertainties and limitations inherent in the risk estimates, as well as noting that very few areas were included. In addition, he has given careful consideration to the majority of the CASAC's advice in their review of the 2021 draft PA, but has drawn different conclusions with respect to how currently available evidence and air quality information inform the selection of level for the 24-hour primary $PM_{2.5}$ standard.

In considering the advice of the majority of CASAC, the Administrator notes that a decision to set the level of the 24-hour standard to below 35 μg/m^3 would place a large amount of emphasis on the potential public health importance of further reducing the occurrence of peak $PM_{2.5}$ concentrations. However, the Administrator concludes that there is insufficient basis to conclude that a more stringent standard to further reduce peak concentrations is needed or would benefit public health. As discussed above, he judges that the $PM_{2.5}$ exposures in controlled human exposure studies that correspond to peak concentrations will already be well controlled via the combination of the revised annual standard, with a level of 9.0 μg/m^3, and the 24-hour standard with its level 35 μg/m^3 and its 98th percentile form. Taking into consideration the inconsistent results reported in controlled human exposure studies, the intermediate nature of the health effects observed in the controlled human exposure studies that are not typically considered adverse, the health status of the study participants, and how infrequently peak concentrations of potential concern are anticipated to occur in areas meeting the revised primary annual $PM_{2.5}$ standard, he judges that the current 24-hour standard is requisite to protect against the effects reported in these studies with an adequate margin of safety. Likewise, he judges that neither the epidemiologic studies (including the studies that use restricted analyses) nor the risk assessment provide a sufficient basis for revising the 24-hour standard. As discussed above, the epidemiologic studies, including short-term studies and those with restricted analyses, are not well-suited for identifying a level for a 24-hour standard to address health effects associated with peak concentrations. The restricted analyses support the conclusion that the health effects associated with $PM_{2.5}$ is not associated primarily with exposure to higher concentrations of the main analyses, but like other epidemiologic studies they typically report only long-term mean 24-hour concentrations (*e.g.,* restricted epidemiologic studies do not report the number or the percentile of health events or the percentile of $PM_{2.5}$ concentrations across the highest part of the restricted air quality distribution, including the 98th percentile) and do not identify any particular concentration within the air quality distribution above which effects have been observed and below which effects have not been observed. Similarly, the risk assessment highlights that the annual standard is controlling across much of the U.S. and is generally more effective at reducing risk than the 24-hour standard and, taking into account the limitations and assumptions of the risk assessment discussed above, does not provide a basis for revising the 24-hour standard. For the reasons discussed herein, the Administrator judges that the uncertainties as to whether there would be public health benefits from a more stringent 24-hour standard are too great to justify revising the standard.

Thus, having carefully considered the scientific evidence, quantitative information, CASAC advice, and public comments, the Administrator is retaining the current primary 24-hour $PM_{2.5}$ standard, with its level of to 35 μg/m^3 and its 98th percentile form. In the Administrator's judgment, based on the currently available evidence and information, a 24-hour standard set at this level and using the specified indicator, averaging time, and form would be requisite to protect public health with an adequate margin of safety, in conjunction with the annual standard. As noted, in evaluating the adequacy of the current standards, the Administrator focuses on evaluating the public health protection afforded by the annual and 24-hour standards, taken together, against adverse health effects associated with long- or short-term $PM_{2.5}$ exposures. A 24-hour standard set at a level of 35 μg/m^3, in conjunction with a revised annual standard level of 9.0 μg/m^3, in the judgment of the Administrator, provides an appropriate level of public health protection, for both long- and short-term $PM_{2.5}$ exposures. The Administrator believes that a 24-hour standard set at 35 μg/m^3 would continue to be sufficient to protect public health with a margin of safety, and believes that a lower standard would be more than what is necessary to provide this degree of protection when considered in conjunction with a revised annual standard. The Administrator concludes the current 24-hour standard at a level of 35 μg/m^3, in conjunction with a revised annual standard level of 9.0 μg/m^3, will provide appropriate protection

in areas in which the long-term mean concentrations are already relatively low (*i.e.,* below 9 μg/m^3) but where there may be elevated short-term peak $PM_{2.5}$ concentrations, often associated with strong local or seasonal sources. This judgment by the Administrator appropriately considers the degree of protection that is neither more nor less stringent than necessary for this purpose and recognizes that the CAA does not require that primary standards be set at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect public health with an adequate margin of safety.

In making this decision to retain the current level of the primary $PM_{2.5}$ 24-hour standard at 35 μg/m^3 in conjunction with revising the annual standard level from 12.0 μg/m^3 to 9.0 μg/m^3, given all of the evidence and information discussed above, the Administrator judges that the revised suite of primary $PM_{2.5}$ standards and the rationale supporting these levels appropriately reflects consideration of the strength of the available evidence and other information and its associated uncertainties as well as the advice of CASAC and consideration of public comments. He additionally judges that this suite of primary $PM_{2.5}$ standards is requisite to protect public health, including at-risk populations, with an adequate margin of safety from effects associated with long and short-term exposures to fine particles. This judgment by the Administrator appropriately considers the requirement for standards that are requisite to protect public health but are neither more nor less stringent than necessary.

C. Decisions on the Primary $PM_{2.5}$ Standards

For the reasons discussed above, and taking into account the information and assessments presented in the 2019 ISA and ISA Supplement, the scientific and quantitative risk information in the 2022 PA, the advice and recommendations of the CASAC, and public comments, the Administrator revises the current suite of primary $PM_{2.5}$ standards. Specifically, the Administrator revises the level of the primary annual $PM_{2.5}$ standard to 9.0 μg/m^3 while retaining its form, indicator and averaging time. In conjunction with revising the primary annual $PM_{2.5}$ standard level to provide protection from effects associated with long- and short-term $PM_{2.5}$ exposures, the Administrator retains the level of 35 μg/m^3 and the 98th percentile form, indicator and averaging time of the primary 24-hour $PM_{2.5}$ standard to continue to provide supplemental protection for areas with high peak $PM_{2.5}$ concentrations. The Administrator concludes that this suite of standards is requisite to protect public health with an adequate margin of safety against health effects potentially associated with long- and short-term $PM_{2.5}$ exposures.

III. Rationale for Decisions on the Primary PM_{10} Standard

This section presents the rationale for the Administrator's decision to retain the existing primary PM_{10} standard. This decision is based on a thorough review of the latest scientific information, published through January 2018 [126] and evaluated in the 2019 ISA, on human health effects associated with $PM_{10–2.5}$ in ambient air. As described in section I above and in section 1.2 of the ISA Supplement, the scope of the updated scientific evaluation of the health effects evidence is based on those PM size fractions, exposure durations, and health effects category combinations where the 2019 ISA concluded a causal relationship exists (U.S. EPA, 2019a, U.S. EPA, 2022b).). Therefore, because the 2019 ISA did not conclude a causal relationship for $PM_{10–2.5}$ for any exposure durations or health effect categories, the ISA Supplement does not include an evaluation of additional studies for $PM_{10–2.5}$. As a result, the 2019 ISA continues to serve as the scientific foundation for assessing the adequacy of the primary PM_{10} standard in this reconsideration of the 2020 final decision (U.S. EPA, 2019a, section 1.7; U.S. EPA, 2022a). The Administrator's decision also takes into account the 2022 PA evaluation of the policy-relevant information in the 2019 ISA, CASAC advice and recommendations, and public comments.

In presenting the rationale for the Administrator's final decision and its foundations, Section III.A provides background on the 2020 final decision to retain the primary PM_{10} and a brief summary of key aspects of the currently available health effects information. Section III.B summarizes the CASAC advice and the Administrator's proposed conclusions to retain the existing primary PM_{10} standard, addresses public comments received on the proposal, and presents the Administrator's conclusions on the adequacy of the current standard, drawing on consideration of information in the 2019 ISA and the 2022 PA, advice from the CASAC, and comments from the public. Section III.C summarizes the Administrator's decision on the primary PM_{10} standard.

A. Introduction

The general approach for this reconsideration of the 2020 final decision on the primary PM_{10} standard relies on the scientific information available for this review, as well as the Administrator's judgments regarding the available public health effects evidence, and the appropriate degree of public health protection for the existing standards. With the 2020 decision, the then-Administrator retained the existing primary 24-hour PM_{10} standard, with its level of 150 μg/m^3 and its one-expected-exceedance form on average over three years, to continue to provide public health protection against short-term exposures to $PM_{10–2.5}$ (85 FR 82725, December 18, 2020).

1. Background on the Current Standard

Consistent with the 2009 ISA, the 2019 ISA concluded that the available epidemiologic, controlled human exposure, and animal toxicological studies, including uncertainties, provided support for the causality determinations of ''suggestive of, but not sufficient to infer, a causal relationship'' between short-term exposures to $PM_{10–2.5}$ and cardiovascular effects, respiratory effects, and mortality (U.S. EPA, 2019a, section 1.4.2). The 2019 ISA also reached the conclusion that the evidence supports a ''suggestive of, but not sufficient to infer, a causal relationship'' between short-term $PM_{10–2.5}$ exposures and metabolic effects, an endpoint that was not evaluated in the 2009 ISA (U.S. EPA, 2019a, section 1.4.2).

Compared to the 2009 ISA, the 2019 ISA includes expanded evidence for the relationships between long-term exposures and cardiovascular effects, metabolic effects, nervous system effects, cancer, and mortality. The 2019 ISA concluded that the small number of epidemiologic and experimental studies, including uncertainties, contribute to the determination that, ''the evidence is suggestive of, but not sufficient to infer, a causal relationship between long-term $PM_{10–2.5}$ exposure and cardiovascular effects, metabolic effects, nervous system effects, cancer, and mortality and cancer (U.S. EPA, 2019a, p. 10–87). For long-term exposures and cardiovascular effects,

[126] In addition to the review's opening ''call for information'' (79 FR 71764, December 3, 2014), the 2019 ISA identified and evaluated studies and reports that have undergone scientific peer review and were published or accepted for publication between January 1, 2009, through approximately January 2018 (U.S. EPA, 2019a, p. ES–2). References cited in the 2019 ISA, the references considered for inclusion but not cited, and electronic links to bibliographic information and abstracts can be found at: *https://hero.epa.gov/hero/particulate-matter.*

cardiovascular effects, and cancer, this is an upgrade from the ''inadequate to infer the presence or absence of a causal relationship'' conclusions in the 2009 ISA (U.S. EPA, 2019a, section 1.4.2). This determination is also the first for long-term exposures and metabolic effects, as the 2009 ISA did not include metabolic effects as an endpoint (U.S. EPA, 2019a section 1.4.2).

In considering the available body of evidence, it was noted in the 2020 review there were considerable uncertainties and limitations associated with the experimental evidence for $PM_{2.5}$ exposures and health effects, and as such more weight was placed on the available epidemiologic evidence. Therefore, the primary focus in the 2020 review was on multi-city and single-city epidemiologic studies that evaluated associations between short-term $PM_{10–2.5}$ and mortality, cardiovascular effects (hospital admissions and emergency department visits, as well as blood pressure and hypertension), and respiratory effects. Despite differences in the approaches [127] used to estimate ambient $PM_{10–2.5}$ concentrations, the majority of the studies reported positive, though often not statistically significant, associations with short-term $PM_{10–2.5}$ exposures. Most $PM_{10–2.5}$ effect estimates remained positive in copollutant models that included either gaseous pollutants or other particulate matter size fractions (*e.g.,* $PM_{2.5}$). In U.S. study locations likely to have met the PM_{10} standard during the study period, a few studies reported positive associations between $PM_{10–2.5}$ and mortality that were statistically significant and remained so in copollutant models (U.S. EPA, 2019a). In addition to the epidemiologic studies, there were a small number of controlled human exposure studies evaluated in the 2019 ISA that reported alterations in heart rate variability or increased pulmonary inflammation following short-term exposure to $PM_{10–2.5}$, providing some support for the associations in the epidemiologic studies. Animal toxicological studies examined the effect of short-term $PM_{10–2.5}$ exposures using non-inhalation (*e.g.,* intratracheal instillation) route.[128] Therefore, these studies provided limited evidence for the biological plausibility of $PM_{10–2.5}$-induced effects (U.S. EPA, 2019a). Although the scientific evidence available in the 2019 ISA expanded the understanding of health effects associated with $PM_{10–2.5}$ exposures, a number of important uncertainties remained. These uncertainties, and their implications for interpreting the scientific evidence, include the following:

- The potential for confounding by copollutants, notably $PM_{2.5}$, was addressed with copollutant models in a relatively small number of $PM_{10–2.5}$ epidemiologic studies (U.S. EPA, 2019a). This was particularly important given the relatively small body of experimental evidence (*i.e.,* controlled human exposure and animal toxicological studies) available to support the independent effect of $PM_{10–2.5}$ on human health. This increases the uncertainty regarding the extent to which $PM_{10–2.5}$ itself, rather than one or more copollutants, is responsible for the mortality and morbidity effects reported in epidemiologic studies.
- There was greater spatial variability in $PM_{10–2.5}$ concentrations than $PM_{2.5}$ concentrations, resulting in the potential for increased exposure error for $PM_{10–2.5}$ (U.S. EPA, 2019a). Available measurements did not provide sufficient information to adequately characterize the spatial distribution of $PM_{10–2.5}$ concentrations (U.S. EPA, 2019a). The limitations in estimates of ambient $PM_{10–2.5}$ concentrations ''would tend to increase uncertainty and make it more difficult to detect effects of $PM_{10–2.5}$ in epidemiologic studies'' (U.S. EPA, 2019a).
- Estimation of $PM_{10–2.5}$ concentrations over which reported health outcomes occur remain highly uncertain. When compared with $PM_{2.5}$, there is uncertainty spanning all epidemiologic studies examining associations with $PM_{10–2.5}$ including deficiencies in the existing monitoring networks, the lack of a systematic evaluation of the various methods used to estimate $PM_{10–2.5}$ concentrations and the resulting uncertainty in the spatial as well as the temporal variability in $PM_{10–2.5}$ concentration (U.S. EPA, 2019a).). Given these limitations in routine monitoring, epidemiologic studies employed a number of different approaches for estimating $PM_{10–2.5}$ concentrations, including (1) calculating the difference between PM_{10} and $PM_{2.5}$ at co-located monitors, (2) calculating the difference between county-wide averages of monitored PM_{10} and $PM_{2.5}$ based on monitors that are not necessarily co-located, and (3) direct measurement of $PM_{10–2.5}$ using a dichotomous sampler (U.S. EPA, 2019a, section 1.4.2). Given the relatively small number of $PM_{10–2.5}$ monitoring sites, the relatively large spatial variability in ambient $PM_{10–2.5}$ concentrations, the use of different approaches to estimating ambient $PM_{10–2.5}$ concentrations across epidemiologic studies, and the limitations inherent in such estimates, the distributions of $PM_{10–2.5}$ concentrations over which reported health outcomes occur remain highly uncertain (U.S. EPA, 2019a).

There was relatively little information available to characterize potential exposure differences that may inform the apparent variability in associations between short-term $PM_{10–2.5}$ exposures and health effects across study locations (U.S. EPA, 2019a). Specifically, the potential spatial and temporal variability in $PM_{10–2.5}$ exposures complicates the interpretation of results between study locations as well as the relative lack of information on the chemical and biological composition of $PM_{10–2.5}$ (U.S. EPA, 2009a U.S. EPA, 2019a).

In reaching his decision in 2020 to retain the existing 24-hour primary PM_{10} standard, the then-Administrator specifically noted that, while the health effects evidence was somewhat expanded since the prior reviews, the overall conclusions in the 2019 ISA, including uncertainties and limitations, were generally consistent with what was considered in the 2012 review (85 FR 82725, December 18, 2020). In addition, the then-Administrator recognized that there were still a number of uncertainties and limitations associated with the available evidence.

With regard to the evidence on $PM_{10–2.5}$-related health effects, the then-Administrator noted that epidemiologic studies continued to report positive associations with mortality and morbidity in cities across North America, Europe, and Asia, where $PM_{10–2.5}$ sources and composition were expected to vary widely. While significant uncertainties remained in the 2020 review, the then-Administrator recognized that this expanded body of evidence had broadened the range of effects that have been linked with $PM_{10–2.5}$ exposures. The studies evaluated in the 2019 ISA expanded the scientific foundation presented in the 2009 ISA and led to revised causality determinations (and new determinations) for long-term $PM_{10–2.5}$

[127] As discussed further below, methods employed by the epidemiologic studies to estimate ambient $PM_{10–2.5}$ concentrations include: (1) Calculating the difference between PM_{10} and $PM_{2.5}$ at co-located monitors, (2) calculating the difference between county-wide averages of monitored PM_{10} and $PM_{2.5}$ based on monitors that are not necessarily co-located, and (3) direct measurement of $PM_{10–2.5}$ using a dichotomous sampler (U.S. EPA, 2019a, section 1.4.2).

[128] Non-inhalation exposure experiments (*i.e.,* intratracheal [IT] instillation) are informative for size fractions (*e.g.,* $PM_{10–2.5}$) that cannot penetrate the airway of a study animal and may provide information relevant to biological plausibility and dosimetry (U.S. EPA, 2019a, section A–12).

exposures and mortality, cardiovascular effects, metabolic effects, nervous system effects, and cancer (85 FR 82726, December 18, 2020). Drawing from his consideration of this evidence, the then-Administrator concluded that the scientific information available since the time of the last review supported a decision to maintain a primary PM_{10} standard to provide public health protection against $PM_{10–2.5}$ exposures, regardless of location, source of origin, or particle composition (85 FR 82726, December 18, 2020). With regard to uncertainties in the available evidence, the then-Administrator first noted that a number of limitations were identified in the 2012 review related to: (1) Estimates of ambient $PM_{10–2.5}$ concentrations used in epidemiologic studies; (2) limited evaluation of copollutant models to address the potential for confounding; and (3) limited experimental studies supporting biological plausibility for $PM_{10–2.5}$-related effects. Despite the expanded body of evidence for $PM_{10–2.5}$ exposures and health effects, the then-Administrator recognized that uncertainties in the 2020 review continued to include those associated with the exposure estimates used in epidemiologic studies, the independence of the $PM_{10–2.5}$ health effect associations, and the biologically plausible pathways for $PM_{10–2.5}$ health effects (85 FR 82726, December 18, 2020). These uncertainties contributed to the 2019 ISA determinations that the evidence is at most ''suggestive of, but not sufficient to infer'' causal relationships (85 FR 82726, December 18, 2020). In considering the available evidence in his basis for the decision, the then-Administrator emphasized evidence supporting ''causal'' and ''likely to be causal'' relationships, and therefore, judged that the $PM_{10–2.5}$-related health effects evidence provided an uncertain scientific foundation for making standard-setting decisions. He further judged limitations in the evidence raised questions as to whether additional public health improvements would be achieved by revising the existing PM_{10} standard (85 FR 24126, April 30, 2020). In the 2020 decision, for all of the reasons discussed above and recognizing the CASAC conclusion that the evidence provided support for retaining the current standard, the then-Administrator concluded that it was appropriate to retain the existing primary PM_{10} standard, without revision. His decision was consistent with the CASAC advice related to the primary PM_{10} standard. Specifically, the CASAC agreed with the 2020 PA conclusions that, while these effects are important, the ''evidence does not call into question the adequacy of the public health protection afforded by the current primary PM_{10} standard'' and ''supports consideration of retaining the current standard in this review'' (Cox, 2019b, p. 3 of consensus letter). Thus, the then-Administrator concluded that the primary PM_{10} standard (in all of its elements (*i.e.,* indicator, averaging time, form, and level)) was requisite to protect public health with an adequate margin of safety against effects that have been associated with $PM_{10–2.5}$. In light of this conclusion, the EPA retained the existing PM_{10} standard.

2. Overview of the Health Effects Evidence

The information summarized here is based on the scientific assessment of the health effects evidence available in this reconsideration; this evaluation is documented in the 2019 ISA and its policy implications are discussed further in the 2022 PA. As noted above, the ISA Supplement does not include an evaluation of studies for $PM_{10–2.5}$, and the 2019 ISA continues to serve as the scientific foundation for this reconsideration.

a. Nature of Effects

For the health effect categories and exposure duration combinations evaluated, the 2019 ISA concludes that the evidence supports causality determinations for $PM_{10–2.5}$ that are at most ''suggestive of, but not sufficient to infer, a causal relationship''. While the evidence supporting the causal nature of relationships between exposure to $PM_{10–2.5}$ has been strengthened for some health effect categories since the completion of the 2009 ISA, the 2019 ISA concludes that overall ''the uncertainties in the evidence identified in the 2009 ISA have, to date, still not been addressed'' (U.S. EPA, 2019a, section 1.4.2, p. 1–41; U.S. EPA, 2022b, section 4.3.1). Specifically, epidemiologic studies available in the 2012 review relied on various methods to estimate $PM_{10–2.5}$ concentrations, and these methods had not been systematically compared to evaluate spatial and temporal correlations in $PM_{10–2.5}$ concentrations. Methods included: (1) Calculating the difference between PM_{10} and $PM_{2.5}$ concentrations at co-located monitors, (2) calculating the difference between county-wide averages of monitored PM_{10}- and $PM_{2.5}$-based on monitors that are not necessarily co-located, and (3) direct measurement of $PM_{10–2.5}$ using a dichotomous sampler (U.S. EPA, 2019a, section 1.4.2). As described in the 2019 ISA, there continues to be variability across epidemiologic studies in the approaches used to estimate $PM_{10–2.5}$ concentrations. Additionally, some studies estimate long-term $PM_{10–2.5}$ exposures as the difference between PM_{10} and $PM_{2.5}$ concentrations based on information from spatiotemporal or land use regression (LUR) models, in addition to monitors. The various methods used to estimate $PM_{10–2.5}$ concentrations have not been systematically evaluated (U.S. EPA, 2019a, section 3.3.1.1), contributing to uncertainty regarding the spatial and temporal correlations in $PM_{10–2.5}$ concentrations across methods and in the $PM_{10–2.5}$ exposure estimates used in epidemiologic studies (U.S. EPA, 2019a, section 2.5.1.2.3). Given the greater spatial and temporal variability of $PM_{10–2.5}$ and the lower number of $PM_{10–2.5}$ monitoring sites, compared to $PM_{2.5}$, this uncertainty is particularly important for the coarse size fraction. Beyond the uncertainty associated with $PM_{10–2.5}$ exposure estimates in epidemiologic studies, the limited information on the potential for confounding by copollutants and the limited support available for the biological plausibility of health effects following $PM_{10–2.5}$ exposures also continue to contribute to uncertainty in the $PM_{10–2.5}$ health evidence. Uncertainty related to potential confounding stems from the relatively small number of epidemiologic studies that have evaluated $PM_{10–2.5}$ health effect associations in copollutants models with both gaseous pollutants and other PM size fractions. On the other hand, uncertainty related to the biological plausibility of effects attributed to $PM_{10–2.5}$ exposures results from the small number of controlled human exposure and animal toxicological studies that have evaluated the health effects of experimental $PM_{10–2.5}$ inhalation exposures. The evidence supporting the 2019 ISA's ''suggestive of, but not sufficient to infer, a causal relationship'' causality determinations for $PM_{10–2.5}$, including uncertainties in this evidence, is summarized below in sections III.B.1.a through III.B.1.f.

i. Mortality

Due to the dearth of studies examining the association between long-term $PM_{10–2.5}$ exposure and mortality, the 2009 ISA concluded that the evidence was ''inadequate to determine if a causal relationship exists'' (U.S. EPA, 2009a). As reported in the 2019 ISA, some cohort studies conducted in the U.S. and Europe report positive associations between long-term $PM_{10–2.5}$ exposure and total (nonaccidental)

mortality, though results are inconsistent across studies (U.S. EPA, 2019a, Table 11–11). The examination of copollutant models in these studies remains limited and, when included, $PM_{10–2.5}$ effect estimates are often attenuated after adjusting for $PM_{2.5}$ (U.S. EPA, 2019a, Table 11–11). Across studies, $PM_{10–2.5}$ exposure concentrations are estimated using a variety of approaches, including direct measurements from dichotomous samplers, calculating the difference between PM_{10} and $PM_{2.5}$ concentrations measured at collocated monitors, and calculating difference of area-wide concentrations of PM_{10} and $PM_{2.5}$. As discussed above, temporal and spatial correlations between these approaches have not been evaluated, contributing to uncertainty regarding the potential for exposure measurement error (U.S. EPA, 2019a, section 3.3.1.1 and Table 11–11). The 2019 ISA concludes that this uncertainty ''reduces the confidence in the associations observed across studies'' (U.S. EPA, 2019a, p. 11–125). The 2019 ISA additionally concludes that the evidence for long-term $PM_{10–2.5}$ exposures and cardiovascular effects, respiratory morbidity, and metabolic disease provide limited biological plausibility for $PM_{10–2.5}$-related mortality (U.S. EPA, 2019a, sections 11.4.1 and 11.4). Taken together, the 2019 ISA concludes that, ''this body of evidence is suggestive, but not sufficient to infer, that a causal relationship exists between long-term $PM_{10–2.5}$ exposure and total mortality'' (U.S. EPA, 2019a, p. 11–125).

With regard to short-term $PM_{10–2.5}$ exposures and mortality, the 2009 ISA concluded that the evidence is ''suggestive of a causal relationship between short-term exposure to $PM_{10–2.5}$ and mortality'' (U.S. EPA, 2009a). The 2019 ISA included multicity epidemiologic studies conducted primarily in Europe and Asia that continue to provide consistent evidence of positive associations between short-term $PM_{10–2.5}$ exposure and total (nonaccidental) mortality (U.S. EPA, 2019a, Table 11–9). Although these studies contribute to increasing confidence in the $PM_{10–2.5}$-mortality relationship, the use of various approaches to estimate $PM_{10–2.5}$ exposures continues to contribute uncertainty to the associations observed. Recent studies expand the assessment of potential copollutant confounding of the $PM_{10–2.5}$-mortality relationship and provide evidence that $PM_{10–2.5}$ associations generally remain positive in copollutant models, though associations are attenuated in some instances (U.S. EPA, 2019a, section 11.3.4.1, Figure 11–28, Table 11–10). The 2019 ISA concludes that, overall, the assessment of potential copollutant confounding is limited due to the lack of information on the correlation between $PM_{10–2.5}$ and gaseous pollutants and the small number of locations in which copollutant analyses have been conducted. Associations with cause-specific mortality (*i.e.,* cardiovascular and respiratory mortality) provide some support for associations with total (nonaccidental) mortality, though associations with respiratory mortality are more uncertain (*i.e.,* wider confidence intervals) and less consistent (U.S. EPA, 2019a, section 11.3.7). The 2019 ISA concludes that the evidence for $PM_{10–2.5}$-related cardiovascular effects provides only limited support for the biological plausibility of a relationship between short-term $PM_{10–2.5}$ exposure and cardiovascular mortality (U.S. EPA, 2019a, section 11.3.7). Based on the overall evidence, the 2019 ISA concludes that, ''this body of evidence is suggestive, but not sufficient to infer, that a causal relationship exists between short-term $PM_{10–2.5}$ exposure and total mortality'' (U.S. EPA, 2019a, p. 11–120).

ii. Cardiovascular Effects

In the 2009 ISA, the evidence describing the relationship between long-term exposure to $PM_{10–2.5}$ and cardiovascular effects was characterized as ''inadequate to infer the presence or absence of a causal relationship.'' The limited number of epidemiologic studies reported contradictory results and experimental evidence demonstrating an effect of $PM_{10–2.5}$ on the cardiovascular system was lacking (U.S. EPA, 2019a, section 6.4).

The evidence relating long-term $PM_{10–2.5}$ exposures to cardiovascular mortality remains limited, with no consistent pattern of associations across studies and, as discussed above, uncertainty stemming from the use of various approaches to estimate $PM_{10–2.5}$ concentrations (U.S. EPA, 2019a, Table 6–70). The evidence for associations with cardiovascular morbidity has grown and, while results across studies are not entirely consistent, some epidemiologic studies report positive associations with ischemic heart disease (IHD) and MI (U.S. EPA, 2019a, Figure 6–34); stroke (U.S. EPA, 2019a, Figure 6–35); atherosclerosis (U.S. EPA, 2019a, section 6.4.5); venous thromboembolism (VTE) (U.S. EPA, 2019a, section 6.4.7); and blood pressure and hypertension (U.S. EPA, 2019a, Section 6.4.6). $PM_{10–2.5}$ cardiovascular mortality effect estimates are often attenuated, but remain positive, in copollutants models that adjust for $PM_{2.5}$. For morbidity outcomes, associations are inconsistent in copollutant models that adjust for $PM_{2.5}$, NO_2, and chronic noise pollution (U.S. EPA, 2019a, p. 6–276). The lack of toxicological evidence for long-term $PM_{10–2.5}$ exposures represents a data gap (U.S. EPA, 2019a, section 6.4.10), resulting in the 2019 ISA conclusion that ''evidence from experimental animal studies is of insufficient quantity to establish biological plausibility'' (U.S. EPA, 2019a, p. 6–277). Based largely on the observation of positive associations in some epidemiologic studies, the 2019 ISA concludes that ''evidence is suggestive of, but not sufficient to infer, a causal relationship between long-term $PM_{10–2.5}$ exposure and cardiovascular effects'' (U.S. EPA, 2019a, p. 6–277).

With regard to short-term $PM_{10–2.5}$ exposures and cardiovascular effects, the 2009 ISA found that the available evidence for short-term $PM_{10–2.5}$ exposure and cardiovascular effects was ''suggestive of a causal relationship.'' This conclusion was based on several epidemiologic studies reporting associations between short-term $PM_{10–2.5}$ exposure and cardiovascular effects, including IHD hospitalizations, supraventricular ectopy, and changes in heart rate variability (HRV). In addition, dust storm events resulting in high concentrations of crustal material were linked to increases in total cardiovascular disease emergency department visits and hospital admissions. However, the 2009 ISA noted the potential for exposure measurement error primarily due to the different methods used across studies to estimate $PM_{10–2.5}$ concentrations and copollutant confounding in these epidemiologic studies. In addition, there was only limited evidence of cardiovascular effects from a small number of experimental studies (*e.g.* animal toxicological studies and controlled human exposure studies) that examined short-term $PM_{10–2.5}$ exposures (U.S. EPA, 2009a, section 6.2.12.2). In the 2019 ISA, key uncertainties included the potential for exposure measurement error, copollutant confounding, and limited evidence of biological plausibility for cardiovascular effects following inhalation exposure (U.S. EPA, 2019a, section 6.3.13).

The evidence for short-term $PM_{10–2.5}$ exposure and cardiovascular outcomes has expanded since the 2009 ISA, though important uncertainties remain. The 2019 ISA notes that there are a small number of epidemiologic studies reporting positive associations between short-term exposure to $PM_{10–2.5}$ and cardiovascular-related morbidity

outcomes. However, the 2019 ISA notes that there is limited evidence to support that these associations are biologically plausible, or independent of copollutant confounding. The 2019 ISA also concludes that it remains unclear how the approaches used to estimate $PM_{10–2.5}$ concentrations in epidemiologic studies compare amongst one another and subsequently how exposure measurement error varies between each method. Specifically, it is unclear how well-correlated $PM_{10–2.5}$ concentrations are both temporally and spatially across these methods and therefore whether exposure measurement error varies across these methods. Taken together, the 2019 ISA concludes that ''the evidence is suggestive of, but not sufficient to infer, a causal relationship between short-term $PM_{10–2.5}$ exposures and cardiovascular effects'' (U.S. EPA, 2019a, p. 6–254).

iii. Respiratory Effects

With regard to short-term $PM_{10–2.5}$ exposures and respiratory effects, the 2009 ISA (U.S. EPA, 2009a) concluded that the relationship between short-term exposure to $PM_{10–2.5}$ and respiratory effects is ''suggestive of a causal relationship'' based on a small number of epidemiologic studies observing associations with some respiratory effects and limited evidence from experimental studies to support biological plausibility. Epidemiologic findings were consistent for respiratory infection and combined respiratory-related diseases, but not for COPD. Studies were characterized by overall uncertainty in the exposure assignment approach and limited information regarding potential copollutant confounding. Controlled human exposure studies of short-term $PM_{10–2.5}$ exposures found no lung function decrements and inconsistent evidence for pulmonary inflammation. Animal toxicological studies were limited to those using non-inhalation (*e.g.,* intratracheal instillation) routes of $PM_{10–2.5}$ exposure.

Recent epidemiologic findings consistently link $PM_{10–2.5}$ exposure to asthma exacerbation and respiratory mortality, with some evidence that associations remain positive (though attenuated in some studies of mortality) in copollutant models that include $PM_{2.5}$ or gaseous pollutants. Epidemiologic studies provide limited evidence for positive associations with other respiratory outcomes, including COPD exacerbation, respiratory infection, and combined respiratory-related diseases (U.S. EPA, 2019a, Table 5–36). As noted above for other endpoints, an uncertainty in these epidemiologic studies is the lack of a systematic evaluation of the various methods used to estimate $PM_{10–2.5}$ concentrations and the resulting uncertainty in the spatial and temporal variability in $PM_{10–2.5}$ concentrations compared to $PM_{2.5}$ (U.S. EPA, 2019a, sections 2.5.1.2.3 and 3.3.1.1). Specifically, the existing monitoring networks do not provide a good characterization of how well correlated concentrations are both spatially and temporally across the $PM_{10–2.5}$ estimation methods and overall spatial and temporal patterns in $PM_{10–2.5}$ concentrations. Taken together, the 2019 ISA concludes that ''the collective evidence is suggestive of, but not sufficient to infer, a causal relationship between short-term $PM_{10–2.5}$ exposure and respiratory effects'' (U.S. EPA, 2019a, p. 5–270).

iv. Cancer

In the 2012 review, little information was available from studies of cancer following inhalation exposures to $PM_{10–2.5}$. Thus, the 2009 ISA determined the evidence was ''inadequate to evaluate the relationship between long-term $PM_{10–2.5}$ exposures and cancer'' (U.S. EPA, 2009a). The scientific information evaluated in the 2019 ISA of long-term $PM_{10–2.5}$ exposure and cancer remains limited, with a few recent epidemiologic studies reporting positive, but imprecise, associations with lung cancer incidence (U.S. EPA, 2019a). Moreover, uncertainty remains in these studies with respect to exposure measurement error due to the use of $PM_{10–2.5}$ predictions that have not been validated by monitored $PM_{10–2.5}$ concentrations (U.S. EPA, 2019a, sections 3.3.2.3 and 10.3.4). Relatively few experimental studies of $PM_{10–2.5}$ have been conducted, though available studies indicate that $PM_{10–2.5}$ exhibits two key characteristics of carcinogens: genotoxicity and oxidative stress. While limited, such experimental studies provide some evidence of biological plausibility for the findings in a small number of epidemiologic studies (U.S. EPA, 2019a, section 10.3.4).

Taken together, the small number of epidemiologic and experimental studies, along with uncertainty with respect to exposure measurement error, contribute to the determination in the 2019 ISA that, ''the evidence is suggestive of, but not sufficient to infer, a causal relationship between long-term $PM_{10–2.5}$ exposure and cancer'' (U.S. EPA, 2019a, p. 10–87).

v. Metabolic Effects

The 2009 ISA did not make a causality determination for $PM_{10–2.5}$-related metabolic effects. One epidemiologic study in the 2019 ISA reports an association between long-term $PM_{10–2.5}$ exposure and incident diabetes, while additional cross-sectional studies report associations with effects on glucose or insulin homeostasis (U.S. EPA, 2019a, section 7.4). As discussed above for other outcomes, uncertainties with the epidemiologic evidence include the potential for copollutant confounding and exposure measurement error due to the different methods used across studies to estimate $PM_{10–2.5}$ concentrations (U.S. EPA, 2019a, Tables 7–14 and 7–15). The evidence base to support the biological plausibility of metabolic effects following $PM_{10–2.5}$ exposures is limited, but a cross-sectional study that investigated biomarkers of insulin resistance and systemic and peripheral inflammation may support a pathway leading to type 2 diabetes (U.S. EPA, 2019a, sections 7.4.1 and 7.4.3). Based on the expanded, though still limited evidence base, the 2019 ISA concludes that, ''[o]verall, the evidence is suggestive of, but not sufficient to infer, a causal relationship between [long]-term $PM_{10–2.5}$ exposure and metabolic effects'' (U.S. EPA, 2019a, p. 7–56).

vi. Nervous System Effects

The 2009 ISA did not make a causality determination for $PM_{10–2.5}$-related nervous system effects. In the 2019 ISA, available epidemiologic studies report associations between $PM_{10–2.5}$ and impaired cognition and anxiety in adults in longitudinal analyses (U.S. EPA, 2019a, Table 8–25, section 8.4.5). Associations of long-term exposure with neurodevelopmental effects are not consistently reported in children (U.S. EPA, 2019a, sections 8.4.4 and 8.4.5). Uncertainties in these studies include the potential for copollutant confounding, as no studies examined copollutants models (U.S. EPA, 2019a, section 8.4.5), and for exposure measurement error, given the use of various methods to estimate $PM_{10–2.5}$ concentrations (U.S. EPA, 2019a, Table 8–25). In addition, there is limited animal toxicological evidence supporting the biological plausibility of nervous system effects (U.S. EPA, 2019a, sections 8.4.1 and 8.4.5). Overall, the 2019 ISA concludes that, ''the evidence is suggestive of, but not sufficient to infer, a causal relationship'' between long-term $PM_{10–2.5}$ exposure and nervous system effects (U.S. EPA, 2019a, p. 8–75).

B. Conclusions on the Primary PM_{10} Standard

In drawing conclusions on the adequacy of the current primary PM_{10} standard, in view of the advances in scientific knowledge and additional information now available, the Administrator has considered the evidence base, information, and policy judgments that were the foundation of the 2020 review and reflects upon the body of information and evidence available in this reconsideration. In so doing, the Administrator has taken into account both evidence-based and quantitative information-based considerations, as well as advice from the CASAC and public comments. Evidence-based considerations draw upon the EPA's integrated synthesis of the scientific evidence from animal toxicologic, controlled human exposure, and epidemiologic studies evaluating health effects related to exposures to $PM_{10-2.5}$ as presented in the 2019 ISA and discussed in section III.A.2. In addition to the evidence, the Administrator has weighed a range of policy-relevant considerations as discussed in the 2022 PA and summarized in sections III.B and III.C of the proposal and summarized in section III.B.2 below. These considerations, along with the advice from the CASAC (section III.B.1) and public comments (section III.B.3), are discussed below. A more detailed summary of all significant comments, along with the EPA's responses in the Response to Comments document, can be found in the docket for this rulemaking (Docket No. EPA–HQ–OAR–2015–00072). This document is available for review in the docket for this rulemaking and through EPA's NAAQS website (link). The Administrator's conclusions in this reconsideration regarding the adequacy of the current primary PM_{10} standard and whether any revisions are appropriate are described in section III.B.4.

1. CASAC Advice

As described in section I.X, the EPA decided to prepare a revised PA for the reconsideration of the 2020 final decision. The CASAC's advice on the 2019 draft PA and the 2021 draft PA was documented in letters to the prior and current Administrators (Cox, 2019b; Sheppard, 2022a) and is summarized below. In reviewing both the 2019 draft PA and the 2021 draft PA, the CASAC agreed with the EPA's preliminary conclusion that the available scientific evidence, including its uncertainties and limitations, does not call into question the adequacy of the current primary PM_{10} standard and that the standard should be retained, without revision.

In its review of the 2019 draft PA, the CASAC concurred with the overall preliminary conclusion that it is appropriate to consider retaining the current primary PM_{10} standard, without revision. In their agreement with the conclusions in the 2019 draft PA, the CASAC stated that ''that key uncertainties identified in the last review remain'' (Cox, 2019b) and that ''none of the identified health outcomes linked to $PM_{10-2.5}$'' were judged to be causal or likely to be causal (Cox, 2019b, p. 12 of consensus responses). Moreover, to reduce these uncertainties in future reviews, the CASAC recommended improvements to $PM_{10-2.5}$ exposure assessment, including a more extensive network for direct monitoring of the $PM_{10-2.5}$ fraction (Cox, 2019b, p. 13 of consensus responses). The CASAC also recommended additional controlled human exposure and animal toxicological studies of the $PM_{10-2.5}$ fraction to improve the understanding of biological mechanisms and pathways (Cox, 2019b, p. 13 of consensus responses). Overall, the CASAC agreed with the EPA's preliminary conclusion in the 2019 draft PA that ''. . . the available evidence does not call into question the adequacy of the public health protection afforded by the current primary PM_{10} standard and that evidence supports consideration of retaining the current standard in this review'' (Cox, 2019b, p. 3 of letter).

In its review of the 2021 draft PA, the CASAC provided advice on the adequacy of the current primary PM_{10} standard in the context of its review of the revised PA for this reconsideration (Sheppard, 2022a) [129].) [130]. In this context, the CASAC supported the preliminary conclusion in the 2021 draft PA that the evidence reviewed in the 2019 ISA does not call into question the public health protection provided by the current primary PM_{10} standard against $PM_{10-2.5}$ exposures and concurs with the 2021 draft PA's overall preliminary conclusion that it is appropriate to consider retaining the current primary PM_{10} standard (Sheppard, 2022a, p. 4 of consensus letter). Additionally, the CASAC concurred that ''. . . at this time, PM_{10} is an appropriate choice as the indicator for $PM_{10-2.5}$'' and ''that it is important to retain the level of protection afforded by the current PM_{10} standard'' (Sheppard, 2022a, p. 4 of consensus letter). The CASAC also recognized uncertainties associated with the scientific evidence, including ''compared to $PM_{2.5}$ studies, the more limited number of epidemiology studies with positive statistically significant findings, and the difficulty in extracting the sole contribution of coarse PM to observed adverse health effects'' (Sheppard, 2022a, p. 19 of consensus responses).

The CASAC recommended several areas for additional research to reduce uncertainties in the $PM_{10-2.5}$ exposure estimates used in the epidemiologic studies, to evaluate the independence of $PM_{10-2.5}$ health effect associations, to evaluate the biological plausibility of $PM_{10-2.5}$-related effects, and to increase the number of studies examining $PM_{10-2.5}$-related health effects in at-risk populations (Sheppard, 2022a, p. 20 of consensus responses). Furthermore, the CASAC ''recognizes a need for, and supports investment in research and deployment of measurement systems to better characterize $PM_{10-2.5}$'' and to ''provide information that can improve public health'' (Sheppard, 2022a, p. 20 of consensus responses).

2. Basis for the Proposed Decision

At the time of the proposal, the Administrator carefully considered the assessment of the current evidence and conclusions reached in the 2019 ISA, considerations and staff conclusions and associated rationales presented in the 2020 PA and 2022 PA, and advice and recommendations of the CASAC (88 FR 5634, January 27, 2023). Consistent with previous reviews, the Administrator first considered the available scientific evidence for $PM_{10-2.5}$-related exposures and health effects, as evaluated in the 2019 ISA. As an initial matter, the Administrator recognized that the scientific evidence for $PM_{10-2.5}$-related effects available in this reconsideration is the same body of evidence that was available at the time of the 2020 review, as evaluated in the 2019 ISA and summarized in section III.A.2 above. The 2019 ISA concludes that the evidence supports ''suggestive of, but not sufficient to infer'' causal relationships between short- and long-term exposures to $PM_{10-2.5}$ and cardiovascular effects, cancer, and mortality and long-term $PM_{10-2.5}$ exposures and metabolic effects and nervous system effects (U.S. EPA, 2019a). The Administrator noted that

[129] As described in section I.C.5.b above, the scope of the ISA Supplement did not include consideration of studies of health effects associated with exposure to $PM_{10-2.5}$. Therefore, the information and conclusions presented in the 2022 PA are very similar to those in the 2020 PA.

[130] As described in section I.C.5.b above, the scope of the ISA Supplement did not include consideration of studies of health effects associated with exposure to $PM_{10-2.5}$. Therefore, the information and conclusions presented in the 2022 PA are very similar to those in the 2020 PA.

the evidence for several $PM_{10–2.5}$-related health effects has expanded since the completion of the 2009 ISA, but important uncertainties remain. The uncertainties in the epidemiologic studies contribute to the determinations in the 2019 ISA that the evidence for short and long-term $PM_{10–2.5}$ exposures and mortality, cardiovascular effects, metabolic effects, nervous system effects, and cancer is ''suggestive of, but not sufficient to infer'' causal relationships (U.S. EPA, 2019a; U.S. EPA, 2022b, section 4.3.1). Drawing from the evidence evaluated in the 2019 ISA and consideration of the scientific evidence in the 2022 PA, the Administrator noted that, consistent with previous reviews, the 2019 ISA and the 2022 PA highlight a number of uncertainties associated with the evidence, including: (1) $PM_{10–2.5}$ exposure estimates used in epidemiologic studies, (2) independence of $PM_{10–2.5}$ health effect associations, and (3) biological plausibility of the $PM_{10–2.5}$-related effects. These uncertainties contribute to the determinations in the 2019 ISA that the evidence for short-term $PM_{10–2.5}$ exposures and key health effects is ''suggestive of, but not sufficient to infer'' causal relationships. In considering the available scientific evidence, consistent with approaches employed in past NAAQS reviews, the Administrator placed the most weight on evidence supporting ''causal'' and ''likely to be causal'' relationships. In so doing, he noted that the available evidence for short- and long-term $PM_{10–2.5}$ exposures and health effects does not support causality determinations of a ''causal relationship'' or ''likely to be causal relationship.'' Furthermore, the Administrator recognized that, because of the uncertainties and limitations in the evidence base, the 2022 PA does not include a quantitative assessment of $PM_{10–2.5}$ exposures and risk that might further inform decisions regarding the adequacy of the current 24-hour primary PM_{10} standard. Therefore, in light of the 2019 ISA conclusions that the evidence supports ''suggestive of, but not sufficient to infer'' causal relationships. The Administrator judged that there are substantial uncertainties that raise questions regarding the degree to which additional public health improvements would be achieved by revising the existing PM_{10} standard. In considering the available evidence for long-term $PM_{10–2.5}$ exposures, the Administrator noted that there is limited evidence that would support consideration of an annual standard to provide protection against such effects, in conjunction with the current primary 24-hour PM_{10} standard. He preliminarily concluded that the current primary 24-hour $PM_{2.5}$ standard that reduces 24-hour exposures also likely reduces long-term average exposures, and therefore provides some margin of safety against the health effects associated with long-term $PM_{10–2.5}$ exposures.

In reaching his proposed decision on the adequacy of the current primary 24-hour PM_{10} standard, the Administrator also considered advice from the CASAC. As noted above in section III.B.1, the CASAC recognized uncertainties associated with the scientific evidence and agreed with the 2019 draft PA and 2021 draft PA conclusions that the scientific evidence does not call into question the adequacy of the primary PM_{10} standard and supports consideration of retaining the current standard.

When considering the above information together, the Administrator proposed to conclude that the available scientific evidence continues to support a PM_{10} standard to provide some measure of protection against $PM_{10–2.5}$ exposures. Additionally, he recognized that there are important uncertainties and limitations associated with the available evidence for $PM_{10–2.5}$-related health effects, for both short and long-term exposure, as evaluated in the 2019 ISA. Consistent with the decisions in the previous reviews, the Administrator proposed to conclude that these limitations lead to considerable uncertainty regarding the potential public health implications of revising the level of the current primary 24-hour PM_{10} standard. Thus, based on his consideration of the evidence and associated uncertainties and limitations for $PM_{10–2.5}$-related health effects and his consideration of CASAC advice on the primary PM_{10} standard, the Administrator proposed to retain the current primary PM_{10} standard, without revision.

3. Comments on the Proposed Decision

Of the public comments received on the proposal, very few commenters provided comments on the primary PM_{10} standard. Of those commenters who did provide comments on the primary PM_{10} standard, the majority agree with the EPA's proposed decision to retain the primary PM_{10} standard. In so doing, these commenters agree with the EPA's rationale regarding the available scientific information, including uncertainties and limitations, for informing decisions on the standard. These commenters state that no new scientific evidence or quantitative information has emerged since the 2020 decision to retain the current standard. Furthermore, these commenters note that the EPA did not evaluate any new scientific evidence related to $PM_{10–2.5}$ exposures and health effects as a part of the 2022 ISA Supplement developed for this reconsideration, nor did the revised 2022 PA consider any new or different information from the 2020 PA, and therefore, the EPA reached the same conclusion as is the 2020 PA that the current standard is adequate and should be retained. This group includes industries and industry groups, as well as some State and local governments. All of these commenters generally note their agreements with the rationale provided in the proposal and the CASAC concurrence with the 2021 draft PA conclusion that the available information does not call into question the adequacy of the current standard, and therefore, does not support revision and that the current standard should be retained.

Some commenters, including those from environmental and public health organizations and groups, some states, and individuals, disagreed with the Administrator's proposed decision to retain the current primary PM_{10} standard. These commenters recommend that the EPA revise the primary PM_{10} standard to a lower level to provide increased public health protection, citing to the available scientific evidence, as well as the proposed revision to the primary $PM_{2.5}$ standard.

Commenters who disagreed with the proposal to retain the current standard state that revision to the primary PM_{10} standard is necessary to protect public health with an adequate margin of safety. In their recommendations for revising the standard, some commenters contend that the current standard, with its indicator of PM_{10} to target exposures to $PM_{10–2.5}$, has become less protective as ambient concentrations of $PM_{2.5}$ have been reduced with revisions to that standard. These commenters assert that the current primary PM_{10} standard allows increased exposure to $PM_{10–2.5}$ in ambient air because retaining the primary PM_{10} would allow proportionately more $PM_{10–2.5}$ mass as the $PM_{2.5}$ standard has been revised downward. Moreover, in support of their recommendations, the commenters note that the available evidence of $PM_{10–2.5}$-related health effects has been expanded and strengthened since the time of the last review. Taken together, the commenters contend that the primary PM_{10} standard should be revised and failure to do so would be arbitrary and capricious. Some of these

commenters assert that the level of the primary PM_{10} standard should be revised to 140 or 145 μg/m³, concurrent with a strengthened primary 24-hour $PM_{2.5}$ standard, while other commenters recommend revising the level of the standard to within the range of 65–75 μg/m³, to provide increased public health protection.

We disagree with the commenters that the primary PM_{10} standard should be revised because of reductions in ambient concentrations of $PM_{2.5}$. As an initial matter, we note that overall, ambient concentrations of both PM_{10} and $PM_{2.5}$ have declined significantly over time. Ambient concentrations of PM_{10} have declined by 46% across the U.S. from 2000 to 2019,[131] while $PM_{2.5}$ concentrations in ambient air have declined by 43% during this same time period.[132] As noted in the 2022 PA (p. 2–41), the majority of $PM_{10-2.5}$ sites have generally remained steady and do not exhibit a trend of increasing or decreasing concentrations during this time period, reflecting the relatively consistent level of dust emission across the U.S. from 2000 to 2019 (U.S. EPA, 2022b).

The 2019 ISA provides a comparison of the relative contribution of $PM_{2.5}$ and $PM_{10-2.5}$ to PM_{10} concentrations by region and season using the more comprehensive monitoring data from the NCore network available in this reconsideration (U.S. EPA, 2019, section 2.5.1.1.4). The data indicate that, for urban areas, there are roughly equivalent amounts of $PM_{2.5}$ and $PM_{10-2.5}$ contributing to PM_{10} in ambient air, while rural locations have a slightly higher contribution of $PM_{10-2.5}$ contributing to PM_{10} concentrations than $PM_{2.5}$ (U.S. EPA, 2019, section 2.5.1.1.4, Table 2–7). There is generally a greater contribution from the $PM_{2.5}$ fraction in the East and a greater contribution from the $PM_{10-2.5}$ fraction in the West and Midwest.

The EPA recognizes that when the primary annual $PM_{2.5}$ standard was revised from 15.0 μg/m³ to 12.0 μg/m³ while leaving the 24-hour $PM_{2.5}$ standards unchanged at 35 μg/m³ and the 24-hour PM_{10} standard unchanged at 150 μg/m³, the $PM_{10-2.5}$ fraction of PM_{10} could increase in some areas as the $PM_{2.5}$ fraction decreases (78 FR 3085, March 03, 2013). As described in the 2019 ISA, PM_{10} has become considerably coarser across the U.S. compared to similar observations in the 2009 ISA such that, in urban areas, the mass of the coarse fraction of PM is similar to or greater than the mass of the fine fraction of PM (U.S. EPA, 2019, section 2.5.1.1.4; U.S. EPA, 2009c). However, in considering recent air quality data, the EPA notes that in most areas of the country $PM_{2.5}$ and PM_{10} concentrations have declined and are well below their respective 24-hour standards. While the contribution of fine and coarse PM to PM_{10} mass concentrations may vary spatially and temporally, based on the trends in recent air quality data, the Administrator concludes that the current primary 24-hour PM_{10} standard is maintaining air quality at level that provides requisite protection against $PM_{10-2.5}$. That is, recent air quality data does not suggest that $PM_{10-2.5}$ concentrations have been increasing as $PM_{2.5}$ concentrations have been decreasing. In considering the available $PM_{10-2.5}$ health effects evidence in this reconsideration, there continue to be significant uncertainties and limitations, specifically with respect to the exposure assessment methods used to estimate $PM_{10-2.5}$ concentrations, that make it difficult to fully assess the public health implications of revising the primary PM_{10} standard even considering the possibility for additional variability in the relative ratio of $PM_{2.5}$ to $PM_{10-2.5}$ in current PM_{10} air quality across the U.S. As described in detail above in section III.A.2 and in the proposal (85 FR 5558, January 27, 2023), the uncertainties and limitations in the health effects evidence for $PM_{10-2.5}$ contributed to the determinations in the 2019 ISA that the evidence for key $PM_{10-2.5}$ health effects is ''suggestive of, but not sufficient to infer, a causal relationship'' or ''inadequate to infer the presence, or absence of a causal relationship'' (U.S. EPA, 2019a). While the evidence base for $PM_{10-2.5}$-related health effects has somewhat expanded since the 2009 ISA, the Administrator concludes that the evidence remains too limited to inform judgments regarding whether a more protective primary PM_{10} standard is warranted at this time.

Beyond the uncertainties and limitations associated with the available scientific evidence, the EPA also notes that, while the NCore monitoring network has been expanded since the time of the last review, epidemiologic studies available in this review do not use $PM_{10-2.5}$ NCore data in evaluating associations between $PM_{10-2.5}$ in ambient air and long- or short-term exposures. In the absence of such evidence, the public health implications of changes in ambient $PM_{10-2.5}$ concentrations as $PM_{2.5}$ concentrations decrease remain unclear. Therefore, the EPA continues to recognize this as an area for future research, to address the existing uncertainties (U.S. EPA, 2022b, section 4.6), and inform future reviews of the PM NAAQS. Taken together, as at the time of proposal, the Administrator concludes that these and other limitations in the $PM_{10-2.5}$ evidence raised questions as to whether additional public health improvements would be achieved by revising the existing PM_{10} standard, particularly when considering such judgments along with his decision to retain the current primary 24-hour $PM_{2.5}$ standard. Therefore, the EPA does not agree with the commenters that the currently available air quality information or scientific evidence support revisions to the primary PM_{10} standard in this reconsideration.

Consistent with their comments on the 2020 proposal, some commenters disagreed with the Administrator's proposed conclusion to retain the current primary PM_{10} standard, primarily focusing their comments on the need for revisions to the form of the standard or the level of the standard. With regard to comments on the form of the standard, some commenters assert that the EPA should revise the standard by adopting a separate form (or a ''compliance threshold'' in their words)—the 99th percentile, averaged over three years—for the primary PM_{10} standard for continuous monitors, which provide data every day, while maintaining the current form of the standard (one exceedance, averaged over three years) for 1-in-6 samplers, given the increased use of continuous monitoring and to ease the burden of demonstrating exceptional events. These commenters, in support of their comment, contend that the 99th percentile would effectively change the form from the 2nd highest to the 4th highest and would allow no more than three exceedances per year, averaged over three years. These commenters additionally highlight the EPA's decision in the 1997 review to adopt a 99th percentile form, averaged over three years, citing to advantages of a percentile-based form in the Administrator's rationale in that review. The comments further assert that a 99th percentile form for the primary PM_{10} standard is still more conservative than the form for other short-term NAAQS (*e.g.,* $PM_{2.5}$ and NO_2).

[131] PM_{10} concentrations presented as the annual second maximum 24-hour concentration (in μg/m³) at 262 sites in the U.S. For more information, see: *https://www.epa.gov/air-trends/particulate-matter-pm10-trends*

[132] $PM_{2.5}$ concentrations presented as the seasonally-weighted annual average concentration (in μg/m³) at 406 sites in the U.S. For more information, see: *https://www.epa.gov/air-trends/particulate-matter-pm25-trends*

First, the EPA has long recognized that the form is an integral part of the NAAQS and must be selected together with the other elements (*i.e.,* indicator, averaging time, level) of the NAAQS to ensure the appropriate stringency and requisite degree of public health protection. Thus, if the EPA were to change the form according to the monitoring method it would be establishing two different NAAQS, varying based on the monitoring method. The EPA has not done this to date, did not propose such an approach, and declines to adopt it for the final rule, as we believe such a decision in this final rule is beyond the scope of the proposal, and that each PM standard should have a single form, indicator, level and averaging time, chosen by the Administrator as necessary and appropriate. While certain continuous monitors may be established and approved as a Federal Equivalent Method (FEM) for PM_{10}, as an alternative to a Federal Reference Method (FRM), the use of an FEM is intended as an alternative means of determining compliance with the NAAQS, not as authorizing a different NAAQS.

Even if the commenters had asked that the change in form be made without regard to monitoring method, the EPA does not believe such a change would be warranted. The change in form for continuous monitors suggested by the commenters, without also lowering the level of such a standard, would allow more exceedances and thereby reduce the public health protection provided against exposures to $PM_{10–2.5}$ in ambient air, resulting in a less stringent primary PM_{10} standard than the current standard. These commenters have not provided new evidence or analyses to support their conclusion that an appropriate degree of public health protection could be achieved by allowing the use of an alternative form (*i.e.,* 99th percentile), while retaining the other elements of the standard.

With regard to the commenters' assertion that an alternate form of the standard would ease the burden of demonstrating exceptional events, the EPA recognizes, consistent with the CAA, that it may be appropriate to exclude monitoring data influenced by ''exceptional'' events when making certain regulatory determinations. However, the EPA notes that the cost of implementation of the standards may not be considered by the EPA in reviewing the standards. The EPA continues to update and develop documentation and tools to facilitate the implementation of the 2016 Exceptional Events Rule, including new $PM_{2.5}$ implementation focused products under development that are intended to assist air agencies with the development of demonstrations for specific types of exceptional events. With regard to the commenters' specific concerns for wildfires or high winds, the EPA released updated guidance documents on the preparation of exceptional event demonstrations related to wildfires in September 2016, high wind dust events in April 2019, and prescribed fires in August 2019. These guidance documents outline the regulatory requirements and provide examples for air agencies preparing demonstrations for wildfires, high wind dust, and prescribed fire events. For all of the reasons discussed above, the EPA does not agree with the commenters that the form of the primary PM_{10} standard should be revised to a 99th percentile for continuous monitors.

4. Administrator's Conclusions

This section summarizes the Administrator's considerations and conclusions related to the current primary PM_{10} standard. In establishing primary standards under the Act that are ''requisite'' to protect the public health with an adequate margin of safety, the Administrator is seeking to establish standards that are neither more nor less stringent than necessary for this purpose. In so doing, the Administrator notes that his final decision in this reconsideration is a public health policy judgment that draws upon scientific information, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the information. Accordingly, he recognizes that his decision requires judgments based on the interpretation of the evidence that neither overstates nor understates the strength or limitations of the evidence nor the appropriate inferences to be drawn. He recognizes, as described in section I.A above, that the Act does not require that primary standards be set at a zero-risk level; rather, the NAAQS must be sufficient but not more stringent than necessary to protect public health, including the health of sensitive groups with an adequate margin of safety.

Given these requirements, and consistent with the primary $PM_{2.5}$ standards discussed above (section II.C.3), the Administrator's final decision in this reconsideration of the current primary PM_{10} standard will be a public health policy judgment that draws upon the scientific information examining the health effects of $PM_{10–2.5}$ exposures, including how to consider the range and magnitude of uncertainties inherent in that information. The Administrator's final decision is based on an interpretation of the scientific evidence that neither overstates nor understates its strengths and limitations, nor the appropriate inferences to be drawn.

Having carefully considered advice from the CASAC and public comments, as discussed above, the Administrator notes that the fundamental scientific conclusions on health effects of $PM_{10–2.5}$ in ambient air that were reached in the 2019 ISA and summarized in the 2020 PA and 2022 PA remain valid. Additionally, the Administrator believes the judgments he proposed (85 FR 5558, January 27, 2023) with regard to the evidence remain appropriate. Further, in considering the adequacy of the current primary PM_{10} standard in this reconsideration, the Administrator has carefully considered the policy-relevant evidence and conclusions contained in the 2019 ISA; the rationale and conclusions presented in the 2020 PA and 2022 PA; the advice and recommendations from the CASAC in their reviews of the 2019 draft PA and 2021 draft PA; and public comments, as addressed in section III.B.3 above and in the RTC document. In the discussion below, the Administrator gives weight to the conclusions in the 2020 PA and 2022 PA, with which the CASAC has concurred, as summarized in section III.C of the proposal and takes note of the key aspects of the rationale for those conclusions that contribute to his decision in this review. In considering this information, the Administrator concludes that the preliminary conclusions and policy judgments supporting his proposed decision remain valid, and that the current primary PM_{10} standard provides requisite protection of public health with an adequate margin of safety and should be retained. In considering the 2020 PA and 2022 PA evaluations and conclusions, the Administrator notes that, while the health effects evidence is somewhat expanded since the 2009 ISA as described in section III.A.2 above, the overall conclusions are generally consistent with those reached in the 2009 ISA (U.S. EPA, 2020b, section 4.4). In so doing, he additionally notes that the CASAC supported the preliminary conclusion in the 2019 draft PA and 2021 draft PA that the evidence reviewed in the 2019 ISA does not call into question the public health protection provided by the current primary PM_{10} standard against $PM_{10–2.5}$ exposures and concurs that it is appropriate to consider retaining the current primary PM_{10} standard (Cox,

2019b, p. 13 of consensus responses; Sheppard, 2022a, p. 4 of consensus letter).

As noted below, the scientific evidence for $PM_{10–2.5}$-related health effects has expanded somewhat since the 2012 review, in particular for long-term exposures. The Administrator recognizes, however, that there are a number of uncertainties and limitations associated with the available information, as described in the proposal (85 FR 5558, January 27, 2023) and below. With regard to the current evidence on $PM_{10–2.5}$-related health effects, the Administrator takes note of recent epidemiologic studies that continue to report positive associations with mortality and morbidity in cities across North America, Europe, and Asia, where $PM_{10–2.5}$ sources and composition are expected to vary widely. While significant uncertainties remain, as described below, the Administrator recognizes that this expanded body of evidence has broadened the range of effects that have been linked with $PM_{10–2.5}$ exposures. These studies provide an important part of the scientific foundation supporting the 2019 ISA's revised causality determinations (and new determinations) for long-term $PM_{10–2.5}$ exposures and mortality, cardiovascular effects, metabolic effects, nervous system effects, and cancer (U.S. EPA, 2019a; U.S. EPA, 2022b, section 4.2). Drawing from his consideration of this evidence, the Administrator concludes that the available scientific information supports a decision to maintain a primary PM_{10} standard to provide public health protection against $PM_{10–2.5}$ exposures, regardless of location, source of origin, or particle composition. With regard to uncertainties in the evidence, the Administrator first notes that a number of limitations were identified in the 2012 review related to: (1) Estimates of ambient $PM_{10–2.5}$ concentrations used in epidemiologic studies; (2) limited evaluation of copollutant models to address the potential for confounding; and (3) limited experimental studies supporting biological plausibility for $PM_{10–2.5}$-related effects. Despite the expanded body of evidence for $PM_{10–2.5}$ exposures and health effects assessed in the 2019 ISA, the Administrator recognizes that uncertainties remain, similar to those in the 2012 review. As summarized in section III.A.2 above and in responding to public comments, uncertainties in the available scientific evidence continue to include those associated with the exposure estimates used in epidemiologic studies, the independence of the $PM_{10–2.5}$ health effect associations, and the biologically plausible pathways for $PM_{10–2.5}$ health effects (U.S. EPA, 2022b, section 4.3). These uncertainties contribute to the 2019 ISA determinations that the evidence is ''suggestive of, but not sufficient to infer'' causal relationships (U.S. EPA, 2019a). The Administrator recognizes that the NAAQS must allow for a margin of safety but also places emphasis on evidence supporting ''causal'' or ''likely to be causal'' relationships (as described in sections II.A.2 and III.A.2 above). Finding that there is too much uncertainty that a more stringent standard would improve public health, the Administrator judges that the available evidence provides support for his conclusion that the current standard provides the requisite level of protection from the effects of $PM_{10–2.5}$. In making this judgment, the Administrator considers whether this level of protection is more than what is requisite and whether a less stringent standard would be appropriate to consider. He notes that there continues to be uncertainty associated with the evidence, as reflected by the ''suggestive of, but not sufficient to infer'' causal determinations. The Administrator recognizes that the CAA requirement that primary standards provide an adequate margin of safety, as summarized in section I.A above, is intended to address uncertainties associated with inconclusive scientific evidence and technical information, as well as to provide a reasonable degree of protection against hazards that research has not yet identified. In light of these considerations and the current body of evidence, including uncertainties and limitations, the Administrator concludes that a less stringent standard would not provide the requisite protection of public health, including an adequate margin of safety. The Administrator also considers whether the level of protection associated with the current standard is less than what is requisite and whether a more stringent standard would be appropriate to consider. In so doing, the Administrator considers, as discussed above, the level of protection offered from exposures for which public health implications are less clear. In so doing, he again notes the significant uncertainties and limitations that persist in the scientific evidence. In particular, he notes limitations in the approaches used to estimate ambient $PM_{10–2.5}$ concentrations in epidemiologic studies, limited examination of the potential for confounding by co-occurring pollutants, and limited support for the biological plausibility of the serious effects reported in many epidemiologic studies that are reflected by the ''suggestive of, but not sufficient to infer'' causal determinations. Thus, in light of the currently available information, including the uncertainties and limitations of the evidence base available to inform his judgments regarding protection against $PM_{10–2.5}$-related effects, the Administrator does not find it appropriate to increase the stringency of the standard in order to provide the requisite public health protection. Rather, he judges it appropriate to maintain the level of protection provided by the current primary PM_{10} standard for $PM_{10–2.5}$ exposures and he does not judge that the available information and the associated uncertainties indicate the need for a greater level of public health protection.

In reaching his conclusions on the primary PM_{10} standard, the Administrator also considers advice from the CASAC. In their comments, the CASAC noted that uncertainties that were identified in the 2012 review persist in the evidence for $PM_{10–2.5}$-related health effects (Cox, 2019b, p. 13 of consensus responses; Sheppard, 2022a, p. 4 of consensus letter) In considering these comments, the Administrator takes note of the CASAC consideration of the evidence, and associated uncertainties, and its conclusion that the evidence reviewed in the 2019 ISA does not call into question the adequacy of the public health protection afforded by the current primary PM_{10} standard (Cox, 2019b, p. 3 of letter; Sheppard, 2022a, p. 4 of consensus letter). The Administrator further notes the unanimous conclusions of the CASAC that evidence supports consideration of retaining the current primary PM_{10} standard (Cox, 2019b, p. 3 of consensus letter; Sheppard, 2022a, p. 4 of consensus letter). In addition to the CASAC's advice, the Administrator also considers public comments, the majority of which supported retaining the primary PM_{10} standard, citing to and agreeing with the Administrator's rationale for his proposed decision. The Administrator also recognizes that a few public commenters supported revising the primary PM_{10} standard in order to provide increased protection against $PM_{10–2.5}$-related health effects.

The Administrator also notes that the scientific record for his decision on the primary PM_{10} standard is the same as the record before the then-Administrator in 2020, as the scope of the ISA Supplement focused on health effect categories where the 2019 ISA concluded a causal relationship (*i.e.,*

short- and long-term $PM_{2.5}$ exposure and cardiovascular effects and mortality). Therefore, because no health outcome categories for short- or long-term $PM_{10–2.5}$ exposure in the 2019 ISA were greater than ''suggestive of, but not sufficient to infer, a causal relationship'', the ISA Supplement did not evaluate studies published after the literature cutoff date of the 2019 ISA related to $PM_{10–2.5}$ exposures and health effects. The Administrator further notes his decision is consistent with the decision of the prior Administrator in 2020 to retain the primary PM_{10} standard.

With regard to the indicator for the primary PM_{10} standard, the Administrator recognizes that the 2022 PA notes that the evidence continues to support retaining the PM_{10} indicator to provide public health protection against $PM_{10–2.5}$-related effects. He notes that, consistent with the approaches in previous reviews, a standard with a PM_{10} mass-based indicator, in conjunction with a $PM_{2.5}$ mass-based standard, will result in controlling allowable concentrations of $PM_{10–2.5}$. The Administrator also takes note of the 2019 ISA comparison that showed that the relative contribution of $PM_{2.5}$ and $PM_{10–2.5}$ to PM_{10} concentrations can vary across the U.S. by region and season, with urban locations having a somewhat higher contribution of $PM_{2.5}$ contributing to PM_{10} concentrations than $PM_{10–2.5}$ (U.S. EPA, 2019a, section 2.5.1.1.4, Table 2–7). In these urban locations, where $PM_{2.5}$ concentrations are somewhat higher than in rural locations, the toxicity of the PM_{10} may be higher due to contaminating $PM_{2.5}$. Further, although uncertainties with the evidence persist, the strongest health effects evidence associated with $PM_{10–2.5}$ comes from epidemiologic studies conducted in urban areas. He also notes that the CASAC agreed with the EPA's conclusions that a PM_{10} indicator remained appropriate (Cox, 2019b, p. 13 of consensus responses; Sheppard, 2022a, p. 4 of letter). In light of this information, the Administrator concludes that the PM_{10} indicator remains appropriate and provides protection from exposure to all coarse PM, regardless of location, source of origin, or particle composition.

Similarly, with regard to averaging time, form, and level of the standard, the Administrator takes note of uncertainties in the available evidence and information and continues to find that the current standard, as defined by in all of its elements, is requisite. As an initial matter, the Administrator notes that the current primary PM_{10} standard, with its level of 150 $\mu g/m^3$, 24-hour averaging time, not to be exceeded more than once per year on average over three years, is intended to protect against short-term peak $PM_{10–2.5}$ exposures. In so doing, while the Administrator notes that changes in $PM_{2.5}$ concentrations in ambient air can influence the contribution of the fine and coarse fractions to PM_{10} mass, such that reductions in $PM_{2.5}$ concentrations can lead to more allowable $PM_{10–2.5}$ under the current primary PM_{10} standard, he recognizes that there is no new information available in this reconsideration to suggest that the public health protection provided by the current standard is not requisite or that a more stringent standard is warranted at this time. The Administrator concludes that, particularly in light of his decision to retain the primary 24-hour $PM_{2.5}$ standard with its level of 35 $\mu g/m^3$ as described in section II.B.4 above, the primary PM_{10} standard would be expected to maintain $PM_{10–2.5}$ concentrations in ambient air below those that have been considered to be associated with serious health effects in past NAAQS reviews. The Administrator also notes that while the scientific evidence available in the 2019 ISA has expanded since the completion of the 2009 ISA, he concludes that this information does not provide support for the causal or likely to be causal relationships upon which he places the greatest weight in considering the adequacy of the current standards. He further concludes that the uncertainties and limitations of the scientific evidence, along with the absence of information to inform a quantitative exposure or risk assessment, make it difficult to reach decisions regarding whether a more protective standard is warranted at this time. He has additionally considered the public comments regarding revisions to these elements of the standard and continues to judge that the existing level and the existing form, in all its aspects, together with the other elements of the existing standard provide an appropriate level of public health protection. For all of the reasons discussed above and recognizing the CASAC's conclusion that the current evidence provides support for retaining the current standard, the Administrator concludes that the current primary PM_{10} standard (in all of its elements) is requisite to protect public health with an adequate margin of safety from effects of $PM_{10–2.5}$ in ambient air and should be retained without revision.

C. Decision on the Primary PM_{10} Standard

For the reasons discussed above and considering information and assessments presented in the 2019 ISA and the 2022 PA, the advice from the CASAC, and public comments, the Administrator concludes that the current primary PM_{10} standard is requisite to protect public health with an adequate margin of safety, including the health of at-risk populations, and is retaining the current standard without revision.

IV. Communication of Public Health

A. Air Quality Index Overview

Information about the public health implications of ambient concentrations of criteria pollutants is communicated to the public using the Air Quality Index (AQI) reported on the EPA's AirNow website.[133] The current AQI has been in use since its inception in 1999.[134] It provides useful, timely, and easily understandable information about the daily degree of pollution. The goal of the AQI is to establish a nationally uniform system of indexing pollution concentrations for ozone, carbon monoxide, nitrogen dioxide, PM, and sulfur dioxide. The AQI is recognized internationally as a proven tool to effectively communicate air quality information to the public as demonstrated by the fact that many countries have created similar indices based on the AQI.

The AQI converts an individual pollutant concentration in a community's air to a number on a scale from 0 to 500. Reported AQI values for specific pollutants enable the public to know whether air pollution levels in a particular location are characterized as good (0–50), moderate (51–100), unhealthy for sensitive groups (101–150), unhealthy (151–200), very unhealthy (201–300), or hazardous (301+). Across criteria pollutants, the AQI value of 100 typically corresponds to the level of the short-term (*e.g.,* 24-hour, 8-hour, or 1-hour standard) NAAQS for each pollutant. Below an index value of 100, an intermediate value of 50 is defined either as the level of the annual standard if an annual standard has been established (*e.g.,* $PM_{2.5}$, nitrogen dioxide), a

[133] See *http://www.airnow.gov/.*

[134] In 1976, the EPA established a nationally uniform air quality index, then called the Pollutant Standard Index (PSI), for use by State and local agencies on a voluntary basis (41 FR 37660, September 7, 1976; 52 FR 24634, July 1,1987). In August 1999, the EPA adopted revisions to this air quality index (64 FR 42530, August 4, 1999) and renamed the index the AQI.

concentration equal to one-half the value of the 24-hour standard used to define an index value of 100 (*e.g.,* carbon monoxide), or a concentration based directly on health effects evidence (*e.g.,* ozone). An AQI value greater than 100 means that a pollutant is in one of the unhealthy categories (*i.e.,* unhealthy for sensitive groups, unhealthy, very unhealthy, or hazardous). An AQI value at or below 100 means that a pollutant concentration is in one of the satisfactory categories (*i.e.,* moderate or good). The scientific evidence on pollutant-related health effects for each NAAQS review support decisions related to pollutant concentrations at which to set the various AQI breakpoints, which delineate the AQI categories for each individual pollutant (*i.e.,* the pollutant concentrations corresponding to index values of 150, 200, 300, and 500). The AQI is reported three ways by the EPA and State, local and Tribal agencies, all of which are useful and complementary. The daily AQI is reported for the previous day and used to observe trends in community air quality, the AQI forecast helps people plan their outdoor activities for the next day, and the near-real-time AQI, or NowCast AQI, tells people whether it is a good time for outdoor activity.

Historically, State and local agencies have primarily used the AQI to provide general information to the public about air quality and its relationship to public health. For more than two decades, many State and local agencies, as well as the EPA and other Federal agencies, have been developing new and innovative programs and initiatives to provide more information related to air quality and health messaging to the public in a more timely way. These initiatives, including air quality forecasting, near real-time data reporting through the AirNow website, use of data from air quality sensors on the EPA and U.S. Forest Service's (USFS) Fire and Smoke Map, and air quality action day programs, provide useful, up-to-date, and timely information to the public about air pollution and its health effects. Such information can help the public learn when their well-being may be compromised, so they can take actions to avoid or to reduce exposures to ambient air pollution at concentrations of concern. This information can also encourage the public to take actions that will reduce air pollution on days when concentrations are projected to be of concern to local communities (*e.g.,* air quality action day programs can encourage individuals to drive less or carpool).

B. Air Quality Index Category Breakpoints for $PM_{2.5}$

Recognizing the scientific information available and current AQI reporting practices, the EPA proposed several revisions to the AQI $PM_{2.5}$ breakpoints. EPA solicited and received comments on these proposed revisions. Upon reviewing the information in the proposal and considering the comments received EPA is making final revisions to the AQI category breakpoints for $PM_{2.5}$. This section summarizes the proposed revisions, which can be read in full in the proposal (88 FR 5638, January 27, 2023), significant comments, and final revisions.

1. Summary of Proposed Revisions

One purpose of the AQI is to communicate to the public when air quality is poor and thus when they should consider taking actions to reduce their exposures. The higher the AQI value, the higher the level of air pollution and the greater the health concern. In recognition of the scientific information available that is informing the reconsideration of the 2020 final decision on the primary $PM_{2.5}$ standards, including a number of new controlled human exposure and epidemiologic studies published since the completion of the 2009 ISA, as well as additional epidemiologic studies from other peer reviewed documents that evaluate the health effects of wildfire smoke exposure and that can inform the selection of AQI breakpoints at higher $PM_{2.5}$ concentrations,[135] the EPA proposed to make two sets of changes to the $PM_{2.5}$ sub-index of the AQI. First, the EPA proposed to continue to use the approach used in the revisions to the AQI in 2012 (77 FR 38890, June 29, 2012) of setting the lower breakpoints (50, 100 and 150) to be based on the levels of the primary $PM_{2.5}$ annual and 24-hour standards and proposed to revise the lower breakpoints to be consistent with changes to the primary $PM_{2.5}$ standards that are part of this reconsideration. Second, the EPA proposed to revise the upper AQI breakpoints (200 and above) and to replace the linear-relationship approach used in 1999 to set these breakpoints, with an approach that more fully considers the $PM_{2.5}$ health effects evidence from controlled human exposure and epidemiologic studies that have become available in the last 20 years (64 FR 42530, August 4, 1999).

[135] In evaluating the scientific evidence available to inform decisions regarding the AQI breakpoints, the EPA considered studies that were included as a part of the 2019 ISA and ISA Supplement, but also considered other studies that were not included as a part of the review of the air quality criteria. The ISAs have specific criteria for study inclusion and consideration in reaching conclusions regarding causal relationships, and some studies that may not have met those criteria (*e.g.,* epidemiologic studies that evaluate the health effects of wildfire smoke exposure that would have higher $PM_{2.5}$ concentrations, which are outside of the scope of the ISA) were identified as studies that could be used to inform decisions on the AQI, particularly for the upper breakpoints.

a. Air Quality Index Values of 50, 100 and 150

With respect to the lower AQI breakpoints in the proposal (88 FR 5638, January 27, 2023), the EPA proposed to conclude that it is appropriate to continue setting these breakpoints to be consistent with the primary annual and 24-hour $PM_{2.5}$ standard levels. The lowest AQI value of 50 provides the breakpoint between the ''good'' and ''moderate'' categories. At and below this concentration, air quality is considered ''good'' for everyone. Above this concentration, in the ''moderate'' category, the AQI contains advisories for unusually sensitive individuals. The EPA has historically set this breakpoint at the level of the primary annual $PM_{2.5}$ standard. In doing so, the EPA has recognized that: (1) The annual standard is set to provide protection to the public, including at-risk populations, from $PM_{2.5}$ concentrations, which, when experienced on average for a year, have the potential to result in adverse health effects; and (2) the AQI exposure period represents a shorter exposure period (*e.g.,* 24-hour (or less)) while focusing on the most sensitive individuals. The EPA saw no basis for deviating from this approach in this reconsideration. Thus, the EPA proposed to set the AQI value of 50 at a daily (*i.e.,* 24-hour) average concentration equal to the level of the primary annual $PM_{2.5}$ standard that is promulgated.

The historical approach to setting an AQI value of 100, which is the breakpoint between the ''moderate'' and ''unhealthy for sensitive groups'' categories, and above which advisories are generated for sensitive groups, is to set it at the same level as the primary 24-hour $PM_{2.5}$ standard. In so doing, the EPA has recognized that the primary 24-hour $PM_{2.5}$ standard is set to provide protection to the public, including at-risk populations, from short-term exposures to $PM_{2.5}$ concentrations that have the potential to result in adverse health effects. Given this, it is appropriate to generate advisories for sensitive groups at concentrations above this level. In the past, State, local, and Tribal air quality agencies have expressed strong support for this approach (78 FR 3086, January 15, 2013). The EPA saw no basis to deviate

from this approach in this reconsideration. In the proposal (88 FR 5638, January 27, 2023), the EPA proposed to retain the current primary 24-hour $PM_{2.5}$ standard with its level of 35 μg/m³ but took comment on revising the level of that standard to 25 μg/m³ (section II.D.3.b). Thus, the EPA proposed to retain the AQI value of 100 set at the level of the current primary 24-hour $PM_{2.5}$ standard concentration of 35 μg/m³ (*i.e.,* 24-hour average).

With respect to an AQI value of 150, which is the breakpoint between the ''unhealthy for sensitive groups'' and ''unhealthy categories,'' this breakpoint concentration in this reconsideration is based upon the considering the same health effects information, as assessed in the 2019 ISA and ISA Supplement and described in section II above, that informs the proposed decisions on the level of the 24-hour standard and the AQI value of 100. Previously, the Agency has used a proportional adjustment in which the AQI value of 150 was set proportionally to the AQI value of 100. This proportional adjustment inherently recognizes that the available epidemiologic studies provide no evidence of discernible thresholds, below which effects do not occur in either sensitive groups or in the general population, that could inform conclusions regarding concentrations at which to set this breakpoint. Given that the epidemiologic evidence continues to be the most relevant health effects evidence for informing this range of AQI values, the EPA saw no basis to deviate from this approach in this reconsideration. Therefore, the EPA proposed to set an AQI value of 150 proportionally, depending on the breakpoint concentration of the AQI value of 100 (*i.e.,* 55.4 for a 24-hour standard of 35 μg/m³).

b. Air Quality Index Values of 200 and Above

In the proposal (88 FR 5639, January 27, 2023), the EPA summarized the history of setting the AQI values of 300 and above in the 1999 rule (64 FR 42530, August 4, 1999) and established breakpoints for $PM_{2.5}$ in that range. In general, the AQI values between 100 and 500 were based on $PM_{2.5}$ concentrations that generally reflected a linear relationship between increasing index values and increasing $PM_{2.5}$ concentrations.[136] It was found that this linear relationship was generally consistent with the health effects evidence, which suggested that as $PM_{2.5}$ concentrations increase, increasingly larger numbers of people are likely to experience serious health effects in this range of $PM_{2.5}$ concentrations (64 FR 42536, August 4, 1999). For the AQI breakpoint of 500, the concentration was based on the method used to establish a previously existing PM_{10} breakpoint that was informed by studies conducted in London using the British Smoke method, which uses a different particle size cutpoint as noted in the proposal (88 FR 5639, January 27, 2023). Due to limited ambient $PM_{2.5}$ monitoring data available at that time, the decision on the 500 value concentration for $PM_{2.5}$ was based on the stated assumption that PM concentrations measured by the British Smoke method were approximately equivalent to $PM_{2.5}$ concentrations (64 FR 42530, August 4, 1999). Given that the British Smoke method has a larger particle size cutpoint than the current $PM_{2.5}$ monitoring method, which has a cutpoint of 2.5 microns, a concentration of 500 μg/m³ based on the British Smoke method would be equivalent to a lower $PM_{2.5}$ concentration. With respect to the upper breakpoints of the AQI, the EPA has historically been concerned about establishing these upper breakpoints using evidence based on larger size fractions of PM, given that $PM_{2.5}$ is the indicator for the AQI. While monitoring data for higher $PM_{2.5}$ concentrations in ambient air has been available for many years, the health effects evidence has only recently become available for consideration in informing decisions on the upper breakpoints of the AQI.

As part of this reconsideration, the EPA recognized that the health effects evidence associated with $PM_{2.5}$ exposure has greatly expanded in recent years. Multiple controlled human exposure studies have become available that provide information about health effects across a range of concentrations. While many of the new studies evaluated in the 2019 ISA focused on examining health effects associated with exposure to lower $PM_{2.5}$ concentrations, there are also several new controlled human exposure studies that provide information about the health effects observed in study participants at concentrations well above the standard levels. Additionally, there are also epidemiologic studies now available and evaluated in other Agency peer-reviewed documents that can inform health effects associated with higher $PM_{2.5}$ concentrations (U.S. EPA, 2021b).[137] Thus, the EPA concluded that it is appropriate to reevaluate the upper AQI breakpoints, taking into account the expanded body of scientific evidence, particularly given several new epidemiologic studies conducted during high pollution events like wildfires and multiple controlled human exposure studies. While it remains unclear the exact $PM_{2.5}$ concentrations at which specific health effects occur, the more recent studies do provide more refined information about the concentration range in which these effects might occur in some populations. These studies provide support for coherence of effects across scientific disciplines and potentially biologically plausible pathways for the overt population-level health effects observed in epidemiologic studies. Therefore, taking into account the short exposure time period in these studies (*e.g.,* 1–6 hours) and that the studies generally do not include at-risk (or sensitive) populations, but rather young, healthy adults, these studies, in conjunction with information from epidemiologic studies, the EPA preliminarily concluded it would be appropriate to be more cautionary and offer advisories to the public for reducing exposures at lower concentrations than recommended with the current AQI breakpoints.

The AQI value of 200 is the breakpoint between the ''unhealthy'' and ''very unhealthy'' categories. At AQI values above 200, the AQI would be providing a health warning that the risk of anyone experiencing a health effect following short-term exposures to these $PM_{2.5}$ concentrations has increased. To inform proposed decisions on this breakpoint, the EPA takes note of studies indicating the potential for respiratory or cardiovascular effects that are on their own representative of or are on the biologically plausible pathway to more serious health outcomes (*e.g.,* emergency department visits, hospital admissions). The controlled human exposure studies evaluated in the 2009 and 2019 ISAs provide evidence of inflammation as well as cardiovascular effects in healthy subjects at and above 120 μg/m³. For example, Ramanathan et al. (2016) observed a transient reduction in antioxidant/anti-inflammatory function after exposing healthy young subjects to a mean concentration of 150 μg/m³ of $PM_{2.5}$ for 2 hours. Urch et al.

[136] The AQI breakpoint at 150 was originally set in 1999 to be linearly related to the concentrations at the 100 and 500 breakpoints but then revised in 2012 to be proportional to the AQI breakpoint concentration at 100 (78 FR 3181, January 15, 2013).

[137] In this reconsideration, the controlled human exposure studies were evaluated in the 2019 ISA, whereas the epidemiologic studies of wildfire smoke exposures were included in the EPA Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. (U.S. EPA 2021b).

(2010) also reported increased markers of inflammation when exposing both asthmatic and non-asthmatic subjects to a mean concentration of 140 μg/m^3 of $PM_{2.5}$ for 3 hours. In studies specifically examining cardiovascular effects, Ghio et al. (2000) and Ghio et al. (2003) exposed healthy subjects to a mean concentration of 120 μg/m^3 for 2 hours and reported significantly increased levels of fibrinogen, a marker of coagulation that increases during inflammation. Sivagangabalan et al. (2011) exposed healthy subjects to a mean concentration of 150 μg/m^3 of $PM_{2.5}$ for 2 hours and noted an increased QT interval (3.4 ± 1.4) indicating some evidence for conduction abnormalities, an indicator of possible arrhythmias. Lastly, Brook et al. (2009) reported a transient increase of 2.9 mm Hg in diastolic blood pressure in healthy subjects during the 2-hour exposure to a mean concentration of 148 μg/m^3 of $PM_{2.5}$.

In addition to epidemiologic studies evaluated in the 2019 ISA that analyzed exposures at ambient $PM_{2.5}$ concentrations, there are a number of recent epidemiologic studies focusing on wildfire smoke that have become available that were evaluated in the EPA's recently released peer-reviewed assessment on wildland fire (U.S. EPA, 2021b). One of these studies, Hutchinson et al. (2018), conducted a bidirectional case-crossover analysis to examine associations between wildfire-specific $PM_{2.5}$ exposure and respiratory-related healthcare encounters (*i.e.,* ED visits, inpatient hospital admissions, and outpatient visits) prior and during the 2007 San Diego wildfires. This study found positive and significant associations to $PM_{2.5}$ exposures and respiratory-related healthcare encounters. Further, during the initial 5-day period of the wildfire event, the study observed that there was evidence of increases in a number of respiratory-related outcomes particularly ED visits for asthma, upper respiratory infection, respiratory symptoms, acute bronchitis, and all respiratory-related visits (Hutchinson et al., 2018). When examining the air quality during the wildfire event, $PM_{2.5}$ concentrations were highest during the initial five days of the wildfire, with 24-hour average $PM_{2.5}$ concentrations of 89.1 μg/m^3 across all zip codes and with the highest 24-hour average of 160 μg/m^3 on the first day (Hutchinson et al., 2018).

When considering this collective body of evidence from controlled human exposure and epidemiologic studies, the Agency proposed to set an AQI value of 200 at a daily (*i.e.,* 24-hour average) concentration of $PM_{2.5}$ of 125 μg/m^3. As discussed above and in the proposal (88 FR 5640, January 27, 2023), this concentration is at the lower end of the concentrations consistently shown to be associated with respiratory and cardiovascular effects in controlled human exposure studies following short-term exposures (*e.g.,* 2–3 hours) and in young, healthy adults (Ghio et al., 2000; Ghio et al., 2003; Urch et al., 2010; Ramanathan et al., 2016; Sivagangabalan et al., 2011; and Brook et al., 2009) and also within the range of 5-day average and maximum concentrations observed to be associated with respiratory-related outcomes following exposure to wildfire smoke (Hutchinson et al., 2018).

The AQI value of 300 denotes the breakpoint between the ''very unhealthy'' and ''hazardous'' categories, and thus marks the beginning of the ''hazardous'' AQI category. At AQI values above 300, the AQI provides a health warning that everyone is likely to experience effects following short-term exposures to these $PM_{2.5}$ concentrations. To inform decisions on this AQI breakpoint, the EPA takes note of controlled human exposure studies that consistently show subclinical effects which are often associated with more severe cardiovascular outcomes. As discussed above, Brook et al. (2009) reported a transient increase of 2.9 mm Hg in diastolic blood pressure in healthy subjects during the 2-hour exposure to a mean concentration of 148 μg/m^3 of $PM_{2.5}$. Bellavia et al. (2013) exposed healthy subjects to an average $PM_{2.5}$ concentration of 242 μg/m^3 for 2 hours and reported increased systolic blood pressure (2.53 mm Hg). Tong et al. (2015) exposed healthy subjects to an average $PM_{2.5}$ concentration of 253 μg/m^3 for 2 hours and observed a significant increase in diastolic blood pressure (2.1 mm Hg) and a nonsignificant increase in systolic blood pressure (2.5 mm Hg). Lucking et al. (2011) reported impaired vascular function and increased potential for coagulation when exposing healthy subjects to diesel exhaust (DE) with an average $PM_{2.5}$ concentration of 320 μg/m^3 for a duration of 1 hour.[138] These studies all provided evidence of impaired vascular function, including vasodilatation impairment and increased thrombus formation, with Tong et al. (2015), Bellavia et al. (2013), Brook et al. (2009) all reporting increases in blood pressure. Additionally, Behbod et al. (2013) reported increased inflammatory markers following a 2-hour exposure to an average $PM_{2.5}$ concentration of 250 μg/m^3 in healthy subjects.

In addition to the controlled human exposure studies discussed above, the epidemiologic study conducted by DeFlorio-Barker et al. (2019) examined the relationship between wildfire smoke and cardiopulmonary hospitalizations among adults 65 years of age and older from 2008–2010 in 692 U.S. counties. The authors reported a 2.22% increase in all-cause respiratory hospitalizations on wildfire smoke days for a 10 μg/m^3 increase in 24-hour average $PM_{2.5}$ concentrations (DeFlorio-Barker et al., 2019). The maximum 24-hour average concentration in this study on wildfire smoke days was 212.5 μg/m^3 (DeFlorio-Barker et al., 2019). In considering this study, the EPA notes the increased probability that even healthy adults experience effects at this maximum exposure concentration, particularly given that this maximum concentration is near the exposure concentrations in controlled human exposure studies that consistently reported evidence of impaired vascular function and several that reported increases in blood pressure in healthy adults following 2-hour exposures.

Based on the information discussed above and in the proposal (88 FR 5640, January 27, 2023), the EPA proposed to revise the 300 level of the AQI, which marks the beginning of the ''hazardous'' AQI category, to a concentration that is consistent with the $PM_{2.5}$ concentrations associated with health effects as reported in the controlled human exposure (Brook et al., 2009; Bellavia et al., 2013; Tong et al., 2015; Behbod et al., 2013) and epidemiologic studies (DeFlorio-Barker et al. (2019). Specifically, the Agency proposed to set an AQI value of 300 at a daily (*i.e.,* 24-hour average) $PM_{2.5}$ concentration of 225 μg/m^3. This concentration falls between the 2-hour average concentrations reported in controlled human exposure studies found to be consistently associated, in healthy adults, with impaired vascular function and/or increases in blood pressure, which could both be a precursor to more severe cardiovascular effects following short-term (1- to 2-hour) exposures, and the maximum 24-hour average $PM_{2.5}$ concentrations on wildfire smoke days reported in the epidemiologic study conducted by DeFlorio-Barker et al. (2019).

[138] Although participants in Lucking et al. (2011) were exposed to diesel exhaust (DE), the authors also conducted analyses using a particle trap, and as noted in the 2019 ISA, this type of study design allows for the assessment of the role of $PM_{2.5}$ on the health effects observed by removing PM from the DE mixture.

c. Air Quality Index Value of 500

Lastly, the EPA also proposed revisions to the 500 value of the AQI. The 500 value of the AQI is within the ''hazardous'' category but is specified and used to calculate the slope of the AQI values in the ''hazardous category'' above and below AQI values of 500. In the past, this breakpoint had a very prominent role in determining the current upper AQI values given that it was used as part of the linear relationship with the concentration at the AQI value of 100 to determine the AQI values of 200 and 300 in 1999 (64 FR 42530, August 4, 1999).

As discussed above and in the proposal (88 FR 5641, January 27, 2023), the current breakpoint concentration for the 500 value of the AQI was set in 1999 at a 24-hour average $PM_{2.5}$ concentration of 500 μg/m³ and was based on studies conducted in London using the British Smoke method, which used a different particle size cutpoint and likely overestimated the $PM_{2.5}$ concentration. In looking to improve upon that approach, the EPA considered several recent controlled human exposure studies that observe health effects that are on the biologically plausible pathway to more severe cardiovascular outcomes and note that these seem to follow exposures to high $PM_{2.5}$ concentrations that are well above those typically observed in ambient air. More specifically, in controlled human exposure studies, Vieira et al. (2016a) and Vieira et al. (2016b) exposed healthy subjects and subjects with heart failure to diesel exhaust (DE) with a mean $PM_{2.5}$ concentration of 325 μg/m³ for 21 minutes and reported decreased stroke volume, and increased arterial stiffness (an indicator of endothelial dysfunction) in both healthy and heart failure subjects.[139] Also as summarized above and discussed in the proposal (88 FR 5641, January 27, 2023), Lucking et al. (2011) exposed healthy subjects to DE with a mean $PM_{2.5}$ concentration of 320 μg/m³ for 1 hour.[140] Epidemiologic studies have linked the types of cardiovascular effects observed in these controlled human exposure studies with the exacerbation of ischemic heart disease (IHD) and heart failure as well as myocardial infarction (MI) and stroke.

In addition to the controlled human exposure studies discussed in the proposal (88 FR 5641, January 27, 2023) and summarized above, recent epidemiologic studies examining the relationship between concentrations of $PM_{2.5}$ during wildfires and respiratory health also informed the proposed decisions on the concentration for the AQI value of 500. As discussed in the proposal (88 FR 5641, January 27, 2023) and summarized earlier in this section, Hutchinson et al. (2018) reported increases in a number of respiratory-related ED visits for asthma, upper respiratory infection, respiratory symptoms, acute bronchitis, and all combined respiratory-related visits based on data from Medi-Cal claims for emergency department presentations, inpatient hospitalizations, and outpatient visits during the initial 5-day period of the 2007 San Diego fire. During the initial 5-day window, $PM_{2.5}$ concentrations were found to be at their highest with the 95th percentile of 24-hour average concentrations of 333 μg/m³.

Although studies of short-term (*i.e.,* daily) exposures to wildfire smoke are more informative in considering alternative level for the AQI value of 500 since they mirror the 24-hour exposure timeframe, additional information from epidemiologic studies of longer-term exposures (*i.e.,* over many weeks) during wildfire events can provide supporting information. As discussed in the proposal (88 FR 5641, January 27, 2023) and summarized here, Orr et al. (2020) conducted a longitudinal study that reported exposure to wildfire smoke from a multi-month fire resulted in reduced lung function in subsequent years and concluded that exposure to high $PM_{2.5}$ concentrations during a multi-week fire event may lead to health consequences, such as declines in lung function. During the 2017 wildfire event (August 1 to September 19, 2017), Orr et al. (2020) reported that many days during the multi-month fire had $PM_{2.5}$ concentrations above 300 μg/m³, resulting in a daily average $PM_{2.5}$ concentration of 220.9 μg/m³ with a maximum $PM_{2.5}$ concentration of 638 μg/m³.

The controlled human exposure studies provide biological plausibility for results of epidemiologic studies that document increases in respiratory-related health care events during the wildfires. The collective evidence from controlled human exposure and epidemiologic studies, which includes decreases in stroke volume, increased arterial stiffness, impaired vascular function and respiratory-related healthcare encounters provide health-based evidence that informed the proposed decisions on the level of the AQI value of 500. Given the concentrations observed in these studies, the Agency proposed to revise the AQI value of 500 to a level set at a daily (*i.e.,* 24-hour average) $PM_{2.5}$ concentration of 325 μg/m³. This concentration is at or below the lowest concentrations observed in the controlled human exposure studies associated with more severe effects discussed above and also at the low end of the daily concentrations observed in the epidemiologic studies conducted by Hutchinson et al. (2018) and Orr et al. (2020).

Table 1 below summarizes the proposed breakpoints for the $PM_{2.5}$ sub-index.

TABLE 1—PROPOSED BREAKPOINTS FOR $PM_{2.5}$ SUB-INDEX

AQI category	Index values	Proposed breakpoints (μg/m³, 24-hour average)
Good	0–50	0.0–(9.0–10.0)
Moderate	51–100	(9.1–10.1)–35.4
Unhealthy for Sensitive Groups	101–150	35.5–55.4
Unhealthy	151–200	55.5–125.4
Very Unhealthy	201–300	125.5–225.4

[139] These effects were attenuated when the DE was filtered, to reduce $PM_{2.5}$ concentrations, indicating the effects were likely associated with $PM_{2.5}$ exposure.

[140] When applying a particle trap, $PM_{2.5}$ concentrations were reduced, and effects associated with cardiovascular function including impaired vascular function, as measured by vasodilatation and thrombus formation were attenuated indicating associations with $PM_{2.5}$.

TABLE 1—PROPOSED BREAKPOINTS FOR $PM_{2.5}$ SUB-INDEX—Continued

AQI category	Index values	Proposed breakpoints ($\mu g/m^3$, 24-hour average)
Hazardous [1]	301+	225.5

[1] AQI values between breakpoints are calculated using equation 1 in appendix G. For AQI values in the hazardous category, AQI values greater than 500 should be calculated using equation 1 and the $PM_{2.5}$ concentration specified for the AQI value of 500.

2. Summary of Significant Comments on Proposed Revisions

The EPA received many comments on the proposed changes to the $PM_{2.5}$ AQI breakpoints. Many commenters generally supported all the proposed revisions to the AQI breakpoints based on the revisions to the primary annual and daily $PM_{2.5}$ standards and recent scientific evidence discussed in the proposal (88 FR 5558, January 27, 2023). However, we received specific comments on proposed revisions to the breakpoints in the lower end of the AQI, related to their linkage to the annual and daily $PM_{2.5}$ standards, and proposed revisions to the breakpoints at the upper end of the AQI, based on EPA's interpretation of available health effects evidence.

a. Air Quality Index Values of 50, 100, and 150

Some commenters agreed with using the historical approach of setting the 50, 100 and 150 breakpoints of the AQI to be consistent with the primary $PM_{2.5}$ standards. Some cited the reason that this approach creates consistent communication with respect to air quality and the standards, and this is how the other AQI sub-indices are set. A few commenters disagreed with the historical approach and suggested instead that the 50 breakpoint of the AQI should not be revised at all, or that the 50 and 100 breakpoints of the AQI should be supported directly by health data similar to the basis for the proposed 200, 300 and 500 breakpoints.

The few commenters that disagreed with the historical approach of the 50 breakpoint of the AQI noted that setting a short-term breakpoint to annual standard was not logical since it is a long-term standard and not meant to be interpreted for short-term messaging with the AQI, in particular when reported hourly via the NowCast. These commenters also noted that additional studies are needed to identify the health impacts of short-term exposures at low concentrations. They also noted that lowering the 50 breakpoint of the AQI in conjunction with the annual standard may cause confusion with the public because some State programs and policy decisions are connected to the AQI while others are based on PM concentrations, which could lead to inconsistent messaging reducing the public's trust. These comments were supported by noting that revised breakpoints could lead to more moderate days than in the past, but the monitor values would be the same as before when the commenters considered it ''healthy,'' possibly eroding trust in air agencies' messaging. Commenters also noted if the breakpoints are revised, the public will not visually be able to detect the difference between what was considered a good AQI day versus a now moderate AQI day.

The EPA disagrees with these commenters. With respect to setting a short-term breakpoint to the level of a much longer-term (annual) standard, setting the lower AQI breakpoints at the level of the annual and daily $PM_{2.5}$ standards for communication purposes was discussed in the proposed reconsideration (88 FR 5558, January 27, 2023) and previously supported by State organizations in the 2012 PM Final Rule (77 FR 38890, June 29, 2012). Both the AQI and the Pollutant Standards Index, which came before it, have historically been normalized across pollutants by defining an index value of 50 and 100 as the numerical level of the annual (when defined) and short-term (*i.e.,* averaging time of 24-hours or less) primary NAAQS for each pollutant. This approach clearly communicates the air quality to the public. The EPA considers this approach to be appropriate given the available evidence and structure of the standard. As discussed in section II.B above and in the notice of final rulemaking for the 2012 review (77 FR 38890, June 29, 2012), the primary annual and 24-hour $PM_{2.5}$ standards work together in concert to provide public health protection. The annual $PM_{2.5}$ standard is generally viewed as the principal means of providing public health protection against ''typical'' daily and annual $PM_{2.5}$ exposures, while the 24-hour $PM_{2.5}$ standard is generally viewed as a means of providing protection against short-term exposures to ''peak'' $PM_{2.5}$ concentrations, such as can occur in areas with strong contributions from local or seasonal sources, even when annual average $PM_{2.5}$ concentrations remain relatively low. Because the annual standard provides public health protection for typical daily $PM_{2.5}$ exposures, the EPA thinks it is appropriate to use that level for the 50 breakpoint of the AQI and describe daily air quality at and below the level of the annual standard ''Good.'' Since an annual standard allows for days with air quality above that level, it is appropriate to call days just above it ''Moderate.'' If the 50 breakpoint of the AQI was set at a level above the annual standard, it would be possible for the majority of days to be called ''good'' in a year when an area exceeds the annual standard. This could cause confusion with the public about air quality if the general perception is that local air quality is ''good,'' but the area fails to meet the annual standard. In addition, the EPA continues to find it appropriate to use the NowCast with the $PM_{2.5}$ AQI index to provide more real-time information to the public. As discussed in the AQI Technical Assistance Document, while the NowCast algorithm is approximating a 24-hour average exposure, it can reflect concentrations observed over shorter averaging times when air quality is changing rapidly (U.S. EPA, 2018a). The EPA continues to consider the use of the primary annual standard level suitable in the NowCast given the health evidence supporting the standard and given that the reported concentrations are an approximation of ''typical'' daily exposure. Additionally, the EPA reflects the nature of the NowCast in the associated health messaging.

With regard to the commenter stating the public may not be able to visually detect a difference in the air quality, the EPA notes that the AQI is intended to be a communication tool for public awareness precisely because it is generally difficult for the public to visually judge air quality risks when air pollution is ''moderate.'' Moreover, since the establishment of the AQI, the EPA and State and local air agencies and organizations have developed experience in educating the public about changes in the standards and,

concurrently, related changes to AQI breakpoints and advisories. When the standards change, the EPA and State and local agencies have sought to help the public understand that air quality is not getting worse, it's that the health evidence underlying the standards and the AQI has changed. The EPA's Air Quality System (AQS), the primary repository for air quality monitoring data, is also adjusted to reflect the revised breakpoints. Specifically, all historical AQI values in AQS are recomputed with the revised breakpoints, so that all data queries and reports downstream of AQS will show appropriate trends in AQI values over time. If any State, local or Tribal air agency is concerned that people are or will be confused on a moderate AQI day, then they could use the communication information that has been developed with this rulemaking.

Some commenters stated that the AQI should not necessarily be linked to the primary $PM_{2.5}$ standards. One example is the comment that if the annual standard is not lowered to 8 μg/m³, the EPA should lower the 50 breakpoint of the AQI to that level to better inform the public of the need for behavioral modifications to reduce the harm to health from $PM_{2.5}$ exposure. Similar to the reasons discussed above, the EPA concludes that setting the 50 breakpoint of the AQI at the level of the annual $PM_{2.5}$ standard is appropriate from a health perspective and for communication purposes. The Administrator has judged the primary annual standard (in conjunction with the other primary standards) as revised in this final action to be requisite to protect public health with an adequate margin of safety, based on the health evidence discussed in section II.A.2. Setting the 50 breakpoint lower than the annual standard also has the potential to cause confusion with the public since it does not reflect the standards and the Administrator's judgments about the standards as well.

With regard to the 100 breakpoint of the AQI, several commenters expressed the view that the level of the 24-hour $PM_{2.5}$ standard and an AQI value of 100 should be set at 25 μg/m³ based on the body of evidence and lower end of the range recommended by CASAC. These commenters noted that if the current 24-hour standard and AQI value of 100 is retained at 35 μg/m³ then the public will not be able to make informed decisions about actions to take to protect their health. Many of these commenters further recommended that the AQI value of 100 should be lowered to 25 μg/m³ even if the standard is retained. Commenters expressed the view that this would more adequately allow the public to take health-protective actions.

The EPA disagrees with these commenters and notes that many State, Tribal and local air agencies have expressed strong support for aligning the 100 breakpoint of the AQI with the short-term 24-hour primary $PM_{2.5}$ standards as discussed in the proposal (88 FR 5558, January 27, 2023). The EPA agrees with the view, expressed by State, local and Tribal entities, that aligning the lower breakpoints with the standards enables clear communication of the standards. This alignment approach is also utilized in the other AQI sub-indices lower breakpoints and taking a different approach with the $PM_{2.5}$ AQI could cause confusion. Additionally, the Administrator has judged that it is appropriate to retain the 24-hour standard at a level of 35 μg/m³ (in conjunction with the other primary standards) to protect public health with an adequate margin of safety, based on the health evidence discussed in section II.A.2. Thus, EPA disagrees that it is necessary or appropriate to set the 100 breakpoint at a lower concentration to provide further information to the public. The 50 breakpoint, which is set at a level below 25 μg/m³, will continue to provide information to members of the public particularly concerned about exposures to $PM_{2.5}$. As with the 50 breakpoint, aligning the breakpoint with the standard both reflects the Administrator's judgment about the health risks and eliminates the potential to cause confusion in the public about those risks.

b. Air Quality Index Values of 200 and Above

Some commenters supported the proposed revisions to the 200, 300 and 500 breakpoints that recognize the expanded body of scientific evidence, particularly several new epidemiologic studies conducted during high pollution events such as wildfires and multiple controlled human exposure studies. A few commenters agreed with incorporating the expanded body of scientific evidence into the 200, 300 and 500 breakpoints, but suggested a modified linear approach between 200 (115 μg/m³) and 500 (312 μg/m³, setting the 300 breakpoint to 187 μg/m³) based on recent epidemiologic wildfire smoke studies.

Other commenters disagreed with the proposed revisions and suggested the EPA should continue using the previous breakpoints that follow the 1999 linear approach (64 FR 42530, August 4, 1999), because not changing the breakpoints would simplify communications. A few commenters stated the proposed revisions to the AQI upper breakpoints are not justified because the scientific evidence supporting the revisions is inadequate. To support this view, the commenters suggest that only three epidemiologic studies were used in determining the upper breakpoints and none of them were representative of potential effects in the general public; of the 13 studies cited only three were near the proposed revised breakpoints; four of the studies involved exposure to PM from diesel and traffic pollution, which is different than PM from wildfire smoke; and the data supporting the revisions only indicated ''mild'' health effects that were mostly in sensitive populations.

The EPA agrees with the majority of commenters that supported utilizing the expanded body of scientific evidence to revise the 200, 300 and 500 breakpoints of the AQI. The EPA appreciates the suggestion of using a revised linear approach from 200 to 500. But rather than using the available evidence to only set the breakpoint of 500, the EPA finds it appropriate to set the breakpoints for 200, 300 and 500 using an evidence-based approach, by relying on information presented in both controlled human exposure studies and epidemiologic studies that examine relationships between high $PM_{2.5}$ exposure episodes (*i.e.,* periods of wildfire smoke) and various health outcomes. Setting these breakpoints based directly on health effects evidence, which can be communicated, is more useful and appropriate than using a linear approach, because it can better describe the potential health effects and symptoms which also helps the public better understand why more health protective actions are needed. By its nature, a linear approach does not evaluate and identify associated health effects and risk factors.

The EPA disagrees with the commenters that expressed the view that these upper breakpoints should not be revised based largely on the numerous peer-reviewed studies published since the 200, 300 and 500 breakpoints were originally established in 1999 (64 FR 42530, August 4, 1999). As discussed in the proposal (88 FR 5641, January 27, 2023), the rationale behind the proposed revisions is rooted in the fact the upper AQI breakpoints are based on outdated scientific evidence. Specifically, the traditional linear approach was predicated on the 500 value of the AQI, which was estimated using health studies that used the British Smoke Method. The British Smoke Method is based on a particle size fraction (4.5 microns) that is larger

than $PM_{2.5}$. Given that the British Smoke method has a larger particle size cutpoint than the current $PM_{2.5}$ monitoring method, which has a cutpoint of 2.5 microns, a concentration of 500 μg/m^3 based on the British Smoke method would be equivalent to a lower $PM_{2.5}$ concentration (88 FR 5641, January 27, 2023). The combination of a larger particle size fraction informing previous decisions around upper AQI breakpoints and more recent scientific evidence than the London Fog Episode, on the potential health consequences of what we currently consider to be high $PM_{2.5}$ exposures, provides the underlying basis for revising the upper breakpoints to better inform the public about air quality to allow the public to take health protective actions as appropriate. Moreover, as discussed above, until recently there was limited information upon which to base the breakpoints between 150 and 500, so the linear approach was a reasonable substitute. While not changing the breakpoints may be easier because there is no change to communicate, using a health-based approach is more appropriate, because it helps the public better understand that more health protective actions are needed.

The Agency disagrees that the scientific evidence discussed in the proposal is inadequate to revise the 200, 300 and 500 breakpoints of the AQI (88 FR 5640, January 27, 2023). The EPA disagrees that these studies should not be considered because they ''indicated mild health effects in sensitive populations.'' The EPA notes that many of the subclinical effects discussed in the proposal (88 FR 5640, January 27, 2023) that informed the breakpoints are on the biologically plausible pathway (see 2019 ISA, section 6.1.1 and Figure 6–1) to more severe cardiovascular outcomes, such as ED visits, hospital admissions, and death as depicted in the large number of epidemiologic studies evaluated in the 2019 ISA and ISA Supplement. From a public health perspective, the purpose of the AQI is to inform the public when air quality could adversely affect their health. The scientific evidence informed revisions to the breakpoints at the upper end of the AQI allow it to better reflect the risk of experiencing health effects at higher $PM_{2.5}$ concentrations. In addition, the EPA disagrees with the commenter that the effects reported at these higher concentrations were observed only in sensitive populations as these effects were also reported in healthy populations (Ghio et al., 2000; Ghio et al., 2003; Urch et al., 2010; Ramanathan et al., 2016; Sivagangabalan et al., 2011; Brook et al., 2009; Bellavia et al. (2013); Tong et al. (2015); Behbod et al. (2013); Vieira et al. (2016a) Vieira et al. (2016b); and Lucking et al. (2011)).

c. Other Comments

The EPA received a few additional comments on elements of the $PM_{2.5}$ AQI, including the averaging time. Some commenters expressed the view that the 24-hour averaging time was not useful when informing the public how to protect their health, particularly during rapidly changing conditions such as wildfire smoke events. Instead, they suggested a subdaily averaging time of 1–3 hours would be more effective because it more closely aligns with how people breathe.

A few of these commenters suggested that instead of changing the AQI averaging time, which aligns with the short-term standard, the EPA could create a public health warning system for unhealthy $PM_{2.5}$ levels. The commenters noted that aligning the AQI averaging time with the short-term standard could be useful for consistent communication with the standards and attainment but suggested that a subdaily warning system could better allow the public to take health protective actions.

The EPA disagrees that a shorter averaging period for the $PM_{2.5}$ AQI sub-index would be better. The health effects evidence supporting a subdaily metric is limited and inconsistent. As part of its review of the health effects evidence, the 2019 ISA evaluated whether a subdaily metric would be more closely related to health effects. Most epidemiologic studies that examined the relationship between short-term $PM_{2.5}$ exposures and health effects evaluated an exposure metric averaged over 24-hours. Some recent studies, focusing on respiratory and cardiovascular effects and mortality, have examined whether there is evidence that subdaily exposure metrics are more closely related to health effects than a traditional 24-hour average metric. After evaluating this limited newer evidence, the 2019 ISA concluded that ''collectively, the available evidence does not indicate that subdaily averaging periods for $PM_{2.5}$ are more closely associated with health effects than the 24-hour avg exposure metric,'' (2019 ISA, chapter 1, section 1.5.2.1, pp. 146–147; U.S. EPA, 2022a).

In addition, there are communication benefits to aligning the averaging time of the AQI with the daily standard, as some of these commenters note, such as providing consistent messages about when it may be beneficial for people to take actions to reduce $PM_{2.5}$ exposures. Furthermore, with regard to an additional warning system, the EPA is concerned that having two air quality communication systems operating at the same time would likely be confusing to the public and reduce the effectiveness of the systems.

At the same time, the EPA recognizes that when air quality is rapidly changing, such as during wildfire smoke events, reporting information based on a 24-hour metric may not be as useful for the public as reporting more frequently would be. The EPA has balanced concerns about being able to provide timely communication of air quality hazards when conditions are changing quickly with the goal of limiting the number of air quality communications systems and its judgment that the evidence supports a 24-hour-based metric linked to the daily standard by establishing the NowCast, which takes into consideration subdaily $PM_{2.5}$ concentrations and provides a near real-time AQI value based on the AQI colors and scale. Specifically, the NowCast shows air quality conditions for the most current hour of $PM_{2.5}$ data available by using a calculation that involves multiple hours of past data. As noted in the AQI Technical Assistance Document, the NowCast currently uses longer averages during periods of stable air quality and shorter averages (down to a 3-hour average) when air quality is changing rapidly, such as during a wildfire (U.S. EPA, 2018a). As discussed further in section IV.D.2 of this notice, the EPA uses the NowCast to approximate the complete daily AQI (24-hour average) during any given hour. This means the subdaily NowCast is approximating a 24-hour average exposure, which aligns with the health evidence and the existing AQI communications network, while also being capable of communicating rapidly changing conditions to the public.

3. Summary of Final Revisions

Upon reviewing and considering the comments on the proposed revisions (summarized above in Section IV.C) along with the scientific evidence outlined in the proposal (88 FR 5639, January 27, 2023) and summarized above in section IV.A, the EPA is finalizing the proposed changes to the AQI.

Thus, as discussed in section IV of the preamble (88 FR 5639, January 27, 2023) to the proposed rule, the EPA is taking final action to revise the AQI value of 50 to 9.0 μg/m^3, 24-hour average, consistent with the final decision on the primary annual $PM_{2.5}$ standard level as summarized in section II.C of the

preamble to the final rule; retain the AQI value of 100 at 35 μg/m^3, 24-hour average, consistent with the final decision on the primary 24-hour $PM_{2.5}$ standard level as summarized in section II.C of the preamble to the final rule; and retain the AQI value of 150 at 55 μg/m^3, 24-hour average. The EPA is also taking action to revise the AQI value of 200 to 125 μg/m^3, 24-hour average; 300 to 225 μg/m^3, 24-hour average; and 500 to 325 μg/m^3, 24-hour average, consistent with the rationale discussed above and the health evidence discussed in section IV of the preamble (88 FR 5639, January 27, 2023) to the proposed rule. The EPA has prepared communications materials to assist States with adjusting to the revised AQI and looks forward to working with, and learning from the experiences of, State, local, and Tribal governments in implementing these changes.

C. Air Quality Index Category Breakpoints for PM_{10}

The EPA proposed to retain the PM_{10} sub-index of the AQI consistent with the proposed decision to retain the primary PM_{10} standard, and consistent with the health effects information that supports this proposed decision, as discussed in section III.D of the proposal (88 FR 5632, January 27, 2023). EPA did not receive comments on this and is taking final action to retain the PM_{10} sub-index of the AQI for the reasons stated in the preamble to the proposed rule (88 FR 5642, January 27, 2023).

D. Air Quality Index Reporting

With respect to the reporting requirements for the AQI and as noted in the proposal (88 FR 5642, January 27, 2023) there have been many technological advances in air quality monitoring and data reporting since the appendix G to 40 CFR part 58 was last revised in 1999. Federal, State, local, and Tribal agencies have used these changes to make health information and air quality data more readily available and easier to access. Given this, it is useful to update the reporting requirements and recommendations to match current practices and ensure the public has the most useful and timely information to take health-protective behaviors.

1. Summary of Proposed Revisions

Currently, appendix G defines daily reporting as five days per week. When this reporting requirement was originated in 1999 the technology available at that time was not sufficient to calculate and report the AQI more than five days per week without requiring additional staffing on the weekends. Since that time, advances in technology have allowed for reporting seven days per week automatically without expending additional resources on weekends. As a result, most State, local, and Tribal air agencies now report the AQI seven days per a week. Given these technological advances and noting that reporting agencies currently report the AQI seven days per week, the EPA proposed that State, local, and Tribal agencies that report the AQI be required to report it seven days a week, ensuring that the members of the public continue to have access to daily air quality and health information that they can use to take steps to protect their health.

Improvements in monitoring networks and modeling capabilities have also enabled the ability to report the AQI in near real-time. This allows State, local, and Tribal air agencies to provide timely air quality information to the public for making health-protective decisions and to help satisfy AQI reporting requirements. The availability of near real-time AQI data also allows for more timely responses by the public when air quality conditions are changing rapidly, such as during wildfire smoke events. Subdaily reporting of the AQI can be critical when there are rapidly change conditions and/or high pollution events so that the public is able to make informed decisions to protect their health. Many State, local, and Tribal air agencies currently report the AQI hourly to ensure that the public has access to accurate and timely information. In recognition of these advances, and to continue to provide for near-real time AQI reporting that the public has come to rely on, the EPA proposed to recommend that State, local, and Tribal agencies report the AQI in near-real time.

In lieu of or along with reporting the near-real-time AQI directly to the public, most State/local and Tribal agencies submit hourly air quality data to the EPA. The EPA and some State, local and Tribal air quality agencies use this near-real-time data to create products for use by the public, weather service providers and the media as discussed in the proposal (88 FR 5643, January 27, 2023). To continue to ensure the availability of the products that the public and many stakeholders rely upon, the EPA proposed to recommend that State, local, and Tribal air quality agencies submit hourly data to the EPA's air quality database. Submitting hourly data to the EPA for use on the AirNow website and in other products also enables State, local, and Tribal air quality agencies to meet the recommendation to report the AQI in near-real-time.

In addition to the proposed updates to the reporting requirements and recommendations for near-real-time reporting and data submission recommendations, the Agency also proposed reformatting the question-and-answer format used in appendix G to align with the current standard formatting used in the Code of Federal Regulations. In proposing to update the format, the EPA did not reopen the language that has merely been moved or rearranged as there are no substantive changes.

Another change the EPA proposed to make to appendix G is with regard to Table 2—Breakpoints for the AQI for purposes of clarity. As discussed in the proposal (88 FR 5642, January 27, 2023) and summarized here, the EPA proposed to collapse the two rows presented for the Hazardous Category into one. The two rows in the current table specify pollutant concentrations for two AQI ranges within the Hazardous category (301–400 and 401–500), with an intermediate break at 400. The 400 breakpoint for all criteria pollutants in the current Table 2 is set at the proportional pollutant concentration approximately halfway between the Index values of 300 and 500. In proposing updated AQI breakpoints for $PM_{2.5}$, the EPA considered adjusting the 400 breakpoint similarly. However, the EPA concluded that collapsing the two rows into a single range (301–500) would provide a more transparent and easy-to-follow presentation of the pollutant concentrations corresponding to the AQI range for the Hazardous category. Moreover, collapsing the Hazardous category into a single row in Table 2 has no substantive effect on the Emergency Episode program in 40 CFR part 51, appendix L. Thus, the EPA proposed to remove the breakpoint of 400 from the table in appendix G but this change would not substantively affect the derivation of the AQI for any pollutant.

In addition, the EPA proposed to move some information currently in appendix G into the Technical Assistance Document for the Reporting of Daily Air Quality, or TAD (U.S. EPA, 2018a), so that it can be updated in a more timely manner to reflect current scientific and health effects evidence and current communication methods, thereby assisting State, local, and Tribal agencies in providing accurate and timely information to the public. Information that was proposed to be moved from appendix G to the TAD included the definitions of the sensitive (at-risk) populations for each pollutant.

This definition is typically evaluated and updated, as warranted, in most NAAQS reviews, even if the standard is not revised. Generally, if the standard is not revised in a review of the NAAQS, then appendix G is also not revised. Moving the definitions of sensitive groups to the TAD allows them to be updated even when a NAAQS is not revised to be consistent with the definitions of the sensitive (at-risk) populations identified in the ISA for that NAAQS review. Also, the proposal (88 FR 5642, January 27, 2023) recognized that the ways that air quality and health information is supplied to the news media and public changes regularly and thus proposed that information about suggested approaches for public communication be taken out of appendix G and discussed in the TAD.

2. Summary of Significant Comments on the Proposed Revisions

The EPA received many comments on the proposed changes to AQI reporting, many of which supported the proposed revisions. EPA discusses several of the topics that received the most attention from commenters below. Discussion of other comments received on the proposed changes to the AQI can be found in section IV of the Responses to Significant Comments on the 2023 Proposed Reconsideration of the National Ambient Air Quality Standards for Particulate Matter.

Most commenters expressed support for revising the definition of ''daily reporting'' from five days a week to seven days a week. A commenter did not support this change and recommended the EPA maintain the definition of daily as five days per week, noting that State and local air agencies do not routinely work seven days per week and would not be available to perform quality control of this data and report it reliably on weekends.

The EPA appreciates the support for this proposed revision and disagrees that the proposed change would require personnel to perform quality control of AQI data on weekends. 40 CFR part 58 Appendix D defines continuous monitoring requirements for agencies participating in the State/Local Air Monitoring Stations (SLAMS) network, and Appendix G states that agencies '' . . . must use concentration data from State/Local Air Monitoring Stations (SLAMS) required by 40 CFR 58.10'' when reporting the AQI. Therefore, as noted in Appendix D and G, Agencies are required to report the AQI using monitors within SLAMS, which are not subject to daily quality control/validation.

A few commenters noted that the proposal preamble language mentioned AQI is reported three ways (88 FR 5637, 5638, January 27, 2023): ''The AQI is reported three ways all of which are useful and complementary. The daily AQI is reported for the previous day and used to observe trends in community air quality, the AQI forecast helps people plan their outdoor activities for the next day, and the near-real-time AQI, or NowCast AQI, tells people whether it is a good time for outdoor activity.'' These commenters suggested that the NowCast is being codified in 40 CFR part 58 Appendix G as a method of calculating the AQI, which they oppose, saying that codifying its use is inappropriate given the shortest averaging period of the $PM_{2.5}$ NAAQS remains at 24-hours. Some stated that NowCast values have no direct correlation to the AQI calculation methodology codified in 40 CFR part 58 Appendix G. These commenters say that codifying the NowCast would impose a significant burden on States' forecasting staff.

However, some other commenters noted they appreciate the public-friendly format and near real-time data the NowCast provides and use it in their clinical encounters with patients. One air agency recognized the importance of the NowCast near real-time AQI during high pollution events and suggested the EPA should provide more ''concrete'' health messaging for these short-term spikes.

The EPA disagrees that the preamble language proposed to codify the NowCast or to impose a burden on reporting agencies. The preamble to the proposed rule references the AQI being reported in three ways and it does so because the EPA and many State, local and Tribal air quality agencies already report it these three ways. However, text included in the preamble is generally explanatory and does not alter regulatory provisions. Comments that State that EPA is codifying the NowCast into Appendix G are incorrect. Further, in proposed revisions to 40 CFR part 58 Appendix G, the EPA recommended, but did not propose to require, the use of air quality forecasts and a subdaily AQI. Consistent with the proposal, the EPA is therefore not finalizing any additional requirement or burden on States' forecasting staff relative to forecasts or a subdaily AQI.

The EPA disagrees with the comment that the NowCast values have no direct correlation to the AQI calculation methodology codified in 40 CFR part 58 Appendix G. As noted in the AQI Technical Assistance Document (Technical Assistance Document for the Reporting of Daily Air Quality—the Air Quality Index (AQI)), the NowCast algorithm is based on the AQI methodology but provides more real-time information to the public (U.S. EPA, 2018a). While the NowCast algorithm is approximating a 24-hour average exposure, it can reflect concentrations observed over shorter averaging times when air quality is changing rapidly (U.S. EPA, 2018a). The EPA reflects the nature of the NowCast in the health messaging provided there.

As noted in the above discussion of the AQI, air quality can change quickly during the day. A central purpose of the AQI is to help the public know when it is prudent to take action to reduce their exposure to pollution. Accordingly, the EPA developed the NowCast to estimate the 24-hour AQI for the current hour to give people information and tools to reduce their exposures to protect their health, particularly when air quality may be changing. The NowCast gives people the knowledge and ability to take timely action. They can use this information to reduce their exposure—reducing exposures if $PM_{2.5}$ is high only during a few hours a day will help reduce a person's 24-hour exposure—or be active when air quality is better.

The first NowCast method was developed in 2003 and was designed so ''current conditions'' represent the 24-hour $PM_{2.5}$ standard as closely as possible. This method proved to be slow to respond during rapid air quality changes. In 2013, the EPA developed an updated NowCast method for $PM_{2.5}$ [141] that responds more quickly to rapidly changing air quality conditions, such as those we see during wildfires, to make air quality alerts more timely. We analyzed millions of data points in developing this NowCast method and presented this information to State, local and Tribal air agencies. The updated NowCast, which is still in use, was launched August 1, 2013, on AirNow.gov. It was designed to represent a shorter average (target 3-hour) when air quality is changing rapidly, in part because 3-hour averages from some continuous monitors are more stable than 1-hour averages. The NowCast reflects a longer-term (12-hour) average when air quality is stable.

After evaluating the 2013 NowCast method, the EPA concluded that it matched the desired characteristics. The NowCast method responds to rapid changes in air quality yet still reflects a

[141] U.S. EPA. (2013). Transitioning to a New NowCast Method. Presentation available in the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072), at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

longer-term average when air quality is stable; will work in any location with adequate air quality data and for any air quality situation; gives people the best possible estimate of a 24-hour exposure; allows the EPA to caution people in time for them to take protective action and reduce their 24-hour exposure; and ensures that AQI maps on AirNow more closely match what people see.

The AQI is designed to allow people to reduce their exposure when pollution levels are higher and be active outdoors when pollution levels are lower. Since air quality almost always changes during the day, that level of granularity is not possible with a 24-hour forecast. If the public has only the 24-hour forecast, they may miss the times to be active outdoors when air quality is better and may be active outdoors when air quality is worse.

Also as noted above, many entities appreciate the near real-time reporting of the AQI that the NowCast provides and suggested more specific messaging is needed. The EPA appreciates this insight and will continue to consider ways to communicate air quality information most effectively to the public. For example, in light of recent wildfire events, the EPA worked with the USFS to pilot the AirNow Fire and Smoke Map.

3. Summary of Final Revisions

Upon reviewing and considering the comments on the proposed revisions (summarized above in Section IV.C) along with the rationale outlined in the proposal (88 FR 5638, January 27, 2023) and summarized above in section IV.C, the EPA is finalizing the proposed changes to the AQI reporting requirements. Thus, as discussed in section IV of the preamble to the proposed rule, the EPA is taking final action to require the AQI be reported seven days a week; recommend that State, local, and Tribal agencies report the AQI in near-real time; recommend that State, local, and Tribal air quality agencies submit hourly data to the EPA's air quality database; reformat appendix G to align with the current standard formatting used in the Code of Federal Regulations; collapse the two rows in Table 2 presented for the Hazardous Category into one by removing the 400 breakpoint; and move some information currently in appendix G into the Technical Assistance Document for the Reporting of Daily Air Quality, or TAD (U.S. EPA, 2018a) such as including the definitions of the sensitive (at-risk) populations for each pollutant and suggested approaches for public communication as stated in the revised Appendix G.

Table 2 below summarizes the breakpoints for the $PM_{2.5}$ sub-index.

TABLE 2—BREAKPOINTS FOR $PM_{2.5}$ SUB-INDEX

AQI category	Index values	Breakpoints ($\mu g/m^3$, 24-hour average)
Good	0–50	0.0–9.0
Moderate	51–100	9.1–35.4
Unhealthy for Sensitive Groups	101–150	35.5–55.4
Unhealthy	151–200	55.5–125.4
Very Unhealthy	201–300	125.5–225.4
Hazardous [1]	301+	225.5

[1] AQI values between breakpoints are calculated using equation 1 in appendix G. For AQI values in the hazardous category, AQI values greater than 500 should be calculated using equation 1 and the $PM_{2.5}$ concentration specified for the AQI value of 500.

V. Rationale for Decisions on the Secondary PM Standards

This section presents the rationale for the Administrator's decision that no change to the current secondary PM standards is required at this time to provide requisite protection against the public welfare effects of PM within the scope of this reconsideration (*i.e.,* visibility, climate, and materials effects).[142] This decision is based on a thorough review of the scientific evidence generally published through December 2017,[143] as presented in the 2019 ISA (U.S. EPA, 2019a), on the non-ecological public welfare effects of PM pertaining to the presence of PM in ambient air, specifically visibility, climate, and materials effects. Additionally, this decision is based on a thorough evaluation of some studies that became available after the literature cutoff date of the 2019 ISA that could either further inform the adequacy of the current PM NAAQS or address key scientific topics that have evolved since the literature cutoff date for the 2019 ISA, generally through March 2021, as presented in the ISA Supplement [144] (U.S. EPA, 2022a). The selection of welfare effects evaluated within the ISA Supplement was based on the causality determinations reported in the 2019 ISA and the subsequent use of scientific evidence in the 2020 PA.[145]

[142] Consistent with the 2016 Integrated Review Plan (U.S. EPA, 2016), other welfare effects of PM, including ecological effects, are being considered in the separate, on-going review of the secondary NAAQS for oxides of nitrogen, oxides of sulfur and PM. Accordingly, the public welfare protection provided by the secondary PM standards against ecological effects such as those related to deposition of nitrogen- and sulfur-containing compounds in vulnerable ecosystems is being considered in that separate review. Thus, the Administrator's decision in this reconsideration will be focused only and specifically on the adequacy of public welfare protection provided by the secondary PM standards from effects related to visibility, climate, and materials and hereafter ''welfare effects'' refers to non-ecological welfare effects (*i.e.,* visibility, climate, and materials effects).

[143] In addition to the 2020 review's opening ''call for information'' (79 FR 71764, December 3, 2014), the 2019 ISA identified and evaluated studies and reports that have undergone scientific peer review and were published or accepted for publication between January 1, 2009 through approximately January 2018 (U.S. EPA, 2019a, p. ES–2). References that are cited in the 2019 ISA, the references that were considered for inclusion but not cited, and electronic links to bibliographic information and abstracts can be found at: *https://hero.epa.gov/hero/particulate-matter.*

[144] As described in more detail in the ISA Supplement, ''the scope of this Supplement provides specific criteria for the types of studies considered for inclusion within the Supplement. Specifically, studies must be peer reviewed and published between approximately January 2018 and March 2021'' (U.S. EPA, 2022a, section 1.2.2).

[145] As described in section 1.2.1 of the ISA Supplement, ''the selection of welfare effects to evaluate within this Supplement is based on the causality determinations reported in the 2019 PM ISA and the subsequent use of scientific evidence in the 2020 PM PA. The 2019 PM ISA concluded a *causal relationship* for each of the welfare effects categories evaluated (*i.e.,* visibility, climate effects, and materials effects). While the 2020 PM PA considered the broader set of evidence for these effects, for climate effects and material effects, it concluded that there remained 'substantial uncertainties with regard to the quantitative relationships with PM concentrations and concentration patterns that limit[ed] [the] ability to quantitatively assess the public welfare protection provided by the standards from these effects (U.S. EPA, 2020b). Given these uncertainties and limitations, the basis of the discussion on conclusions regarding the secondary standards in the 2020 PM PA primarily focused on visibility effects. Therefore, this Supplement focuses only on visibility effects in evaluating newly available scientific information and is limited to studies

Continued

Specifically, for welfare effects, the focus within the ISA Supplement is on visibility effects. The ISA Supplement does not include an evaluation of studies on climate or materials effects. The Administrator's decision also takes into account the 2022 PA evaluation of the policy-relevant information in the 2019 ISA and ISA Supplement and presentation of quantitative analysis of air quality related to visibility impairment; CASAC advice and recommendations, as reflected in discussions of the drafts of the ISA Supplement and 2022 PA at public meetings and in the CASAC's letters to the Administrator; and public comments received on the proposal.

In presenting the rationale for the Administrator's final decision and its foundations, section V.A provides background on the 2020 final decision to retain the secondary PM standards (section V.A.1), and also provides brief summaries of key aspects of the currently available welfare effects evidence (section V.A.2) and quantitative information (section V.A.3). Section V.B summarizes the CASAC's advice (section V.B.1) and the proposed conclusions (section V.B.2), addresses public comments received on the proposal (section V.B.3), and presents the Administrator's conclusions on the adequacy of the current standards (section V.B.4), drawing on consideration of the available scientific and quantitative information, advice from the CASAC, and comments from the public. Section V.C summarizes the Administrator's decision on the secondary PM standards.

A. Introduction

The general approach for this reconsideration of the 2020 final decision on the secondary PM standards relies on the EPA's assessments of the current scientific evidence and associated quantitative analyses to inform the Administrator's judgments regarding secondary standards that are requisite to protect the public welfare from known or anticipated adverse effects associated with the pollutant's presence in the ambient air. The EPA's assessments are primarily documented in the 2019 ISA, ISA Supplement, and 2022 PA, which builds on the 2020 PA, all of which have received CASAC review and public comment (83 FR 53471, October 23, 2018; 83 FR 55529, November 6, 2018; 85 FR 4655, January 27, 2020; 86 FR 52673, September 22, 2021; 86 FR 54186, September 30, 2021; 86 FR 56263, October 8, 2021; 87 FR 958, January 7, 2022; 87 FR 22207, April 14, 2022; 87 FR 31965, May 26, 2022). In bridging the gap between the scientific assessments of the 2019 ISA and ISA Supplement and the judgments required of the Administrator in determining whether the current standards provide the requisite public welfare protection, the 2022 PA evaluates policy implications of the evaluation of the current evidence in the 2019 ISA and ISA Supplement, and the quantitative information documented in the 2022 PA. In evaluating the public welfare protection afforded by the current standards against PM-related effects within the scope of this reconsideration, the four basic elements of the NAAQS (indicator, averaging time, level, and form) are considered collectively.

The final decision on the adequacy of the current secondary standards is a public welfare policy judgment to be made by the Administrator. In reaching conclusions with regard to the standard, the decision draws on the scientific information and analyses about welfare effects, and associated public welfare significance, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the scientific evidence and analyses. This approach is based on the recognition that the available evidence generally reflects a continuum that includes ambient air exposures at which scientists agree that effects are likely to occur through lower levels at which the likelihood and magnitude of responses become increasingly uncertain. This approach is consistent with the requirements of the provisions of the Clean Air Act related to the review of NAAQS and with how the EPA and the courts have historically interpreted the Act. These provisions require the Administrator to establish secondary standards that, in the judgment of the Administrator, are requisite to protect public welfare from known or anticipated adverse effects associated with the presence of the pollutant in the ambient air. In so doing, the Administrator seeks to establish standards that are neither more nor less stringent than necessary for this purpose. The Act does not require that standards be set at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect the public welfare from known or anticipated adverse effects.

1. Background on the Current Standards

The current secondary PM standards were retained in 2020 based on the scientific and technical information available at that time, as well as the then-Administrator's judgments regarding the available welfare effects evidence, the appropriate degree of public welfare protection for the existing standards, and available air quality information on visibility impairment that may be allowed by such a standard (85 FR 82684, December 18, 2020). With the 2020 decision, the then-Administrator retained the secondary 24-hour $PM_{2.5}$ standard, with its level of 35 $\mu g/m^3$, the annual $PM_{2.5}$ standard, with its level of 15.0 $\mu g/m^3$, and the 24-hour PM_{10} standard, with its level of 150 $\mu g/m^3$. The subsections below focus on the key considerations and the then-Administrator's conclusions in the 2020 final decision for climate and materials effects (section V.A.1.a) and visibility effects (section V.A.2.b).

a. Non-Visibility Effects

In light of the robust evidence base, the 2019 ISA concluded there to be causal relationships between PM and climate effects and materials effects (U.S. EPA, 2019a, sections 13.3.9 and 13.4.2). The 2020 final decision was based on a thorough review in the 2019 ISA of the scientific information on PM-induced climate and materials effects. The decision also took into account: (1) Assessments in the 2020 PA of the most policy-relevant information in the 2019 ISA regarding evidence of adverse effects of PM to climate and materials, (2) uncertainties in the available evidence to inform a quantitative assessment of PM-related climate and materials effects, (3) CASAC advice and recommendations, and (4) public comments received during the development of these documents and on the proposal document.

In considering non-visibility welfare effects in the 2020 decision, the then-Administrator concluded that, while it is important to maintain an appropriate degree of control of fine and coarse particles to address non-visibility welfare effects, ''it is generally appropriate to retain the existing standards and that there is insufficient information to establish any distinct secondary PM standards to address climate and materials effects of PM'' (85 FR 82744, December 18, 2020).

With regard to climate, the then-Administrator recognized that there were a number of improvements and refinements to climate models since the 2012 review. However, while the evidence continued to support a causal relationship between PM and climate effects, the then-Administrator noted that significant limitations continued to exist related to quantifying the contributions of direct and indirect

conducted in the U.S. and Canada'' (U.S. EPA, 2022a, section 1.2.1).

effects of PM and PM components on climate forcing (U.S. EPA, 2020b, sections 5.2.2.1.1 and 5.4). He also recognized that the models continued to exhibit considerable variability in estimates of PM-related climate impacts at regional scales (*e.g.,* ~100 km) as compared to simulations at global scales. Therefore, the resulting uncertainty led the then-Administrator to conclude in the 2020 decision that the available scientific information remained insufficient to quantify climate impacts associated with particular concentrations of PM in ambient air (U.S. EPA, 2020b, section 5.2.2.2.1) or to evaluate or consider a level of PM air quality in the U.S. to protect against climate effects and that there was insufficient information available to base a national ambient standard on climate impacts (85 FR 82744, December 18, 2020).

With regard to materials effects, the then-Administrator noted that the evidence available in the 2019 ISA continued to support a causal relationship between materials effects and PM deposition (U.S. EPA, 2019a, section 13.4). He recognized that the deposition of fine and coarse particles to materials can lead to physical damage and/or impaired aesthetic qualities. Particles can contribute to materials damage by adding to the natural weathering processes and by promoting the corrosion of metals, the degradation of building materials, and the weakening of material components. While some new information was available in the 2019 ISA, the information was from studies primarily conducted outside of the U.S. in areas where PM concentrations in ambient air are higher than those observed in the U.S. (U.S. EPA, 2020b, section 13.4). Additionally, the information assessed in the 2019 ISA did not support quantitative analyses of PM-related materials effects in the 2020 PA (U.S. EPA, 2020b, section 5.2.2.2.2). Given the limited amount of information available and its inherent uncertainties and limitations, the Administrator concluded that he was unable to relate soiling or damage to specific levels of PM in ambient air or to evaluate or consider a level of air quality to protect against such materials effects, and that there was insufficient information available to support a distinct national ambient standard based on materials effects (85 FR 82744, December 18, 2020).

In reviewing the 2019 draft PA, the CASAC agreed with staff conclusions that, while these effects are important, ''the available evidence does not call into question the protection afforded by the current secondary PM standards'' and recommended that the secondary standards ''should be retained'' (Cox, 2019b, p. 3 of letter). In reaching a final decision in 2020, for all of the reasons discussed above and recognizing the CASAC conclusion that the evidence provided support for retaining the current secondary PM standards, the then-Administrator concluded that it was appropriate to retain the existing secondary PM standards, without revision. For climate and materials effects, this conclusion reflected his judgment that, although it remains important to maintain secondary $PM_{2.5}$ and PM_{10} standards to provide some degree of control over long- and short-term concentrations of both fine and coarse particles, there was insufficient information to establish distinct secondary PM standards to address non-visibility PM-related welfare effects (85 FR 82744, December 18, 2020).

b. Visibility Effects

The 2019 ISA concluded that, ''the evidence is sufficient to conclude that a causal relationship exists between PM and visibility impairment'' (U.S. EPA, 2019a, section 13.2.6). The 2020 decision on the adequacy of the secondary standards with regard to visibility effects was a public welfare policy judgment made by the then-Administrator, which drew upon the available scientific evidence for PM-related visibility effects and on analyses of visibility impairment, as well as judgments about the appropriate weight to place on the range of uncertainties inherent in the evidence and analyses. The 2020 final decision was based on a thorough review in the 2019 ISA of the scientific information on PM-related visibility effects. The decision also took into account: (1) Assessments in the 2020 PA of the most policy-relevant information in the 2019 ISA regarding evidence of adverse effects of PM on visibility; (2) air quality analyses of the $PM_{2.5}$ visibility index and design values based on the form and averaging time of the existing secondary 24-hour $PM_{2.5}$ standard; (3) CASAC advice and recommendations; and (4) public comments received during the development of these documents and on the 2020 proposal document.

In considering the visibility effects in the 2020 review, the then-Administrator noted the long-standing body of evidence for PM-related visibility impairment. This evidence, which is based on the fundamental relationship between light extinction and PM mass, demonstrated that ambient PM can impair visibility in both urban and remote areas, and had changed very little since the 2012 review (U.S. EPA, 2019a, section 13.1; U.S. EPA, 2009a, section 9.2.5). The evidence related to public perception of visibility impairment was from studies from four areas in North America.[146] These studies provided information to inform our understanding of levels of visibility impairment that the public judged to be ''acceptable'' (U.S. EPA, 2010b; 85 FR 24131, April 30, 2020). In considering these public preference studies, the then-Administrator noted that no new visibility studies conducted in the U.S. were discussed in the 2019 ISA, and there was little newly available information with regard to acceptable levels of visibility impairment in the U.S. The Administrator recognized that visibility impairment can have implications for people's enjoyment of daily activities and their overall well-being, and therefore, considered the degree to which the current secondary standards protect against PM-related visibility impairment.

Consistent with the 2012 review, in the 2020 review, the then-Administrator first concluded that a target level of protection for a secondary PM standard is most appropriately defined in terms of a visibility index that directly takes into account the factors (*i.e.,* species composition and relative humidity) that influence the relationship between $PM_{2.5}$ in ambient air and PM-related visibility impairment. In defining a target level of protection, the then-Administrator considered the specific aspects of such an index, including the appropriate indicator, averaging time, form and level (78 FR 82742–82744, December 18, 2020).

First, with regard to indicator, the then-Administrator noted that in the 2012 review, the EPA used an index based on estimates of light extinction by $PM_{2.5}$ components calculated using an adjusted version of the IMPROVE algorithm, which allows the estimation of the light extinction using routinely monitored components of $PM_{2.5}$, $PM_{10-2.5}$ mass, and estimates of relative humidity. The then-Administrator recognized that, while there have been some revisions to the IMPROVE algorithm since the time of the 2012

[146] Preference studies were available in four urban areas. Three western preference studies were available, including one in Denver, Colorado (Ely et al., 1991), one in the lower Fraser River valley near Vancouver, British Columbia, Canada (Pryor, 1996), and one in Phoenix, Arizona (BBC Research & Consulting, 2003). A pilot focus group study was also conducted for Washington, DC (Abt Associates, 2001), and a replicate study with 26 participants was also conducted for Washington, DC (Smith and Howell, 2009). More details about these studies are available in Appendix D of the 2022 PA (U.S. EPA, 2022b).

review, our fundamental understanding of the relationship between PM in ambient air and light extinction had changed little and the various IMPROVE algorithms appropriately reflected this relationship across the U.S. In the absence of a monitoring network for direct measurement of light extinction, he concluded that a calculated light extinction indicator that utilizes the IMPROVE algorithms continued to provide a reasonable basis for defining a target level of protection against PM-related visibility impairment (78 FR 82742–82744, December 18, 2020).

In further defining the characteristics of a visibility index, the then-Administrator next considered the appropriate averaging time, form, and level of the index. Given the available scientific information the review, and in considering the CASAC's advice and public comments, the then-Administrator concluded that, consistent with the decision in the 2012 review, a visibility index with a 24-hour averaging time and a form based on the 3-year average of annual 90th percentile values remained reasonable. With regard to the averaging time and form of such an index, the Administrator noted analyses conducted in the last review that demonstrated relatively strong correlations between 24-hour and subdaily (*i.e.,* 4-hour average) $PM_{2.5}$ light extinction (78 FR 3226, January 15, 2013), indicating that a 24-hour averaging time is an appropriate surrogate for the subdaily time periods of the perception of PM-related visibility impairment and the relevant exposure periods for segments of the viewing public. This decision in the 2020 review also recognized that a 24-hour averaging time may be less influenced by atypical conditions and/or atypical instrument performance (78 FR 3226, January 15, 2013). The then-Administrator recognized that there was no new information to support updated analyses of this nature, and therefore, he believed these analyses continued to provide support for consideration of a 24-hour averaging time for a visibility index in this review. With regard to the statistical form of the index, the Administrator noted that, consistent with the 2012 review: (1) A multi-year percentile form offers greater stability from the occasional effect of interannual meteorological variability (78 FR 3198, January 15, 2013; U.S. EPA, 2011, p. 4–58); (2) a 90th percentile represents the median of the distribution of the 20 percent worst visibility days, which are targeted in Federal Class I areas by the Regional Haze Program; and (3) public preference studies did not provide information to identify a different target than that identified for Federal Class I areas (U.S. EPA, 2011, p. 4–59). Therefore, the then-Administrator judged that a visibility index based on estimates of light extinction, with a 24-hour averaging time and a 90th percentile form, averaged over three years, remained appropriate (78 FR 82742–82744, December 18, 2020).

With regard to the level of a visibility index, consistent with the 2012 review, the then-Administrator judged that it was appropriate to establish a target level of protection of 30 deciviews (dv),[147] [148] reflecting the upper end of the range of visibility impairment judged to be acceptable by at least 50% of study participants in the available public preference studies (78 FR 3226, January 15, 2013). The 2011 PA identified a range of levels from 20 to 30 dv based on the responses in the public preference studies available at that time (U.S. EPA, 2011, section 4.3.4). At the time of the 2012 review, the then-Administrator noted a number of uncertainties and limitations in public preference studies, including the small number of stated preference studies available, the relatively small number of study participants, the extent to which the study participants may not be representative of the broader study area population in some of the studies, and the variations in the specific materials and methods used in each study. In considering the available preference studies in 2012, with their inherent uncertainties and limitations, the then-Administrator concluded that the substantial degree of variability and uncertainty in the public preference studies should be reflected in a target level of protection based on the upper end of the range of candidate protection levels (CPLs).

Given that there were no new preference studies in the 2019 ISA, the then-Administrator's judgments in 2020 were based on the same studies, with the same range of levels, available in the 2012 review. The 2020 PA (U.S. EPA, 2020b, section 5.5), discussed a number of limitations and uncertainties associated with these studies. In considering the scientific information, with its uncertainties and limitations, as well as public comments on the level of the target level of protection against visibility impairment, the then-Administrator concluded that it was appropriate to again use a level of 30 dv for the visibility index (78 FR 82742–82744, December 18, 2020).

Having concluded that the protection provided by a standard defined in terms of a $PM_{2.5}$ visibility index, with a 24-hour averaging time, and a 90th percentile form, averaged over 3 years, set at a level of 30 dv, was requisite to protect public welfare with regard to visual air quality, the Administrator next considered the degree of protection from visibility impairment afforded by the existing suite of secondary PM standards.

In this context, the then-Administrator considered the updated analyses of visibility impairment presented in the 2020 PA (U.S. EPA, 2020b, section 5.2.1.2), which reflected a number of improvements since the 2012 review. Specifically, the updated analyses examined multiple versions of the IMPROVE equation, including the version incorporating revisions since the time of the 2012 review. These updated analyses provided a further understanding of how variation in the inputs to the algorithms affect the estimates of light extinction (U.S. EPA, 2020b, Appendix D). Additionally, for a subset of monitoring sites with available $PM_{10-2.5}$ data, the updated analyses better characterized the influence of coarse PM on light extinction than in the 2012 review (U.S. EPA, 2020b, section 5.2.1.2).

The results of the updated analyses in the 2020 PA were consistent with those from the 2012 review. Regardless of which version of the IMPROVE equation was used, the analyses demonstrated that, based on 2015–2017 data, the 3-year visibility metric was at or below about 30 dv in all areas meeting the current 24-hour $PM_{2.5}$ standard, and below 25 dv in most of those areas. In locations with available $PM_{10-2.5}$ monitoring, which met both the current 24-hour secondary $PM_{2.5}$ and PM_{10} standards, 3-year visibility index metrics were at or below 30 dv regardless of whether the coarse fraction was included as an input to the algorithm for estimating light extinction (U.S. EPA, 2020b, section 5.2.1.2). While the inclusion of the coarse fraction had a relatively modest impact on the estimates of light extinction, the then-Administrator recognized the continued importance of the PM_{10} standard given the potential for larger impacts on light extinction in areas with higher coarse particle concentrations, which were not included in the analyses in the 2020 PA due to a lack of available data (U.S. EPA, 2019a, section 13.2.4.1; U.S. EPA, 2020b, section 5.2.1.2). He

[147] Deciview (dv) refers to a scale for characterizing visibility that is defined directly in terms of light extinction. The deciview scale is frequently used in the scientific and regulatory literature on visibility.

[148] For comparison, 20 dv, 25 dv, and 30 dv are equivalent to 64, 112, and 191 megameters (Mm^{-1}), respectively.

noted that the air quality analyses showed that all areas meeting the existing 24-hour $PM_{2.5}$ standard, with its level of 35 μg/m^3, had visual air quality at least as good as 30 dv, based on the visibility index. Thus, the secondary 24-hour $PM_{2.5}$ standard would likely be controlling relative to a 24-hour visibility index set at a level of 30 dv. Additionally, areas would be unlikely to exceed the target level of protection for visibility of 30 dv without also exceeding the existing secondary 24-hour $PM_{2.5}$ standard. Thus, the then-Administrator judged that the 24-hour $PM_{2.5}$ standard provided sufficient protection in all areas against the effects of visibility impairment, *i.e.,* that the existing 24-hour $PM_{2.5}$ standard would provide at least the target level of protection for visual air quality of 30 dv which he judged appropriate (78 FR 82742–82744, December 18, 2020).

2. Overview of Welfare Effects Evidence

The information summarized here is based on the scientific assessment of the welfare effects evidence available in this reconsideration; this assessment is documented in the 2019 ISA and ISA Supplement and its policy implications are further discussed in the 2022 PA. While the 2019 ISA provides the broad scientific foundation for this reconsideration, additional literature has become available since the cutoff date of the 2019 ISA that expands the body of evidence related to visibility effects that can inform the Administrator's judgment on the adequacy of the current secondary PM standards. As such, the ISA Supplement builds on the information in the 2019 ISA with a targeted identification and evaluation of new scientific information regarding visibility effects. As described in the ISA Supplement and the 2022 PA, the selection of welfare effects to evaluate within the ISA Supplement were based on the causality determinations reported in the 2019 ISA and the subsequent use of scientific evidence in the 2020 PA (U.S. EPA, 2019a, section 1.2; U.S. EPA, 2022a, section 1.4.2). The ISA Supplement focuses on U.S. and Canadian studies that provide new information on public preferences for visibility impairment and/or developed new methodologies or conducted quantitative analyses of light extinction (U.S. EPA, 2022a, section 1.2). Such studies of visibility effects and quantitative relationships between visibility impairment and PM in ambient air were considered to be of greatest utility in informing the Administrator's conclusions on the adequacy of the current secondary PM standards. The visibility effects evidence presented within the 2019 ISA, along with the targeted identification and evaluation of new scientific information in the ISA Supplement, provides the scientific basis for the reconsideration of the 2020 final decision on the secondary PM standards for visibility effects. For climate and materials effects, the 2020 PA concluded that there were substantial uncertainties associated with the quantitative relationships with PM concentrations and the concentration patterns that limited the ability to quantitatively assess the public welfare protection provided by the standards from these effects. Therefore, the evaluation of the information related to these effects draws heavily from the 2019 ISA and 2020 PA. The subsections below briefly summarize the nature of PM-related visibility (section V.B.1.a), climate (section V.B.1.b), and materials (section V.B.1.c) effects.

a. Nature of Effects

Visibility impairment can have implications for people's enjoyment of daily activities and for their overall sense of well-being (U.S. EPA, 2009a, section 9.2). The strongest evidence for PM-related visibility impairment comes from the fundamental relationship between light extinction and PM mass (U.S. EPA, 2009a), which confirms a well-established ''causal relationship exists between PM and visibility impairment'' (U.S. EPA, 2009a, p. 2–28). Beyond its effects on visibility, the 2009 ISA also identified a causal relationship ''between PM and climate effects, including both direct effects of radiative forcing and indirect effects that involve cloud and feedbacks that influence precipitation formation and cloud lifetimes'' (U.S. EPA, 2009a, p. 2–29). The evidence also supports a causal relationship between PM and effects on materials, including soiling effects and materials damage (U.S. EPA, 2009a, p. 2–31).

The evidence available in this reconsideration is consistent with the evidence available at the time of the 2012 and 2020 reviews and supports the conclusions of causal relationships between PM and visibility, climate, and materials effects (U.S. EPA, 2019a, chapter 13). Evidence newly available in this reconsideration augments the previously available evidence of the relationship between PM and visibility impairment (U.S. EPA, 2019a, section 13.2; U.S. EPA, 2022a, section 4), climate effects (U.S. EPA, 2019a, section 13.3), and materials effects (U.S. EPA, 2019a, section 13.4).

i. Visibility

The fundamental relationship between light extinction and PM mass, and the EPA's understanding of this relationship, has changed little since the 2009 ISA (U.S. EPA, 2009a). The combined effect of light scattering and absorption by particles and gases is characterized as light extinction, *i.e.,* the fraction of light that is scattered or absorbed per unit of distance in the atmosphere.[149] Light extinction is measured in units of 1/distance, which is often expressed in the technical literature as visibility per megameter (abbreviated Mm^{-1}). Higher values of light extinction (usually given in units of Mm^{-1} or dv) correspond to lower visibility. When PM is present in the air, its contribution to light extinction is typically much greater than that of gases (U.S. EPA, 2019a, section 13.2.1). The impact of PM on light scattering depends on particle size and composition, as well as relative humidity. All particles scatter light, as described by the Mie theory, which relates light scattering to particle size, shape, and index of refraction (U.S. EPA, 2019a, section 13.2.3; Mie, 1908, Van de Hulst, 1981). Fine particles scatter more light than coarse particles on a per unit mass basis and include sulfates, nitrates, organics, light-absorbing carbon, and soil (Malm et al., 1994). Hygroscopic particles like ammonium sulfate, ammonium nitrate, and sea salt increase in size as relative humidity increases, leading to increased light scattering (U.S. EPA, 2019a, section 13.2.3).

As at the time of the 2012 and 2020 reviews, direct measurements of PM light extinction, scattering, and absorption continue to be considered more accurate for quantifying visibility than PM mass-based estimates because measurements do not depend on assumptions about particle characteristics (*e.g.,* size, shape, density, component mixture, etc.) (U.S. EPA, 2019a, section 13.2.2.2). Measurements of light extinction can be made with high time resolution, allowing for characterization of subdaily temporal patterns of visibility impairment. A number of measurement methods have been used for visibility impairment (*e.g.,*

[149] All particles scatter light and, although a larger particle scatters more light than a similarly shaped smaller particle of the same composition, the light scattered per unit of mass is greatest for particles with diameters from ~0.3–1.0 μm (U.S. EPA, 2009a, section 2.5.1; U.S. EPA, 2019a, section 13.2.1). Particles with hygroscopic components (*e.g.,* particulate sulfate and nitrate) contribute more to light extinction at higher relative humidity than at lower relative humidity because they change size in the atmosphere in response to relative humidity.

transmissometers, integrating nephelometers, teleradiometers, telephotometers, and photography and photographic modeling), although each of these methods has its own strengths and limitations (U.S. EPA, 2019a, Table 13–1). While some recent research confirms and adds to the body of knowledge regarding direct measurements as is described in the 2019 ISA and ISA Supplement, no major new developments have been made with these measurement methods since prior reviews (U.S. EPA, 2019a, section 13.2.2.2; U.S. EPA, 2022a, section 4.2).

In the absence of a robust monitoring network for the routine measurement of light extinction across the U.S., estimation of light extinction based on existing PM monitoring can be used. The theoretical relationship between light extinction and PM characteristics, as derived from Mie theory (U.S. EPA, 2019a, Equation 13.5), can be used to estimate light extinction by combining mass scattering efficiencies of particles with particle concentrations (U.S. EPA, 2019a, section 13.2.3; U.S. EPA, 2009a, sections 9.2.2.2 and 9.2.3.1). This estimation of light extinction is consistent with the method used in previous reviews. The algorithm used to estimate light extinction, known as the IMPROVE algorithm,[150] provides for the estimation of light extinction (b_{ext}), in units of Mm^{-1}, using routinely monitored components of fine ($PM_{2.5}$) and coarse ($PM_{10-2.5}$) PM. Relative humidity data are also needed to estimate the contribution by liquid water that is in solution with the hygroscopic components of PM. To estimate each component's contribution to light extinction, their concentrations are multiplied by extinction coefficients and are additionally multiplied by a water growth factor that accounts for their expansion with moisture. Both the extinction efficiency coefficients and water growth factors of the IMPROVE algorithm have been developed by a combination of empirical assessment and theoretical calculation using particle size distributions associated with each of the major aerosol components (U.S. EPA, 2019a, sections 13.2.3.1 and 13.2.3.3).

At the time of the 2012 review, two versions of the IMPROVE algorithm were available in the literature—the original IMPROVE algorithm (Lowenthal and Kumar, 2004, Malm and Hand, 2007, Ryan et al., 2005) and the revised IMPROVE algorithm (Pitchford et al., 2007). As described in detail in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.1) and the 2019 ISA (U.S. EPA, 2019a, section 13.2.3), the algorithm has been further evaluated and refined since the time of the 2012 review (Lowenthal and Kumar, 2016), particularly for PM characteristics and relative humidity in remote areas. All three versions of the IMPROVE algorithm were considered in evaluating visibility impairment in this reconsideration.

Consistent with the evidence available at the time of the 2012 and 2020 reviews, our understanding of public perception of visibility impairment comes from visibility preference studies conducted in four areas in North America.[151] The detailed methodology for these studies are described in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.1), the 2019 ISA (U.S. EPA, 2019a), and the 2009 ISA (U.S. EPA, 2019a). In summary, the study participants were queried regarding multiple images that were either photographs of the same location and scenery that had been taken on different days on which measured extinction data were available or digitized photographs onto which a uniform ''haze'' had been superimposed. Results of the studies indicated a wide range of judgments on what study participants considered to be acceptable visibility across the different study areas, depending on the setting depicted in each photograph. Based on the results of the four cities, a range encompassing the $PM_{2.5}$ visibility index values from images that were judged to be acceptable by at least 50 percent of study participants across all four of the urban preference studies was identified (U.S. EPA, 2010b, p. 4–24; U.S. EPA, 2020b, Figure 5–2). Much lower visibility (considerably more haze resulting in higher values of light extinction) was considered acceptable in Washington, DC, than was in Denver, and 30 dv reflected the level of impairment that was determined to be ''acceptable'' by at least 50 percent of study participants (78 FR 3226–3227, January 15, 2013).

Since the completion of the 2009 and 2019 ISAs, there has been only one public preference study that has become available in the U.S. This study uses images of the Grand Canyon, AZ, described in the ISA Supplement (U.S. EPA, 2022a). The Grand Canyon study, conducted by Malm et al. (2019), has a similar study design to that used in the public preference studies discussed above; however, there are several important differences that make it difficult to directly compare the results of the Malm et al. (2019) study with other public preference studies. As an initial matter, the Grand Canyon study was conducted in a Federal Class I area, as opposed to in an urban area, with a scene depicted in the photographs that did not include urban features.[152] We recognize that public preferences with respect to visibility in Federal Class 1 areas may well differ from visibility preferences in urban areas and other contexts, although there is currently a lack of information to on such questions. Further, the Malm et al. (2019) study also used a much lower range of superimposed ''haze'' than the preference studies discussed above.[153] It is unclear whether the participant preferences are a function in part of the range of potential values presented, such that the participant preferences for the Grand Canyon were generally lower[154] than the other preference studies in part because of the lower range of superimposed ''haze'' for the images in that study, or if their preferences would vary if presented with images with a range of superimposed ''haze'' more comparable to the levels used in the other studies (*i.e.,* more ''haze'' superimposed on the images).

The Malm et al. (2019) study also explored alternate methods for evaluating ''acceptable'' levels of visual air quality from the preference studies, including the use of scene-specific visibility indices as potential indicators of visibility levels as perceived by the observer (Malm et al., 2019). In addition to measures of atmospheric haze, such

[150] The algorithm is referred to as the IMPROVE algorithm as it was developed specifically to use monitoring data generated at IMPROVE network sites and with equipment specifically designed to support the IMPROVE program and was evaluated using IMPROVE optical measurements at the subset of monitoring sites that make those measurements (Malm et al., 1994).

[151] Preference studies were available in four urban areas in the last review: Denver, Colorado (Ely et al., 1991), Vancouver, British Columbia, Canada (Pryor, 1996), Phoenix, Arizona (BBC Research & Consulting, 2003), and Washington, DC (Abt Associates, 2001; Smith and Howell, 2009).

[152] The Grand Canyon study used a single scene looking west down the canyon with a small landscape feature of a 100-km-distant mountain (Mount Trumbull), along with other closer landscape features. The scenes presented in the previously available visibility preference studies are presented in more detail in Table D–9 in the 2022 PA (U.S. EPA, 2022b, Appendix D).

[153] The Grand Canyon study superimposed light extinction ranging from 3 dv to 20 dv on the image slides shown to participants compared to the previously available preference studies. In those studies, the visibility ranges presented were as low as 9 dv and as high as 45 dv. The visibility ranges presented in the previously available visibility preference studies are described in more detail in Table D–9 in the 2022 PA (U.S. EPA, 2022b, Appendix D).

[154] In the Grand Canyon study, the level of impairment that was determined to be ''acceptable'' by at least 50 percent of study participants was 7 dv (Malm et al., 2019).

as atmospheric extinction, used in previously available preference studies, other indices for visual air quality include color and achromatic contrast of single landscape figures, average and equivalent contrast of an entire scene, edge detection algorithms such as the Sobel index, and just-noticeable difference or change indexes. The results reported by Malm et al. (2019) suggest that scene-dependent metrics, such as contrast, may be useful alternate predictors of preference levels compared to universal metrics like light extinction (U.S. EPA, 2022a, section 4.2.1). This is because extinction alone is not a measure of ''haze,'' but of light attenuation per unit distance, and visible ''haze'' is dependent on both light extinction and distance to a landscape feature (U.S. EPA, 2022a, section 4.2.1). However, there are very few studies available that use scene-dependent metrics (*i.e.,* contrast) to evaluate public preference information, which makes it difficult to evaluate them as an alternative to the light extinction approach.

ii. Climate

The available evidence continues to support the conclusion of a causal relationship between PM and climate effects (U.S. EPA, 2019a, section 13.3.9). Since the 2012 review, climate impacts have been extensively studied and recent research reinforces and strengthens the evidence evaluated in the 2009 ISA. Recent evidence provides greater specificity about the details of radiative forcing effects [155] and increases the understanding of additional climate impacts driven by PM radiative effects. The Intergovernmental Panel on Climate Change (IPCC) assesses the role of anthropogenic activity in past and future climate change, and since the completion of the 2009 ISA, has issued the Fifth IPCC Assessment Report (AR5; IPCC, 2013), which summarizes any key scientific advances in understanding the climate effects of PM since the previous report. As in the 2009 ISA, the 2019 ISA draws substantially on the IPCC report to summarize climate effects. As discussed in more detail in the 2022 PA (U.S. EPA, 2022b, section 5.3.2.1.1), the general conclusions are similar between the IPCC AR4 and AR5 reports with regard to effects of PM on global climate. Consistent with the evidence available in the 2012 review, the key components, including sulfate, nitrate, organic carbon (OC), black carbon (BC), and dust, that contribute to climate processes vary in their reflectivity, forcing efficiencies, and direction of forcing. Since the completion of the 2009 ISA, the evidence base has expanded with respect to the mechanisms of climate responses and feedbacks to PM radiative forcing; however, the recently published literature assessed in the 2019 ISA does not reduce the considerable uncertainties that continue to exist related these mechanisms.

As described in the proposal (88 FR 5650, January 27, 2023), PM has a very heterogeneous distribution globally and patterns of forcing tend to correlate with PM loading, with the greatest forcings centralized over continental regions. The climate response to this PM forcing, however, is more complicated since the perturbation to one climate variable (*e.g.,* temperature, cloud cover, precipitation) can lead to a cascade of effects on other variables. While the initial PM radiative forcing may be concentrated regionally, the eventual climate response can be much broader spatially or be concentrated in remote regions, and may be quite complex, affecting multiple climate variables with possible differences in the direction of the forcing in different regions or for different variables (U.S. EPA, 2019a, section 13.3.6). The complex climate system interactions lead to variation among climate models, which have suggested a range of factors that can influence large-scale meteorological processes and may affect temperature, including local feedback effects involving soil moisture and cloud cover, changes in the hygroscopicity of the PM, and interactions with clouds (U.S. EPA, 2019a, section 13.3.7). As a result, there remains insufficient evidence to related climate effects to specific PM levels in ambient air or to establish a quantitative relationship between PM and climate effects, particularly at a regional scale. Further research is needed to better characterize the effects of PM on regional climate in the U.S. before PM climate effects can be quantified.

iii. Materials

Consistent with the evidence assessed in the 2009 ISA, the available evidence continues to support the conclusion that there is a causal relationship between PM deposition and materials effects. Effects of deposited PM, particularly sulfates and nitrates, to materials include both physical damage and impaired aesthetic qualities, generally involving soiling and/or corrosion (U.S. EPA, 2019a, section 13.4.2). Because of their electrolytic, hygroscopic, and acidic properties and their ability to sorb corrosive gases, particles contribute to materials damage by adding to the effects of natural weathering processes, by potentially promoting or accelerating the corrosion of metals, degradation of painted surfaces, deterioration of building materials, and weakening of material components.[156] There is a limited amount of recently available data for consideration in this review from studies primarily conducted outside of the U.S. on buildings and other items of cultural heritage. However, these studies involved concentrations of PM in ambient air greater than those typically observed in the U.S. (U.S. EPA, 2019a, section 13.4).

Building on the evidence available in the 2009 ISA, and as described in detail in the proposal (88 FR 5650, January 27, 2023) and in the 2019 ISA (U.S. EPA, 2019a, section 13.4), research has progressed on (1) the theoretical understanding of soiling of items of cultural heritage; (2) the quantification of degradation rates and further characterization of factors that influence damage of stone materials; (3) materials damage from PM components besides sulfate and black carbon and atmospheric gases besides SO_2; (4) methods for evaluating soiling of materials by PM mixtures; (5) PM-attributable damage to other materials, including glass and photovoltaic panels; (6) development of dose-response relationships for soiling of building materials; and (7) damage functions to quantify material decay as a function of pollutant type and load. While the evidence of PM-related materials effects has expanded somewhat since the completion of the 2009 ISA, there remains insufficient evidence to relate soiling or damage to specific PM levels in ambient air or to establish a quantitative relationship between PM and materials degradation. The recent evidence assessed in the 2019 ISA is generally similar to the evidence available in the 2009 ISA, including

[155] Radiative forcing (RF) for a given atmospheric constituent is defined as the perturbation in net radiative flux, at the tropopause (or the top of the atmosphere) caused by that constituent, in watts per square meter (Wm^{2}), after allowing for temperatures in the stratosphere to adjust to the perturbation but holding all other climate responses constant, including surface and tropospheric temperatures (Fiore et al., 2015; Myhre et al., 2013). A positive forcing indicates net energy trapped in the Earth system and suggests warming of the Earth's surface, whereas a negative forcing indicates net loss of energy and suggests cooling (U.S. EPA, 2019a, section 13.3.2.2).

[156] As discussed in the 2019 ISA (U.S. EPA, 2019a, section 13.4.1), corrosion typically involves reactions of acidic PM (*i.e.,* acidic sulfate or nitrate) with material surfaces, but gases like SO_2 and nitric acid (HNO_3) also contribute. Because ''the impacts of gaseous and particulate N and S wet deposition cannot be clearly distinguished'' (U.S. EPA, 2019a, p. 13–1), the assessment of the evidence in the 2019 ISA considers the combined impacts.

associated limitations and uncertainties and a lack of evidence to inform quantitative relationships between PM and materials effects, therefore leading to similar conclusions about the PM-related effects on materials.

3. Summary of Air Quality and Quantitative Information

Beyond the consideration of the scientific evidence, as discussed in section V.A.2 above, quantitative analyses of PM air quality, when available, can also inform conclusions on the adequacy of the public welfare protection provided by the current secondary PM standards.

a. Visibility Effects

In the 2012 and 2020 reviews, quantitative analyses for PM-related visibility effects focused on daily visibility impairment, given the short-term nature of PM-related visibility effects. The evidence and information available in this reconsideration continues to provide support for the short-term (*i.e.,* hourly or daily) nature of PM-related visibility impairment. As such, the quantitative analyses presented in the 2022 PA continue to focus on daily visibility impairment and utilize a two-phase assessment approach for visibility impairment, consistent with the approaches taken in past reviews. First, the 2022 PA considers the appropriateness of the elements (indicator, averaging time, form, and level) of the visibility index for providing protection against PM-related visibility effects. Second, recent air quality was used to evaluate the relationship between the current secondary 24-hour $PM_{2.5}$ standard and the visibility index. The information available since the 2012 review includes an updated equation for estimating light extinction, summarized in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.1) and described in the 2019 ISA (U.S. EPA, 2019a, section 13.2.3.3), as well as more recent air monitoring data, that together allow for development of an updated assessment of PM-related visibility impairment in study locations in the U.S.

i. Target Level of Protection in Terms of a $PM_{2.5}$ Visibility Index

In evaluating the adequacy of the current secondary PM standards, the 2022 PA first evaluates the appropriateness of the elements (indicator, averaging time, form, and level) identified for a visibility index to protect against visibility effects. In previous reviews, the visibility index as set at a level of 30 dv, with estimated light extinction as the indicator, a 24-hour averaging time, and a 90th percentile form, averaged over three years.

With regard to an indicator for the visibility index, the 2022 PA recognizes the lack of availability of methods and an established network for directly measuring light extinction (U.S. EPA, 2022b, section 5.3.1.1). Therefore, consistent with previous reviews, the 2022 PA concludes that a visibility index based on estimates of light extinction by $PM_{2.5}$ components derived from an adjusted version of the original IMPROVE algorithm to be the most appropriate indicator for the visibility index in this reconsideration. As described in section 5.3.1.1 of the 2022 PA, the IMPROVE algorithm estimates light extinction using routinely monitored components of $PM_{2.5}$ and $PM_{10-2.5}$, along with estimates of relative humidity (U.S. EPA, 2022b, section 5.3.1.1).

With regard to averaging time, the 2022 PA notes that the evidence continues to provide support for the short-term nature of PM-related visibility effects. Given that there is no new information available regarding the time periods during which visibility impairment occurs or public preferences related to specific time periods for visibility impairment, the 2022 PA concludes that it is appropriate to continue to focus on daily visibility impairment. In so doing, the 2022 PA relies on analyses that were conducted in the 2012 review that showed relatively strong correlations between 24-hour and subdaily (*i.e.,* 4-hour average) $PM_{2.5}$ light extinction that indicated that a 24-hour averaging time is an appropriate surrogate for the subdaily time periods relevant for visual perception (U.S. EPA, 2011, Figures G–4 and G–5; Frank, 2012). These analyses continue to provide support for a 24-hour averaging time for the visibility index in this reconsideration. Consistent with previous reviews, the 2022 PA also notes that the 24-hour averaging time may be less influenced by atypical conditions and/or atypical instrument performance than a subdaily averaging time (85 FR 82740, December 18, 2020; 78 FR 3226, January 15, 2013).

With regard to the form for the visibility index, the available information continues to provide support for a 3-year average of annual 90th percentile values. Given that there is no new information to inform selection of an alternate form, as in previous reviews, the 2022 PA notes that the 3-year average form provides stability from the occasional effect of inter-annual meteorological variability that can result in unusually high pollution levels for a particular year (85 FR 82741, December 18, 2020; 78 FR 3198, January 15, 2013; U.S. EPA, 2011, p. 4–58). In so doing, the 2022 PA considers the evaluation in the 2010 Urban-Focused Visibility Assessment (UFVA) of three different statistical forms: 90th, 95th, and 98th percentiles (U.S. EPA, 2010b, Chapter 4).). In considering this evaluation of statistical forms from the 2010 UFVA, consistent with the 2011 PA, the 2022 PA notes that the Regional Haze Program targets the 20 percent most impaired days for visibility improvements in visual air quality in Federal Class I areas and that the median of the distribution of these 20 percent most impaired days would be the 90th percentile. The 2011 PA also noted that strategies that are implemented so that 90 percent of days would have visual air quality that is at or below the level of the visibility index would reasonably be expected to lead to improvements in visual air quality for the 20 percent most impaired days. Additionally, as in the 2011 PA, the 2022 PA recognizes that the available public preference studies do not address frequency of occurrence of different levels of visibility (U.S. EPA, 2022b, section 5.3.1.2). Therefore, the analyses and consideration for the form of a visibility index from the 2011 PA continue to provide support for a 90th percentile form, averaged across three years, in defining the characteristics of a visibility index in this reconsideration.

With regard to the level for the visibility index, the 2022 PA recognizes that there is an additional public preference study (Malm et al., 2019) available in this reconsideration. As noted above, however, this study differs from the previously available public preference studies in several ways, which makes it difficult to integrate this newly available study with the previously available studies. Most significantly, this study was evaluated public preferences for visibility in the Grand Canyon, perhaps the most notable Class I area in the country for visibility purposes. Therefore, the 2022 PA concludes that the Grand Canyon study is not directly comparable to the other available preferences studies and public preferences of visibility impairment in the Malm et al. (2019) study are not appropriate to consider in identifying a range of levels for the target level of protection against visibility impairment for this reconsideration of the secondary PM NAAQS.

Therefore, the 2022 PA continues to rely on the same studies [157] and the range of 20 to 30 dv identified from those studies in previous reviews. With regard to selecting the appropriate target level of protection for visibility impairment within this range, the 2022 PA notes that in previous reviews, a level at the upper end of the range (*i.e.,* 30 dv) was selected given the uncertainties and limitations associated with the public preference studies (U.S. EPA, 2022b, section 5.3.1.1). However, the 2022 PA also recognizes that (1) the degree of protection provided by a secondary PM NAAQS is not determined solely by any one element of the standard but by all elements (*i.e.,* indicator, averaging time, form, and level) being considered together, and (2) decisions regarding the adequacy of the current secondary standards is a public welfare policy judgment to be made by the Administrator. As such, the Administrator may judge that a target level of protection below the upper end of the range (*i.e.,* less than 30 dv) is appropriate, depending on his public welfare policy judgments, which draw upon the available scientific evidence for PM-related visibility effects and on analyses of visibility impairment, as well as judgments about the appropriate weight to place on the range of uncertainties inherent in the evidence and analyses.

In considering the available public preference studies, consistent with past reviews, the 2022 PA concludes that it is reasonable to consider a range of 20 to 30 dv for selecting a target level of protection, including a high value of 30 dv, a midpoint value of 25 dv, and a low value of 20 dv. A target level of protection at or in the upper end of the range would focus on the Washington, DC, preference study results (Abt Associates, 2001; Smith and Howell, 2009), which identified 30 dv as the level of impairment that was determined to be ''acceptable'' by at least 50 percent of study participants. The public preferences of visibility impairment in the Washington, DC, study are likely to be generally representative of urban areas that do not have valued scenic elements (*e.g.,* mountains) in the distant background. This would be more representative of areas in the middle of the country and many areas in the eastern U.S., as well as possibly some areas in the western U.S.

A target level of protection in the middle of the range would be most closely associated with the level of impairment that was determined to be ''acceptable'' by at least 50 percent of study participants in the Phoenix, AZ, study (BBC Research & Consulting, 2003), which was 24 dv. This study, while methodologically similar to the other public preference studies, included participants that were selected as a representative sample of the Phoenix area population [158] and used computer-generated images to depict specific uniform visibility impairment conditions. This study yielded the best results of the four public preference studies in terms of the least noisy preference results and the most representative selection of participants. Therefore, based on this study, the use of 25 dv to represent a midpoint within the range of target levels protection is well supported.

A target level of protection at or just above the lower end of the range would focus on the Denver, CO, study, but may not be as strongly supported as higher levels within the range (Ely et al., 1991). Older studies, such as those conducted in Denver, CO (Ely et al., 1991), and British Columbia, Canada (Pryor, 1996), used photographs that were taken at different times of the day and on different days to capture a range of light extinction levels needed for the preference studies. Compared to studies that used computer-generated images (*i.e.,* those in Phoenix, AZ, and Washington, DC) there was more variability in scene appearance in these older studies that could affect preference rating and includes uncertainties associated with using ambient measurements to represent sight path-averaged light extinction values rather than superimposing a computer-generated amount of haze onto the images. When using photographs, the intrinsic appearance of the scene can change due to meteorological conditions (*i.e.,* shadow patterns and cloud conditions) and spatial variations in ambient air quality that can result in ambient light extinction measurement not being representative of the sight-path-averaged light extinction. Computer-generated images, such as those generated with WinHaze, do not introduce such uncertainties, as the same base photograph is used (*i.e.,* there is no intrinsic change in scene appearance) and the modeled haze that is superimposed on the photograph is determined based on uniform light extinction throughout the scene.

In addition to differences in preferences that may arise from photographs versus computer-generated images, urban visibility preference may differ by location, and such differences may arise from differences in the cityscape scene that is depicted in the images. These differences are related to the perceived value of objects and scenes that are included in the image, as objects at a greater distance have a greater sensitivity to perceived visibility changes as light extinction is changed compared to similar scenes with objects at shorter distances. For example, a person (regardless of their location) evaluating visibility in an image with more scenic elements such as mountains or natural views may value better visibility conditions in these images compared to the same level of visibility impairment in an image that only depicts urban features such as buildings and roads. That is, if a person was shown the same level of visibility impairment in two images depicting different scenes—one with mountains in the background and urban features in the foreground and one with no mountains in the background and nearby buildings in the image without mountains in the distance—may find the amount of haze to be unacceptable in the image with the mountains in the distance because of a greater perceived value of viewing the mountains, while finding the amount of haze to be acceptable in the image with the buildings because of a lesser value of viewing the cityscape or an expectation that such urban areas may generally have higher levels of haze in general. This is consistent when comparing the differences between the Denver, CO, study results (which found the 50% acceptance criteria occurred at the best visual air quality levels among the four cities) and the Washington, DC, results (which found the 50% acceptability criteria occurred at the worst visual air quality levels among the four cities). These results may occur because the most prominent and picturesque feature of the cityscape of Denver is the visible snow-covered mountains in the distance, while the prominent and

[157] As noted above, the available public preference studies include those conducted in Denver, Colorado (Ely et al., 1991), Vancouver, British Columbia, Canada (Pryor, 1996), Phoenix, Arizona (BBC Research & Consulting, 2003), and Washington, DC (Abt Associates, 2001; Smith and Howell, 2009).

[158] The other preference studies did not include populations that were necessarily representative of the population in the area for which the images being judged. For example, in the Denver, CO, study, participants were from intact groups (*i.e.,* those who were meeting for other reasons) and were asked to provide a period of time during a regularly scheduled meeting to participate in the study (Ely et al., 1991). As another example, in the British Columbia, Canada, study, participants were recruited from undergraduate and graduate students enrolled in classes at the University of British Columbia's Department of Geography (Pryor, 1996).

picturesque features of the Washington, DC, cityscape are buildings relatively nearby without prominent and/or valued scenic features that are more distant. Given these variabilities in preferences it is unclear to what extent, the available evidence provides strong support for a target level of protection at the lower end of the range. Future studies that reduce sources of noisiness and uncertainty in the results could provide more information that would support selection of a target level of protection at or just above the lower end of the range.

Taken together, the 2022 PA concludes that available information continues to support a visibility index with estimated light extinction as the indicator, a 24-hour averaging time, and a 90th percentile form, averaged over three years, with a level within the range of 20 to 30 dv.

ii. Relationship Between the $PM_{2.5}$ Visibility Index and the Current Secondary 24-Hour $PM_{2.5}$ Standard

The 2022 PA presents quantitative analyses based on recent air quality that evaluate the relationship between recent air quality and calculated light extinction. As in previous reviews, these analyses explored this relationship as an estimate of visibility impairment in terms of the 24-hour $PM_{2.5}$ standard and the visibility index. Generally, the results of the updated analyses are similar to those based on the data available at the time of the 2012 and 2020 reviews (U.S. EPA, 2022b, section 5.3.1.2). As discussed in section V.C.1.a above, the 2022 PA concludes that the available evidence continues to support a visibility index with estimated light extinction as the indicator, a 24-hour averaging time, and a 90th percentile form, averaged over three years, with a level within the range of 20 to 30 dv. These analyses evaluate visibility impairment in the U.S. under recent air quality conditions, particularly those conditions that meet the current standards, and the relative influence of various factors on light extinction. Given the relationship of visibility with short-term PM, we focus particularly on the short-term PM standards.[159] Compared to the 2012 review, updated analyses incorporate several refinements, including (1) the evaluation of three versions of the IMPROVE equation to calculate light extinction (U.S. EPA, 2022b, Appendix D, Equations D–1 through D–3) in order to better understand the influence of variability in equation inputs;[160] (2) the use of 24-hour relative humidity data, rather than monthly average relative humidity as was used in the 2012 review (U.S. EPA, 2022b, section 5.3.1.2, Appendix D); and (3) the inclusion of the coarse fraction in the estimation of light extinction (U.S. EPA, 2022b, section 5.3.1.2, Appendix D). The analyses in the reconsideration are updated from the 2012 and 2020 reviews and include 60 monitoring sites that measure $PM_{2.5}$ and PM_{10} and are geographically distributed across the U.S. in both urban and rural areas (U.S. EPA, 2022b, Appendix D, Figure D–1).

When light extinction was calculated using the revised IMPROVE equation, in areas that meet the current 24-hour $PM_{2.5}$ standard for the 2017–2019 time period, all sites have light extinction estimates at or below 26 dv (U.S. EPA, 2022b, Figure 5–3). For the four locations that exceed the current 24-hour $PM_{2.5}$ standard, light extinction estimates range from 22 dv to 27 dv (U.S. EPA, 2022b, Figure 5–3). These findings are consistent with the findings of the analyses using the same IMPROVE equation in the 2012 review with data from 102 sites with data from 2008–2010 and in the 2020 review with data from 67 sites with data from 2015–2017. The analyses presented in the 2022 PA indicate similar findings to those from the analyses in the 2012 and 2020 reviews, *i.e.,* the updated quantitative analysis shows that the 3-year visibility metric was no higher than 30 dv[161] at sites meeting the current secondary PM standards, and at most such sites the 3-year visibility index values are much lower (*e.g.,* an average of 20 dv across the 60 sites).[162]

When light extinction was calculated using the revised IMPROVE equation,[163] the resulting 3-year visibility metrics are nearly identical to light extinction estimates calculated using the original IMPROVE equation (U.S. EPA, 2022b, Figure 5–4), but some sites are just slightly higher. Using the revised IMPROVE equation, for those sites that meet the current 24-hour $PM_{2.5}$ standard, the 3-year visibility metric is at or below 26 dv. For the four locations that exceed the current 24-hour $PM_{2.5}$ standard, light extinction estimates range from 22 dv to 29 dv (U.S. EPA, 2022b, Figure 5–4). These results are similar to those for light extinction calculated using the original IMPROVE equation,[164] and those from previous reviews.

When light extinction was calculated using the refined equation from Lowenthal and Kumar (2016), the resulting 3-year visibility metrics are slightly higher at all sites compared to light extinction estimates calculated using the original IMPROVE equation (U.S. EPA, 2022b, Figure 5–5).[165] These higher estimates are to be expected, given the higher OC multiplier included in the IMPROVE equation from Lowenthal and Kumar (2016), which reflects the use of data from remote areas with higher concentrations of organic PM when validating the equation. As such, it is important to note that the Lowenthal and Kumar (2016) version of the equation may overestimate light extinction in non-remote areas, including the urban areas in the updated analyses in this reconsideration.

Nevertheless, when light extinction is calculated using the Lowenthal and

[159] The analyses presented in the 2022 PA focus on the visibility index and the current secondary 24-hour $PM_{2.5}$ standard with a level of 35 $\mu g/m^3$. However, we recognize that all three secondary PM standards influence the PM concentrations associated with the air quality distribution. As noted in section V.A.1 above, the current secondary PM standards include the 24-hour $PM_{2.5}$ standard, with its level of 35 $\mu g/m^3$, the annual $PM_{2.5}$ standard, with its level of 15.0 $\mu g/m^3$, and the 24-hour PM_{10} standard, with its level of 150 $\mu g/m^3$. With regard to the annual $PM_{2.5}$ standard, we note that all 60 areas included in the analyses meet the current secondary annual PM standard (U.S. EPA, 2022b, Table D–7).

[160] While the $PM_{2.5}$ monitoring network has an increasing number of continuous FEM monitors reporting hourly $PM_{2.5}$ mass concentrations, there continue to be data quality uncertainties associated with providing hourly $PM_{2.5}$ mass and component measurements that could be input into IMPROVE equation calculations for subdaily visibility impairment estimates. As detailed in the 2022 PA, there are uncertainties associated with the precision and bias of 24-hour $PM_{2.5}$ measurements (U.S. EPA, 2022b, p. 2–18), as well as to the fractional uncertainty associated with 24-hour PM component measurements (U.S. EPA, 2022b, p. 2–21). Given the uncertainties present when evaluating data quality on a 24-hour basis, the uncertainty associated with subdaily measurements may be even greater. Therefore, the inputs to these light extinction calculations are based on 24-hour average measurements of $PM_{2.5}$ mass and components, rather than subdaily information.

[161] A 3-year visibility metric with a level of 30 dv would be at the upper end of the range of levels identified from the public preference studies.

[162] When light extinction is calculated using the original IMPROVE equation, all 60 sites have 3-year visibility metrics below 30 dv, 58 sites are at or below 25 dv, and 26 sites are at or below 20 dv (see U.S. EPA, 2022b, Appendix D, Table D–3).

[163] As described in more detail in the 2022 PA, the revised IMPROVE equation divides PM components into smaller and larger sizes of particles in $PM_{2.5}$, with separate mass scattering efficiencies and hygroscopic growth functions for each size category (U.S. EPA, 2022b, section 5.3.1.1).

[164] When light extinction is calculated using the revised IMPROVE equation, all 60 sites have 3-year visibility metrics below 30 dv, 56 sites are at or below 25 dv, and 26 sites are at or below 20 dv (see U.S. EPA, 2022b, Appendix D, Table D–3).

[165] When light extinction is calculated using the Lowenthal and Kumar IMPROVE equation, 59 sites have 3-year visibility metrics below 30 dv, 45 sites are at or below 25 dv, and 15 sites are at or below 20 dv. The one site with a 3-year visibility metric of 32 dv exceeds the secondary 24-hour $PM_{2.5}$ standard, with a design value of 56 $\mu g/m^3$ (see U.S. EPA, 2022b, Appendix D, Table D–3).

Kumar (2016) equation for those sites that meet the current 24-hour $PM_{2.5}$ standard, the 3-year visibility metric is generally at or below 28 dv. For those sites that exceed the current 24-hour $PM_{2.5}$ standard, three of these sites have a 3-year visibility metric ranging between 26 dv and 30 dv, while one site in Fresno, California that exceeds the current 24-hour $PM_{2.5}$ standard and has a 3-year visibility index value of 32 dv (compared to 29 dv when light extinction is calculated with the original IMPROVE equation) (see U.S. EPA, 2022b, Appendix D, Table D–3). At this site, it is likely that the 3-year visibility metric using the Lowenthal and Kumar (2016) equation would be below 30 dv if $PM_{2.5}$ concentrations were reduced such that the 24-hour $PM_{2.5}$ level of 35 $\mu g/m^3$ was attained.

In considering visibility impairment under recent air quality conditions, the 2022 PA recognizes that the differences in the inputs to equations estimating light extinction can influence the resulting values. For example, given the varying chemical composition of emissions from different sources, the 2.1 multiplier for converting OC to organic matter (OM) in the Lowenthal and Kumar (2016) equation may not be appropriate for all source types. At the time of the 2012 review, the EPA judged that a 1.6 multiplier was more appropriate, for the purposes of estimating visibility index at sites across the U.S., than the 1.4 or 1.8 multipliers used in the original and revised IMPROVE equations, respectively. A multiplier of 1.8 or 2.1 would account for the more aged and oxygenated organic PM that tends to be found in more remote regions than in urban regions, whereas a multiplier of 1.4 may underestimate the contribution of organic PM found in remote regions when estimating light extinction (78 FR 3206, January 15, 2013; U.S. EPA, 2012, p. IV–5). The available scientific information and results of the air quality analyses indicate that it may be appropriate to select inputs to the IMPROVE equation (*e.g.,* the multiplier for OC to OM) on a regional basis rather than a national basis when calculating light extinction. This is especially true when comparing sites with localized PM sources (such as sites in urban or industrial areas) to sites with PM derived largely from biogenic precursor emissions (that contribute to widespread secondary organic aerosol formation), such as those in the southeastern U.S. The 2022 PA notes, however, that conditions involving PM from such different sources have not been well studied in the context of applying a multiplier to estimate light extinction, contributing uncertainty to estimates of light extinction for such conditions.

At the time of the 2012 review, the EPA noted that $PM_{2.5}$ is the size fraction of PM responsible for most of the visibility impairment in urban areas (77 FR 38980, June 29, 2012). Data available at the time of the 2012 review suggested that, generally, $PM_{10–2.5}$ was a minor contributor to visibility impairment most of the time (U.S. EPA, 2010b) although the coarse fraction may be a major contributor in some areas in the desert southwestern region of the U.S. Moreover, at the time of the 2012 review, there were few data available from $PM_{10–2.5}$ monitors to quantify the contribution of coarse PM to calculated light extinction. Since that time, an expansion in $PM_{10–2.5}$ monitoring efforts has increased the availability of data for use in estimating light extinction with both $PM_{2.5}$ and $PM_{10–2.5}$ concentrations included as inputs in the equations. The analysis in the 2020 PA addressed light extinction at 20 of the 67 $PM_{2.5}$ sites where collocated $PM_{10–2.5}$ monitoring data were available. Since that time, $PM_{10–2.5}$ monitoring data are available at more locations and the analyses presented in the 2022 PA include those for light extinction estimated with coarse and fine PM at all 60 sites. Generally, the contribution of the coarse fraction to light extinction at these sites is minimal, contributing less than 1 dv to the 3-year visibility metric (U.S. EPA, 2020b, section 5.2.1.2). However, the 2022 PA notes that in the updated quantitative analyses, only a few sites were in locations that would be expected to have high concentrations of coarse PM, such as the Southwest. These results are consistent with those in the analyses in the 2019 ISA, which found that mass scattering from $PM_{10-2.5}$ was relatively small (less than 10%) in the eastern and northwestern U.S., whereas mass scattering was much larger in the Southwest (more than 20%) particularly in southern Arizona and New Mexico (U.S. EPA, 2019a, section 13.2.4.1, p. 13–36).

Overall, the findings of these updated quantitative analyses are generally consistent with those in the 2012 and 2020 reviews. The 3-year visibility metric was generally below 26 dv in most areas that meet the current 24-hour $PM_{2.5}$ standard. Small differences in the 3-year visibility metric were observed between the variations of the IMPROVE equation, which may suggest that it may be more appropriate to use one version over another in different regions of the U.S. based on PM characteristics such as particle size and composition to more accurately estimate light extinction.

b. Non-Visibility Effects

Consistent with the evidence available at the time of the 2012 and 2020 reviews, and as described in detail in the 2022 PA (U.S. EPA, 2022b, section 5.3.2.2), the data remain insufficient to conduct quantitative analyses for PM effects on climate and materials. For PM-related climate effects, as explained in more detail in the proposal (88 FR 5654, January 27, 2023), our understanding of PM-related climate effects is still limited by significant key uncertainties. The recently available evidence does not appreciably improve our understanding of the spatial and temporal heterogeneity of PM components that contribute to climate forcing (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). Significant uncertainties also persist related to quantifying the contributions of PM and PM components to the direct and indirect effects on climate forcing, such as changes to the pattern of rainfall, changes to wind patterns, and effects on vertical mixing in the atmosphere (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). Additionally, while improvements have been made to climate models since the completion of the 2009 ISA, the models continue to exhibit variability in estimates of the PM-related climate effects on regional scales (*e.g.,* ~100 km) compared to simulations at the global scale (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). While our understanding of climate forcing on a global scale is somewhat expanded since the 2012 review, significant limitations remain to quantifying potential adverse PM-related climate effects in the U.S. and how they would vary in response to incremental changes in PM concentrations across the U.S. As such, while recent research is available on climate forcing on a global scale, the remaining limitations and uncertainties are significant, and the recent global scale research does not translate directly for use at regional spatial scales. Therefore, the evidence does not provide a clear understanding at the necessary spatial scales for quantifying the relationship between PM mass in ambient air and the associated climate-related effects in the U.S. that would be necessary to evaluate or consider a level of air quality to protect against such effects and for informing consideration of a national PM standard on climate in this reconsideration (U.S. EPA, 2022b, section 5.3.2.2.1; U.S. EPA, 2019a, section 13.3).

For PM-related materials effects, as explained in more detail in the 2022 PA (U.S. EPA, 2022b, section 5.3.2.2), the available evidence has been somewhat expanded to include additional information about the soiling process and the types of materials impacted by PM. This evidence provides some limited information to inform dose-response relationships and damage functions associated with PM, although most of these studies were conducted outside of the U.S. where PM concentrations in ambient air are typically above those observed in the U.S. (U.S. EPA, 2022b, section 5.3.2.1.2; U.S. EPA, 2019a, section 13.4). The evidence on materials effects characterized in the 2019 ISA also includes studies examining effects of PM on the energy efficiency of solar panels and passive cooling building materials, although the evidence remains insufficient to establish quantitative relationships between PM in ambient air and these or other materials effects (U.S. EPA, 2022b, section 5.3.2.1.2). While the available evidence assessed in the 2019 ISA is somewhat expanded since the time of the 2012 review, quantitative relationships have not been established for PM-related soiling and corrosion and frequency of cleaning or repair that further the understanding of the public welfare implications of materials effects (U.S. EPA, 2022b, section 5.3.2.2.2; U.S. EPA, 2019a, section 13.4). Therefore, there is insufficient information to inform quantitative analyses assessing materials effects to inform consideration of a national PM standard on materials in this reconsideration (U.S. EPA, 2022b, section 5.3.2.2.2; U.S. EPA, 2019a, section 13.4).

B. Conclusions on the Secondary PM Standards

In drawing conclusions on the adequacy of the current secondary PM standards, in view of the advances in scientific knowledge and additional information now available, the Administrator has considered the evidence base, information, and policy judgments that were the foundation of the 2020 decision and reflects upon the body of information and evidence available in this reconsideration. In so doing, the Administrator has taken into account both evidence-based and quantitative information-based considerations, as well as advice from the CASAC and public comments. Evidence-based considerations draw upon the EPA's assessment and integrated synthesis of the scientific evidence from studies evaluating welfare effects related to visibility, climate, and materials associated with PM in ambient air as discussed in the 2022 PA (summarized in sections V.B and V.D.2 of the proposal, section V.A.2 above). The quantitative information-based considerations draw from the results of the quantitative analyses of visibility impairment presented in the 2022 PA (as summarized in section V.C of the proposal and V.A.3 above) and consideration of these results in the 2022 PA.

Consideration of the scientific evidence and quantitative information in the 2022 PA and by the Administrator is framed by consideration of a series of policy-relevant questions. Section V.B.2 below summarizes the rationale for the Administrators proposed decision, drawing from section V.D.3 of the proposal. The advice and recommendations of the CASAC and public comments on the proposed decision are addressed below in sections V.B.1 and V.B.3, respectively. The Administrator's conclusions in this reconsideration regarding the adequacy of the secondary PM standards and whether any revisions are appropriate are described in section V.D.4.

1. CASAC Advice

In comments on the 2019 draft PA, the CASAC concurred with the staff's overall preliminary conclusions that it is appropriate to consider retaining the current secondary standards without revision (Cox, 2019b). The CASAC ''finds much of the information . . . on visibility and materials effects of $PM_{2.5}$ to be useful, while recognizing that uncertainties and controversies remain about the best ways to evaluate these effects'' (Cox, 2019b, p. 13 of consensus responses). Regarding climate, while the CASAC agreed that research on PM-related effects has expanded since the 2012 review, it also concluded that ''there are still significant uncertainties associated with the accurate measurement of PM to the direct and indirect effects of PM on climate'' (Cox, 2019b, pp. 13–14 of consensus responses). The committee recommended that the EPA summarize the ''current scientific knowledge and quantitative modeling results for effects of reducing $PM_{2.5}$'' on several climate-related outcomes (Cox, 2019b, p. 14 of consensus responses), while also recognizing that ''it is appropriate to acknowledge uncertainties in climate change impacts and resulting welfare impacts in the United States of reductions in $PM_{2.5}$ levels'' (Cox, 2019b, p. 14 of consensus responses). When considering the overall body of scientific evidence and technical information for PM-related effects on visibility, climate, and materials, the CASAC agreed with the EPA's preliminary conclusions in the 2019 draft PA, stating that ''the available evidence does not call into question the protection afforded by the current secondary PM standards and concurs that they should be retained'' (Cox, 2019b, p. 3 of letter).

In this reconsideration, the CASAC provided its advice regarding the current secondary PM standards in the context of its review of the 2021 draft PA (Sheppard, 2022a). In its comments on the 2021 draft PA, the CASAC first recognized that the scientific evidence is sufficient to support a causal relationship between PM and visibility effects, climate effects and materials effects.

With regard to visibility effects, the CASAC recognized that the identification of a target level of protection for the visibility index is based on a limited number of studies and suggested that ''additional region- and view-specific visibility preference studies and data analyses are needed to support a more refined visibility target'' (Sheppard, 2022a, p. 21 of consensus responses). While the CASAC did not recommend revising either the target level of protection for the visibility index or the level of the current 24-hour $PM_{2.5}$ standard, they did state that a visibility index of 30 deciviews ''needs to be justified'' and ''[i]f a value of 20–25 deciviews is deemed to be an appropriate visibility target level of protection, then a secondary 24-hour $PM_{2.5}$ standard in the range of 25–35 $\mu g/m^3$ should be considered'' (Sheppard, 2022a, p. 21 of consensus responses).

The CASAC also recognized the limited availability of monitoring methods and networks for directly measuring light extinction. As such, they suggest that ''[a] more extensive technical evaluation of the alternatives for visibility indicators and practical measurement methods (including the necessity for a visibility FRM) is need for future reviews'' (Sheppard, 2022a, p. 22 of consensus letter). The majority of the CASAC ''recommend[ed] that an FRM for a directly measured $PM_{2.5}$ light extinction indicator be developed'' to inform the consideration of the protection afforded by the secondary PM standards against visibility impairment, the minority of the CASAC ''believe that a light extinction FRM is not necessary to set a secondary standard protective of visibility'' (Sheppard, 2022a, p. 22 of consensus responses).

With regard to climate, the CASAC noted that ''there is a causal relationship between PM and climate change, but large uncertainties remain'' and recommended additional research (Sheppard, 2022a, p. 22 of consensus responses). With respect to materials damage, the CASAC noted that ''[q]uantitative information on the relationship between PM and material damage is lacking'' and suggested some additional studies and research approaches that could provide additional information on the effects of PM on materials and the quantitative assessment of the relationship between materials effects and PM in ambient air (Sheppard, 2022a, p. 23 of consensus responses).

2. Basis for the Proposed Decision

In reaching his proposed conclusions, the Administrator first recognized that, consistent with the scope of this reconsideration, his decision in this reconsideration will be focused only and specifically on the adequacy of public welfare protection provided by the secondary PM standards from effects related to visibility, climate, and materials. He then considered the assessment of the current evidence and conclusions reached in the 2019 ISA and ISA Supplement; the currently available quantitative information, including associated limitations and uncertainties, described in detail and characterized in the 2022 PA; considerations and staff conclusions and associated rationales presented in the 2022 PA; and the advice and recommendations from the CASAC (88 FR 5655, January 27, 2023).

With respect to visibility, the Administrator noted the longstanding body of evidence that demonstrates a causal relationship between ambient PM and effects on visibility (U.S. EPA, 2019a, section 13.2). and that visibility impairment can have implications for people's enjoyment of daily activities and for their overall sense of well-being. Therefore, as in previous reviews, he considered the degree to which the current secondary standards protect against PM-related visibility impairment. In so doing, and consistent with previous reviews, the Administrator considered the protection provided by the current secondary standards against PM-related visibility impairment in conjunction with the Regional Haze Program [166] for protecting visibility in Class I areas,[167] which together would be expected to achieve appropriate visual air quality across all areas (88 FR 5658, January 27, 2023). The Administrator proposed to conclude that addressing visibility impairment in Class I areas is beyond the scope of the secondary PM NAAQS and that setting the secondary PM NAAQS at a level that would remedy visibility impairment in Class I areas would result in standards that are more stringent than is requisite.

In further considering what standards are requisite to protect against adverse public welfare effects from visibility impairment, the Administrator adopted an approach consistent with the approach used in previous reviews (88 FR 5645, January 27, 2023). That is, he first identified an appropriate target level of protection in terms of a PM visibility index that accounts for the factors that influence the relationship between particles in the ambient air and visibility (*i.e.,* size fraction, species composition, and relative humidity). He then considered air quality analyses examining the relationship between this PM visibility index and the current secondary 24-hour $PM_{2.5}$ standard in locations meeting the current 24-hour $PM_{2.5}$ and PM_{10} standards (U.S. EPA, 2022b, section 5.3.1.2; 88 FR 5650, January 27, 2023).

To identify a target level of protection, the Administrator first considered the characteristics of the visibility index and defines its elements (indicator, averaging time, form, and level). With regard to the indicator for the visibility index, the Administrator recognized that there is a lack of availability of methods and an established network for directly measuring light extinction, consistent with the conclusions reached in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.1) and with the CASAC's recommendation for additional research on direct measurement methods for light extinction in their review of the 2021 draft PA (Sheppard, 2022a, p. 22 of consensus responses). Consistent with the approaches used in reaching decisions in 2012 and 2020, given the lack of such monitoring data, the Administrator preliminarily judged that estimated light extinction, as calculated using one or more versions of the IMPROVE algorithms, continues to be the most appropriate indicator for the visibility index in this reconsideration (88 FR 5659, January 27, 2023).

In further defining the characteristics of a visibility index based on estimates of light extinction, the Administrator considered the appropriate averaging time, form, and level of the index. With regard to the averaging time and form, the Administrator noted that in previous reviews, a 24-hour averaging time was selected and the form was defined as the 3-year average of annual 90th percentile values. The Administrator recognized that the evidence available in this reconsideration and described in the 2022 PA continue to provide support for the short-term nature of PM-related visibility effects. Considering the available analyses of 24-hour and subdaily $PM_{2.5}$ light extinction, and noting that the CASAC did not provide advice or recommendations with regard to the averaging time of the visibility index, the Administrator preliminarily judged that the 24-hour averaging time continues to be appropriate for the visibility index (88 FR 5659, January 27, 2023).

With regard to the form of the visibility index, the Administrator noted that, consistent with the approach taken in other NAAQS, including the current secondary 24-hour $PM_{2.5}$ NAAQS, a multi-year percentile form offers greater stability to the air quality management process by reducing the possibility that statistically unusual indicator values will lead to transient violations of the standard. Using a 3-year average provides stability from the occasional effects of inter-annual meteorological variability that can result in unusually high pollution levels for a particular year (88 FR 5659, January 27, 2023). In considering the percentile that would be appropriate with the 3-year average, the Administrator first noted that the Regional Haze Program targets the 20% most impaired days for improvements in visual air quality in Class I areas.[168] Based on analyses examining 90th, 95th, and 98th percentile forms, the Administrator preliminarily judged that a focus similar to the Regional Haze Program focused on improving the 20% most impaired days suggest that the 90th percentile, which represents the median of the 20% most impaired days, such that 90% of days have visual air quality that is at or below the target level of protection of the visibility

[166] The Regional Haze Program was established by Congress specifically to achieve ''the prevention of any future, and the remedying of existing, impairment of visibility in mandatory Class I areas, which impairment results from man-made air pollution,'' and that Congress established a long-term program to achieve that goal (CAA section 169A).

[167] In adopting section 169A, Congress set a goal of eliminating anthropogenic visibility impairment at Class I areas, as well as a framework for achieving that goal which extends well beyond the planning process and timeframe for attaining secondary NAAQS. Thus, the Regional Haze Program will continue to contribute to reductions in visibility impairment in Class I areas.

[168] As noted above, the Administrator viewed the Regional Haze Program as a complement to the secondary PM NAAQS, and thus took into consideration its approach to improving visibility in considering how to address visibility outside of Class I areas.

index, would be reasonably expected to lead to improvements in visual air quality for the 20% most impaired days (88 FR 5659, January 27, 2023). In the analyses of percentiles, the results suggest that a higher percentile value could have the effect of limiting the occurrence of days with peak PM-related light extinction in areas outside of Federal Class I areas to a greater degree. However, the Administrator preliminarily concluded that it is appropriate to balance concerns about focusing on the group of most impaired days with concerns about focusing on the days with peak visibility impairment. Additionally, the Administrator noted that the CASAC did not provide advice or recommendations related to the form of the visibility index. Therefore, the Administrator preliminarily judged that it remains appropriate to define a visibility index in terms of a 24-hour averaging time and a form based on the 3-year average of annual 90th percentile values (88 FR 5659, January 27, 2023).

With regard to the level of the visibility index, the Administrator first noted that the scientific evidence that is available to inform the level of the visibility index is largely the same as in previous reviews, and continues to provide support for a level within the range of 20 to 30 dv (88 FR 5659–5660, January 27, 2023). The Administrator recognized that significant uncertainties and limitations remained, in particular those related to the public preference studies, including methodological differences between the studies, and that the available studies may not capture the full range of visibility preferences in the U.S. population (88 FR 5659–5660, January 27, 2023). The Administrator also noted that, in their review of the 2021 draft PA, the CASAC recognized that a judgment regarding the appropriate target level of protection for the visibility index is based on a limited number of visibility preference studies, with studies conducted in the western U.S. reporting public preferences for visibility impairment associated with the lower end of the range of levels, while studies conducted in the eastern U.S. reporting public preferences associated with the upper end of the range (Sheppard, 2022a, p. 21 of consensus responses). The Administrator noted that there have long been significant questions about how to set a national standard for visibility that is not overprotective for some areas of the U.S. In establishing the Regional Haze Program to improve visibility in Class I areas, Congress noted that ''as a matter of equity, the national ambient air quality standards cannot be revised to adequately protect visibility in all areas of the country.'' H.R. Rep. 95–294 at 205. Thus, in reaching his proposed conclusion, the Administrator recognized that there are substantial uncertainties and limitations in the public preference studies that should be considered when selecting a target level of protection for the visibility index and took the uncertainties and variability inherent in the public preference studies into account. In so doing, the Administrator first preliminarily judged that, consistent with similar judgments in past reviews, it is appropriate to recognize that the secondary 24-hour $PM_{2.5}$ standard is intended to address visibility impairment across a wide range of regions and circumstances, and that the current standard works in conjunction with the Regional Haze Program to improve visibility, and therefore, it is appropriate to establish a target level of protection based on the upper end of the range of levels. In considering the information available in this reconsideration and the CASAC's advice, the Administrator proposed to conclude that the protection provided by a visibility index based on estimated light extinction, a 24-hour averaging time, and a 90th percentile form, averaged over 3 years, set at a level of 30 dv (the upper end of the range of levels) would be requisite to protect public welfare with regard to visibility impairment (88 FR 5660, January 27, 2023).

In preliminarily concluding that it remains appropriate in this reconsideration to define the target level of protection in terms of a visibility index based on estimated light extinction as described above (*i.e.,* with a 24-hour averaging time; a 3-year, 90th percentile form; and a level of 30 dv), the Administrator next considered the degree of protection from visibility impairment afforded by the existing secondary standards. He considered the updated analyses of PM-related visibility impairment presented in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.2), which reflect several improvements over the analyses conducted in the 2012 review. Specifically, the updated analyses examine multiple versions of the IMPROVE algorithm, including the version incorporating revisions since the 2012 review (section V.B.1.a), which provides an improved understanding of how variation in equation inputs impacts calculated light extinction (U.S. EPA, 2022b, Appendix D). In addition, unlike the analyses in the 2012 review and the 2020 PA, all of the sites included in the analyses had $PM_{10–2.5}$ data available, which allows for better characterization of the influence of the coarse fraction on light extinction (U.S. EPA, 2022b, section 5.3.1.2).

The Administrator noted that the results of these updated analyses are consistent with the results from the 2012 and 2020 reviews (88 FR 5660, January 27, 2023). Regardless of the IMPROVE equation used, these analyses demonstrate that the 3-year visibility metric is at or below 28 dv in all areas meeting the current 24-hour $PM_{2.5}$ standard (section V.C.1.b). Given the results of these analyses, the Administrator preliminarily concluded that the updated scientific evidence and technical information support the adequacy of the current secondary $PM_{2.5}$ and PM_{10} standards to protect against PM-related visibility impairment. While the inclusion of the coarse fraction had a relatively modest impact on calculated light extinction in the analyses presented in the 2022 PA, he nevertheless recognized the continued importance of the PM_{10} standard given the potential for larger impacts in locations with higher coarse particle concentrations, such as in the southwestern U.S., for which only a few sites met the criteria for inclusion in the analyses in the 2022 PA (U.S. EPA, 2019a, section 13.2.4.1; U.S. EPA, 2022b, section 5.3.1.2).

With regard to the adequacy of the secondary 24-hour $PM_{2.5}$ standard, the Administrator noted that the CASAC stated that ''[i]f a value of 20–25 deciviews is deemed to be an appropriate visibility target level of protection, then a secondary 24-hour $PM_{2.5}$ standard in the range of 25–35 $\mu g/m^3$ should be considered'' (Sheppard, 2022a, p. 21 of consensus responses). The Administrator recognized that the CASAC recommended that the Administrator provide additional justification for a visibility index target of 30 dv but did not specifically recommend that he choose an alternative level for the visibility index. The Administrator considered the CASAC's advice, together with the available scientific evidence and quantitative information, in reaching his proposed conclusions. He recognized conclusions regarding the appropriate weight to place on the scientific and technical information examining PM-related visibility impairment including how to consider the range and magnitude of uncertainties inherent in that information is a public welfare policy judgment left to the Administrator. As such, the Administrator noted his conclusion on

the appropriate visibility index (*i.e.,* with a 24-hour averaging time; a 3-year, 90th percentile form; and a level of 30 dv) and his conclusions regarding the quantitative analyses of the relationship between the visibility index and the current secondary 24-hour $PM_{2.5}$ standard. In so doing, he proposed to conclude that the current secondary standards provide requisite protection against PM-related visibility effects (88 FR 5661, January 27, 2023).

In reaching his proposed conclusions, the Administrator also recognized that the available evidence on visibility impairment generally reflects a continuum and that the public preference studies did not identify a specific level of visibility impairment that would be perceived as ''acceptable'' or ''unacceptable'' across the whole U.S. population. However, he noted that a judgment regarding the appropriate target level of protection would take into consideration the appropriate weight to place on the individual public preference studies. In so doing, he noted that placing more weight on the public preference study from Washington, DC, could provide support for a target level of protection at or near 30 dv, whereas placing more weight on the public preference study performed in the Phoenix, AZ, study could provide support for a target level of protection below 30 dv and down to 25 dv. While the Administrator noted that, in their review of the 2021 draft PA, the CASAC did not recommend revising the level of the current 24-hour $PM_{2.5}$ standard, the Administrator recognized that they did recommend greater justification for a target level of protection of 30 dv, and noted that if a target level of protection of 20–25 dv was identified, then a secondary 24-hour $PM_{2.5}$ standard in the range of 25–35 $\mu g/m^3$ should be considered (Sheppard, 2022a, p. 21 of consensus responses). For these reasons, the Administrator solicited comment on his proposed decision to retain the current secondary 24-hour $PM_{2.5}$ standard, as well as the appropriateness of a target level of protection for visibility below 30 dv and as low as 25 dv, and on revising the level of the current secondary 24-hour $PM_{2.5}$ standard to a level as low as 25 $\mu g/m^3$.

With respect to climate effects, the Administrator recognized that a number of improvements and refinements have been made to climate models since the time of the 2012 review. However, despite continuing research and the strong evidence supporting a causal relationship with climate effects (U.S. EPA, 2019a, section 13.3.9), the Administrator noted that there are still significant limitations in quantifying the contributions of the direct and indirect effects of PM and PM components on climate forcing (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). He also recognized that models continue to exhibit considerable variability in estimates of PM-related climate impacts at regional scales (*e.g.,* ~100 km), compared to simulations at the global scale (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). As noted above, the CASAC recognized a causal relationship between PM and climate effects but also the large uncertainties associated with quantitatively assessing such effects, particularly on a national level in the context of a U.S.-based standard. These uncertainties led the Administrator to preliminarily conclude that the scientific information available in this reconsideration remains insufficient to quantify, with confidence, the impacts of ambient PM on climate in the U.S. (U.S. EPA, 2022b, section 5.3.2.2.1) and that there is insufficient information at this time to revise the current secondary PM standards or to promulgate a distinct secondary standard to address PM-related climate effects (88 FR 5661, January 27, 2023).

With respect to materials effects, the Administrator noted that the available evidence continues to support the conclusion that there is a causal relationship with PM deposition (U.S. EPA, 2019a, section 13.4). He recognized that deposition of particles in the fine or coarse fractions can result in physical damage and/or impaired aesthetic qualities. Particles can contribute to materials damage by adding to the effects of natural weathering processes and by promoting the corrosion of metals, the degradation of painted surfaces, the deterioration of building materials, and the weakening of material components. While some recent evidence on materials effects of PM is available in the 2019 ISA, the Administrator noted that this evidence is primarily from studies conducted outside of the U.S. in areas where PM concentrations in ambient air are higher than those observed in the U.S. (U.S. EPA, 2019a, section 13.4). The CASAC also noted the lack of quantitative information relating PM and material effects. Given the limited amount of information on the quantitative relationships between PM and materials effects in the U.S., and uncertainties in the degree to which those effects could be adverse to the public welfare, the Administrator preliminarily judged that the scientific information available in this reconsideration remains insufficient to quantify, with confidence, the public welfare impacts of ambient PM on materials and that there is insufficient information at this time to revise the current secondary PM standards or to promulgate a distinct secondary standard to address PM-related materials effects (88 FR 5661, January 27, 2023).

Taken together, the Administrator proposed to conclude that the scientific and technical information for PM-related visibility impairment, climate impacts, and materials effects, with its attendant uncertainties and limitations, supports the current level of protection provided by the secondary PM standards as being requisite to protect against known and anticipated adverse effects on public welfare. For visibility impairment, this proposed conclusion reflected his consideration of the evidence for PM-related light extinction, together with his consideration of updated analyses of the protection provided by the current secondary $PM_{2.5}$ and PM_{10} standards. For climate and materials effects, this conclusion reflected his preliminary judgment that, although it remains important to maintain secondary $PM_{2.5}$ and PM_{10} standards to provide some degree of control over long- and short-term concentrations of both fine and coarse particles, it is generally appropriate not to change the existing secondary standards at this time and that it is not appropriate to establish any distinct secondary PM standards to address PM-related climate and materials effects at this time. As such, the Administrator recognized that current suite of secondary standards (*i.e.,* the 24-hour $PM_{2.5}$, 24-hour PM_{10}, and annual $PM_{2.5}$ standards) together provide such control for both fine and coarse particles and long- and short-term visibility and non-visibility (*e.g.,* climate and materials) [169] effects related to PM in ambient air. His proposed conclusions on the secondary standards were consistent with advice from the CASAC, which noted substantial uncertainties remain in the scientific evidence for climate and materials effects. Thus, based on his consideration of the evidence and analyses for PM-related welfare effects, as described above, and his consideration of CASAC advice on the secondary standards, the Administrator proposed not to change those standards (*i.e.,* the current 24-hour and annual $PM_{2.5}$ standards, 24-hour PM_{10} standard) at this time (88 FR 5662, January 27, 2023).

[169] As noted earlier, other welfare effects of PM, such as ecological effects, are being considered in the separate, on-going review of the secondary NAAQS for oxides of nitrogen, oxides of sulfur and PM.

3. Comments on the Proposed Decision

Of the public comments received on the proposal, very few were specific to the secondary PM standards. Of those commenters who did provide comments on the secondary PM standards, the majority support the Administrator's proposed decision to retain the current standards. Some commenters disagree with the Administrator's proposed conclusion to retain the current secondary standards, primarily focusing their comments on the need for a revised standard to protect against visibility impairment. In addition to the comments addressed in this notice, the EPA has prepared a Response to Comments document that addresses other specific comments related to setting the secondary PM standards. This document is available for review in the docket for this rulemaking and through the EPA's NAAQS website (*https://www.epa.gov/naaqs/particulate-matter-pm-air-quality-standards*).

We first note that some commenters raise questions about the protection provided by the secondary PM standards for ecological effects (*e.g.,* effects on ecosystems, ecosystem services, or species). However, consistent with the 2016 IRP and as described in the proposal (88 FR 5643, January 27, 2023), other welfare effects of PM, such as the ecological effects identified by commenters, are being considered as part of the separate, ongoing review of the secondary standards for oxides of sulfur, oxides of nitrogen and PM, and thus, those comments are beyond the scope of this action.

Of the comments addressing the proposed decision for the secondary PM standards, many of the commenters support the Administrator's proposed decision to retain the current secondary PM standards, without revision. This group includes industries and industry groups and State and local governments and organizations. All of these commenters generally note their agreement with the rationale provided in the proposal, with a focus on the strength of the available scientific evidence for PM-related welfare effects. Most also recognize that the scientific evidence and quantitative information available in this reconsideration have not substantially altered our previous understanding of PM-related effects on non-ecological welfare effects (*i.e.,* visibility, climate, and materials) and do not call into question the adequacy of the current secondary standards. They find the proposed decision not to change the standards at this time to be well supported and a reasonable exercise of the Administrator's public welfare policy judgment under the CAA. The EPA agrees with these comments regarding the adequacy of the current secondary PM standards and the lack of support for revision of these standards at this time.

The EPA received relatively few comments on the proposed decision that it is not appropriate to establish any distinct secondary PM standards to address PM-related climate effects. Several commenters agree that the available scientific evidence provides support for the 2019 conclusion that there is a causal relationship between PM and climate effects, and the commenters also agree with the EPA that the currently available information is not sufficient for supporting quantitative analyses for the climate effects of PM in ambient air. These commenters support the Administrator's proposed decision not to set a distinct standard for climate.

There were also very few commenters who commented on the proposed decision that it is not appropriate to establish any distinct secondary PM standards to address PM-related materials effects. As with comments on climate effects, commenters generally agree with the EPA that the evidence is not sufficient to support quantitative analyses for PM-related materials effects. However, some commenters contend that EPA failed to explain in the proposal how the current standard is appropriate to protect materials from the effects of PM. These commenters disagree with the EPA's conclusion that quantitative relationships have not been established for PM-related soiling and corrosion and frequency of cleaning or repair of materials, and cite to several studies conducted outside the U.S. that they contend that the EPA should consider since the same materials are present in the U.S. They further contend that, in discussing the available scientific evidence in the 2019 ISA for studies conducted outside of the U.S., the EPA did not provide references to these studies and, therefore, the public is unable to comment on these studies. They further State that EPA failed to consider the following information: (1) Recent work related to soiling of photovoltaic modules and other surfaces, and; (2) damage and degradation resulting from oxidant concentrations and solar radiation for a number of materials, including polymeric materials, plastic, paint, and rubber. These commenters further assert that the EPA failed to propose a standard that provides requisite protection against materials effects attributable to PM.

As an initial matter, we note that the commenters submitted the same comments related to materials effects during the 2020 review. Consistent with our response in the 2020 notice of final rulemaking (85 FR 82737, December 18, 2020), we disagree with the commenters that the EPA failed to consider the relevant scientific information about materials effects available in this reconsideration. The 2019 ISA considered and included studies related to materials effects of PM, including studies conducted in and outside of the U.S., on newly studied materials including photovoltaic modules that were published prior to the cutoff date for the literature search.[170] These include the Besson et al. (2017) study referenced by the commenters (U.S. EPA, 2019a, section 13.4.2). The Grøntoft et al. (2019) study referenced by the same commenters was published after the cutoff date for the literature search for the 2019 ISA. However, the EPA provisionally considered new studies in responding to comments in the 2020 review, including the new studies highlighted by the commenters in their comments on the 2020 notice of proposed rulemaking, in the context of the findings of the 2019 ISA (see Appendix in U.S. EPA, 2020a).[171] Based on the provisional consideration, the EPA concluded in the 2020 review that the new studies are not sufficient to alter the conclusions reached in the 2019 ISA regarding PM and materials effects. For example, the Grøntoft et al. (2019) study was based on European air pollution which as the EPA has noted has higher concentrations (as well as diversity in sources, such as light duty diesel engines) compared to the U.S.. Thus, the EPA did not find it necessary or appropriate to reopen the air quality criteria to consider this study because it would not have been an adequate basis on which to set a NAAQS. As discussed in section I, when the EPA decided to reconsider the standards, it also decided to reopen the air quality criteria to a limited degree, based on its judgment that certain new studies were likely to be useful in reconsidering the standards.

[170] As noted earlier in section V, the 2019 ISA ''identified and evaluated studies and reports that that have undergone scientific peer review and were published or accepted for publication between January 1, 2009, and March 31, 2017. A limited literature update identified some additional studies that were published before December 31, 2017'' (U.S. EPA, 2019a, Appendix, p. A–3).

[171] As discussed in section I.D, the EPA has provisionally considered studies that were highlighted by commenters and that were published after the 2019 ISA. These studies are generally consistent with the evidence assessed in the 2019 ISA, and they do not materially alter our understanding of the scientific evidence or the Agency's conclusions based on that evidence.

Based on the provisional consideration in the 2020 review and the significant data gaps that existed at that time, the EPA did not include these studies within the scope of the 2022 ISA Supplement because, although these studies provide additional support for PM-related materials, the studies would not support quantitative analyses or alternative conclusions regarding these effects. As described in section I.C.5.b above, the ISA Supplement focuses on a thorough evaluation of some studies that became available after the literature cutoff date of the 2019 ISA that could either further inform the adequacy of the current PM NAAQS or address key scientific topics that have evolved since the literature cutoff date for the 2019 ISA. In developing the ISA Supplement, the EPA focused on the non-ecological welfare effects for which the evidence supported a ''causal relationship'' and for which quantitative analyses could be supported by the evidence because those were the welfare effects that were most useful in informing conclusions in the 2020 PA. While the 2020 PA considered the broader set of evidence for materials effects, it concluded that there remained 'substantial uncertainties with regard to the quantitative relationships with PM concentrations and concentration patterns that limit[ed] [the] ability to quantitatively assess the public welfare protection provided by the standards from these effects' (U.S. EPA, 2020b).'' Therefore, the ISA Supplement did not include an evaluation of scientific evidence for PM-related materials effects. However, the EPA has once again provisionally considered new studies in this reconsideration, including the studies highlighted by the commenters, in the context of the 2019 ISA and concludes that, as in the 2020 review, these studies are not sufficient to alter the conclusions reached in the 2019 ISA regarding PM and materials effects or to provide sufficient information on which to base a secondary NAAQS. The EPA agrees there is a causal relationship between the presence of PM in the ambient air and materials effects, but to set a standard, the EPA needs not only to understand at what point materials effects become adverse to public welfare but to be able to relate specific concentrations of ambient PM to those levels of materials effects. Given the significant gaps in the evidence, particularly given that the majority of the recent evidence has been conducted outside of the U.S., establishing any quantitative relationships between particle size, concentration, chemical components, and specific measures of materials damage, such as frequency of painting or repair of materials, the EPA finds the evidence is insufficient to support a secondary NAAQS to protect against materials effects.

With regard to studies conducted outside of the U.S., including those referenced by the commenters, as described in the proposal, in reaching his proposed conclusion, the Administrator recognized that while there was some newly available information related to materials effects of PM included in the 2019 ISA, ''this evidence is primarily from studies conducted outside of the U.S. in areas where PM concentrations in ambient air are higher than those observed in the U.S. (U.S. EPA, 2019a, section 13.4)'' (88 FR 5661, January 27, 2023). We disagree with the commenters that EPA did not provide references for these studies, nor that the lack of references inhibited the public's ability to provide comment on this proposed conclusion. First, the reference to section 13.4 in the 2019 ISA is a direct citation to the evaluation of newly available studies on PM-related materials effects, which includes citations for all materials effects evidence considered in the 2020 review and in this reconsideration. Second, section 5.3.2.1.2 of the 2022 PA considers the available scientific evidence for PM-related materials effects—including citations to the studies newly available in the 2019 ISA—and how that evidence informs conclusions regarding the adequacy of the standard (U.S. EPA, 2022b, section 5.3.2.1.2). Therefore, the EPA disagrees that the proposal failed to provide the proper references to the studies conducted outside of the U.S., and that the public was not provided the opportunity to provide comment on these studies.

Moreover, we disagree with the commenters that the EPA failed to consider quantitative information from studies available in this reconsideration. As detailed in sections 5.3.2.1.2 and 5.3.2.2 of the 2022 PA, and consistent with the information available in the 2020 review, a number of new studies are available that apply new methods to characterize PM-related effects on previously studied materials; however, the evidence remains insufficient to relate soiling or damage to specific levels of PM in ambient air or to establish quantitative relationships between PM and materials degradation. The uncertainties in the evidence identified in the 2012 review persist in the evidence in the 2020 review and in this reconsideration, with significant uncertainties and limitations to establishing quantitative relationships between particle size, concentration, chemical components, and frequency of painting or repair of materials. While some new evidence is available in the 2019 ISA, overall, the data are insufficient to conduct quantitative analyses for PM-related materials effects. Quantitative relationships have not been established between characteristics of PM and frequency of repainting or cleaning of materials, including photovoltaic panels and other energy-efficient materials, that would help inform our understanding of the public welfare implications of soiling in the U.S. (U.S. EPA, 2022b, section 5.3.2.2.2; U.S. EPA, 2019a, section 13.4). Similarly, the information does not support quantitative analyses between microbial deterioration of surfaces and the contribution of carbonaceous PM to the formation of black crusts that contribute to soiling (U.S. EPA, 2022b, section 5.3.2.2.2; U.S. EPA, 2019a, section 13.4). We also note that quantitative relationships are difficult to assess, in particular those characterized using damage functions as these approaches depend on human perception of the level of soiling deemed to be acceptable and evidence in this area remains limited in this reconsideration (U.S. EPA, 2022b, section 5.3.2.1.2). Additionally, we note the CASAC's concurrence with conclusions in the 2020 PA (Cox, 2019b, p. 13 of consensus responses) and the 2022 PA (Sheppard, 2022a, p. 23 of consensus responses) that uncertainties remain about the best way to evaluate materials effects of PM in ambient air. Further, no new studies are available in this reconsideration to link human perception of reduced aesthetic appeal of buildings and other objects to materials effects and PM in ambient air. Finally, uncertainties remain about deposition rates of PM in ambient air to surfaces and the interaction of PM with copollutants on these surfaces (U.S. EPA, 2022b, section 5.6).

With respect to the commenters' assertion that the EPA failed to consider information related to materials damage and degradation from oxidant concentrations and solar radiation for a variety of materials, we first note that, even assuming these sources of materials damage are within the scope of this review of the PM NAAQS, the commenter did not provide any references to the scientific studies that they suggest that the EPA did not consider. Despite the lack of a list of specific references from the commenter, we note that the 2019 ISA considered a number of studies that examined the

relationships between PM and several of the materials listed by the commenters (*e.g.,* paint, plastic, rubber). However, as described in the 2022 PA, these studies did not provide additional information regarding quantitative relationships between PM and materials that could inform quantitative analyses (U.S. EPA, 2022b, sections 5.3.2.1.2 and 5.3.2.2.2), nor did they alter conclusions regarding the adequacy of the current standard (U.S. EPA, 2022b, section 5.5).

As summarized above and in the proposal, the evidence in the 2020 review and in this reconsideration for PM-related effects on materials is not substantively changed from that in the 2012 review. There continues to be a lack of evidence related to materials effects that establishes quantitative relationships and supports quantitative analyses of PM-related materials soiling or damage. While the information available in the 2020 review and in this reconsideration continues to support a causal relationship between PM in ambient air and materials effects (U.S. EPA, 2019a, section 13.4), the EPA is unable to relate soiling or damage to specific levels of PM in ambient air and is unable to evaluate or consider a level of air quality to protect against such materials effects. Although the EPA did not propose a distinct level of air quality or a national standard based on air quality impacts (88 FR 5662, January 27, 2023), we did identify data gaps that prevented us from doing so. The EPA identified a number of key uncertainties and areas of future research (U.S. EPA, 2022b, section 5.6) that may inform consideration of the materials effects of PM in ambient air in future reviews of the PM NAAQS. The EPA notes that one commenter objected to the Administrator's proposed conclusion in the proposal (88 FR 5661, January 27, 2023) that in light of the available evidence for PM-related impacts on climate and on materials that it is appropriate not to change the existing secondary standards at this time. The EPA has explained, in both the proposal and this final action, the basis for its conclusion that there is insufficient evidence to identify any particular secondary standard or standards that would provide requisite protection against climate effects or materials damage. The EPA acknowledges that, as a result, the adoption of any distinct secondary PM standards for those effects would be inconsistent with the requirements of the CAA. The EPA is clarifying that it is not basing its decisions on secondary standards in this reconsideration to address these welfare effects because it has concluded that the available scientific evidence is insufficient to allow the Administrator to make a reasoned judgment about what specific standard(s) would be requisite to protect against known or anticipated adverse effects to public welfare from PM-related materials damage or climate effects.

Some commenters agree with the Administrator's proposed conclusion that a target level of protection for visibility of 30 dv and the level of the secondary 24-hour $PM_{2.5}$ standard of 35 $\mu g/m^3$ continues to be adequate to protect visibility, highlighting improvements in visibility in the U.S. Other commenters who disagree with the proposed decision indicated support for a more stringent standard for visibility impairment, although some of these commenters did not necessarily specify the alternative standard that would, in their judgment, address their concerns related to various aspects of the EPA's proposal, including the available public preference studies, specific aspects of the visibility index, and the target level of protection identified by the Administrator. Rather, most commenters focused on particular aspects of the visibility metric underlying the current secondary 24-hour $PM_{2.5}$ standard, including the form, averaging time, and target level of protection necessary to protect against visibility impairment.

With regard to the commenters' assertion that the current secondary standards are inadequate to protect the public welfare from PM-related visibility impairment, the EPA disagrees that the currently available information is sufficient to suggest that a more stringent standard is warranted. The EPA identified and addressed in great detail the limitations and uncertainties associated with the public preference studies as a part of the 2012 review (78 FR 3210, January 15, 2013). Given that the evidence related to public preferences has not substantially changed since the 2012 review, the EPA reiterated the limitations and uncertainties inherent in the evidence as a part of the 2020 PA (U.S. EPA, 2020b, section 5.5), as well as in the 2022 PA for this reconsideration (U.S. EPA, 2022b, section 5.6). The 2022 PA highlights key uncertainties associated with public perception of visibility impairment and identifies areas for future research to inform future PM NAAQS reviews, including those raised by the commenters (U.S. EPA, 2022b, section 5.6). Specifically, the EPA agrees with commenters that there are several areas where additional information would reduce uncertainty in our interpretation of the available information for purposes of characterizing visibility impairment. As described in more detail in the 2020 PA (U.S. EPA, 2020b, p. 5–41) and the 2022 PA (U.S. EPA, 2022b, p. 5–53), briefly, these areas include: (1) Expanding the number and geographic coverage of preference studies in urban, rural, and Class I areas; (2) evaluating visibility preferences of the U.S. population today, given that the preference studies were conducted more than 15 years ago, during which time air quality in the U.S. has improved; (3) accounting for the influence of varying study methods may have on an individual's response as to what level of visibility impairment is acceptable, and; (4) information on people's judgments on acceptable visibility based on factors that can influence their perception of visibility (*e.g.,* duration of impairment experiences, time of day, frequency of impairment).

However, the EPA disagrees with the commenters that the current secondary PM standards are inadequate and should be made more stringent because of the limitations and uncertainties associated with the available public preference studies. The EPA does not view the limitations of the preference studies and other available evidence as so significant as to render the EPA unable to identify a secondary standard to protect against the adverse effects of PM on visibility, but the EPA also does not believe that the limitations themselves mean that the standards are inadequate. In fact, there is a limited amount of recently available scientific evidence to further inform our understanding of public preferences and visibility impairment is recognized by the Administrator in reaching his proposed decision not to change the current secondary PM standards at this time, given that the evidence base is largely the same as at the time of the 2012 and 2020 reviews.

These same commenters further contend that the EPA failed to use the latest science to develop a visibility index, stating that the EPA failed to consider the contrast of distance methodology employed in a recent meta-analysis of available preference studies (Malm et al., 2019). Commenters claim that the EPA draws conclusions from the Malm et al. (2019) study about how to relate contrast to acceptable visibility preferences in the 2022 ISA Supplement, yet ignores the findings of the study and fails to consider the ''contrast of distance'' methodology in the 2022 PA and the proposal, thereby, in their view, departing from the CASAC's advice to consider this evidence in setting the secondary

standard. Finally, the commenters assert that the EPA did not explain why the available public preference studies are adequate for analysis using a light extinction approach but not using the contrast of distance approach, and that such differential treatment is arbitrary.

We disagree with the commenters that the EPA did not use the latest science in evaluating the visibility index, and that the EPA failed to consider the contrast of distance methodology used in Malm et al. (2019). As the commenters state, the Malm et al. (2019) study was included in the ISA Supplement (U.S. EPA, 2022a, section 4.2.1). However, the EPA disagrees with the assertion that the ISA Supplement reached conclusions about how to relate contrast to acceptable visibility preferences. The ISA Supplement provided an overview of the Malm et al. (2019) study, stating that ''[t]he main conclusion of this study was that the level of acceptable visual air quality is more consistent across studies using metrics that evaluate the distinction of an object from a background than using metrics that evaluate the greatest distance at which an object can be observed.'' Furthermore, the statements that the commenters are referencing in support of this statement (*i.e.,* U.S. EPA, 2022b, pp. 4–5–4–6) are in fact the conclusions of the study itself, rather than conclusions of the EPA. For example, the ISA Supplement notes that ''Malm et al. (2019) suggested that scene-dependent metrics like contrast, which integrate the effects of b_{ext} along the sight paths between observers and landscape features, are better predictors of preference levels than universal metrics like light extinction.'' The suggestion that the contrast of distance methodology is a better predictor than light extinction is one of the study authors, not the EPA. The EPA has not reached a conclusion on whether contrast of distance methodology would be a more appropriate indicator for a visibility index than estimated light extinction because the EPA finds that there is insufficient information in the record at this time to support that it is practical to evaluate, much less adopt, the contrast of distance methodology on a national basis. Specifically, the Malm et al. (2019) study does not provide as a part of their publication the specific input values to the equation to calculate the contrast of distance associated with the available public preference studies (*e.g.,* sight paths from the images), nor do the preference studies present or make publicly available these data in their publications. In the absence of additional studies or publicly available data to further evaluate the contrast of distance methodology, the EPA is unable to consider contrast of distance as an alternative to estimated light extinction in this reconsideration, although we note that it may be appropriate to evaluate it more closely in future reviews.

In reaching conclusions regarding the appropriate indicator for the visibility index, the 2022 PA specifically notes ''that limited new research is available on methods of characterizing visibility or on how visibility is valued by the public, such as visibility preference studies. Thus, while limited new research has further informed our understanding of the influence of atmospheric components of $PM_{2.5}$ on light extinction, the available evidence to inform consideration of the public welfare implications of PM-related visibility impairment remains relatively unchanged'' (U.S. EPA, 2022b, p. 5–50). The EPA again notes in the proposal that ''there are very few studies available that use scene-dependent metrics (*i.e.,* contrast) to evaluate public preference information, which makes it difficult to evaluate them as an alternative to the light extinction approach'' (88 FR 5649–5650, January 27, 2023). To further expand on this statement, the Malm et al. (2019) study does not provide enough information to replicate the results of their contrast of distance approach to allow for a comprehensive evaluation of the potential use of this methodology in considering the results of the public preference studies for determining the target level of protection for visibility.

Some commenters suggests that the methodology could be approximated by simply ensuring that people could always see distant scenic elements, and that characterizing typical average and/or maximal viewing distances cross different geographical areas and regions would be a straightforward Geographical Information Systems (GIS) exercise. The EPA disagrees that this assessment would be straightforward, given the lack of data establishing viewing distances in the available scientific record and the diversity of distance to scenic elements across different areas and regions of the U.S., and finds that this approach is also not practical to adopt in this reconsideration. Finally, while the Malm et al. (2019) study is using an alternative approach for evaluating public preferences and acceptability, we note that this study is evaluating the same public preference studies that have been available for the past several decades. For these reasons, the EPA disagrees with the commenters' allegation that the EPA ignored the findings of the Malm et al. (2019) study and failed to consider the contrast of distance methodology in the 2022 PA and the proposal, and ignored the CASAC's advice to consider this study. The ISA Supplement and the 2022 PA considered the Malm et al. (2019) study, along with the full body of available scientific evidence, and took into account the uncertainties and limitations associated with the evidence for visibility preferences, in reaching conclusions regarding the adequacy of the secondary 24-hour $PM_{2.5}$ standard (U.S. EPA, 2022b, pp. 5–24–5.25, 5–50).

Several comments in support of revising the secondary 24-hour $PM_{2.5}$ standard to protect against visibility generally recommend revisions to the elements of the standard and visibility index (indicator, averaging time, form, and level) consistent with those supported by the CASAC and public comments in previous PM NAAQS reviews. Some commenters assert that the EPA's approach in the 2022 PA and in the proposal for this reconsideration did not evaluate options for alternative secondary PM standards and thereby is flawed. We address comments on the elements of a visibility index and a revised standard for visibility effects below.

As an initial matter, the EPA disagrees to the extent commenters are suggesting that the PA is legally required to analyze options for alternative standards. The PA is a document developed by the EPA in order to assist the Administrator and the CASAC in reaching conclusions regarding the adequacy of the current standards, and its scope is determined by the EPA. Moreover, the 2022 PA did assess a wide range of information relevant to the Administrator's decision and considered a range of potential standards.

First, in developing the 2022 PA and in responding to CASAC's advice and recommendations during its review of the 2021 draft PA, the EPA expanded upon its discussion of determining the target level of protection for the visibility index and considered the extent to which the available scientific information would alter regarding the visibility index and the appropriate target level of protection against PM-related visibility effects (U.S. EPA, 2022b, pp. 5–27–5–29). This detailed discussion expands the consideration of the target level of protection for the visibility index presented in the 2020 PA (U.S. EPA, 2020b) and the 2021 draft PA (U.S. EPA, 2021c), neither of which specifically considered the elements of the visibility index in determining the appropriate target level of protection. In

considering the available information in the 2022 PA, the EPA concluded that the available information continued to provide support for a visibility index with a level of 30 dv, with estimated light extinction as the indicator, a 24-hour averaging time, and a 90th percentile form, averaged over three years.

Additionally, in summarizing the air quality and quantitative information in the proposal for this reconsideration, the EPA further expands upon the discussion added to the 2022 PA related to the target level of protection in terms of a $PM_{2.5}$ visibility index. In so doing, the EPA considers even more extensively the available public preference studies and quantitative analyses (88 FR 5651–5652, January 27, 2023). In particular, there is a more detailed discussion of the public preference studies, including the levels of impairment determined to be ''acceptable'' by at least 50 percent of study participants and the methodologies used in the studies, including uncertainties and limitations associated with the methodologies (88 FR 5652, January 27, 2023). In reaching a proposed decision regarding the adequacy of the secondary PM standards, as well as the appropriate target level of protection for the visibility index, the Administrator considered the available scientific evidence and quantitative analyses, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the scientific evidence and analyses. In so doing, the Administrator proposed to conclude that the protection provided by a visibility index based on estimated light extinction, a 24-hour averaging time, and a 90th percentile form, averaged over 3 years, set at a level of 30 dv would be requisite to protect public welfare with regard to visibility impairment (88 FR 5660, January 27, 2023).

Having provisionally concluded that it was appropriate to define the target level of protection in terms of a visibility index based on estimated light extinction as described above (*i.e.,* with a 24-hour averaging time; a 3-year, 90th percentile form; and a level of 30 dv), the Administrator next considered the degree of protection from visibility afforded by the current secondary PM standards. In so doing, he considered the updated analyses of PM-related visibility impairment presented in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.2) and described in more detail in the proposal (88 FR 5656, January 27, 2023), which included estimating light extinction using multiple versions of the IMPROVE algorithm and inclusion of $PM_{10\text{-}2.5}$ data at all sites to allow for better characterization of the influence of the coarse fraction of PM on light extinction. The Administrator noted that the results of the analyses in the 2022 PA were consistent with those from the 2012 and 2020 reviews. He also recognized that, regardless of the IMPROVE equation that was used, the analyses demonstrated that the 3-year visibility metric is at or below 28 dv in all areas meting the current 24-hour $PM_{2.5}$ standard (88 FR 5657, January 27, 2023). The Administrator also noted that, in their review of the 2021 draft PA, the CASAC stated that ''[i]f a value of 20–25 deciviews is deemed to be an appropriate visibility target level of protection, then a secondary 24-hour standard in the range of 25–35 $\mu g/m^3$ should be considered (Sheppard, 2022a, p. 21 of consensus responses). The Administrator recognized that while the CASAC recommended that additional justification be provided for a visibility index target level of protection of 30 dv, they did not specifically recommend that he choose an alternative level for the visibility index. Therefore, the Administrator considered the available scientific evidence, quantitative information, and the CASAC's advice in reaching his proposed conclusions. The Administrator recognized conclusions regarding the appropriate weight to place on the scientific and technical information, including how to consider the range and magnitude of uncertainties inherent in that information, is a public welfare policy judgment left to the Administrator. As such, the Administrator noted his preliminary conclusion on the appropriate visibility index (*i.e.,* with a 24-hour averaging time; a 3-year, 90th percentile form; and a level of 30 dv) and his preliminary conclusions regarding the quantitative analyses of the relationship between the visibility index and the current secondary 24-hour $PM_{2.5}$ standard. In so doing, he proposed to conclude that the current secondary standards provide requisite protection against PM-related visibility effects (88 FR 5661, January 27, 2023).

However, the Administrator additionally recognized that the available evidence on visibility impairment generally reflects a continuum and that the public preference studies did not identify a specific level of visibility impairment that would be perceived as ''acceptable'' or ''unacceptable'' across the whole U.S. population. He noted a judgment of a target level of protection, below 30 dv and down to 25 dv, could be supported if more weight was put on the public preference study performed in the Phoenix, AZ, study (BBC Research & Consulting, 2003). As described above, while the Administrator noted that the CASAC did not recommend revising the level of the current 24-hour $PM_{2.5}$ standard in their review of the 2021 draft PA, they did state that, should an alternative level be considered for the visibility index, revisions to the secondary 24-hour $PM_{2.5}$ standard should also be considered (Sheppard, 2022a, p. 21 of consensus responses). Thus, the Administrator solicited comment on the appropriateness of a target level of protection for visibility below 30 dv and down as low as 25 dv, and of revising the level of the current secondary 24-hour $PM_{2.5}$ standard to a level as low as 25 $\mu g/m^3$ (88 FR 5662, January 27, 2023), and the Administrator considered these public comments in reaching his final decision on the secondary standards. Thus, the EPA disagrees that the 2022 PA and the proposal did not adequately consider options for revising the secondary PM NAAQS.

With regard to the elements of the visibility index, in considering the adequacy of the current secondary 24-hour $PM_{2.5}$ standard to protect against visibility impairment, as described in the proposal (88 FR 5658–5660, January 27, 2023), the Administrator first defined an appropriate target level of protection in terms of a PM visibility index. In considering the information available in this reconsideration and the CASAC's advice, the Administrator proposed to conclude that the protection provided by a visibility index based on estimated light extinction, a 24-hour averaging time, and 90th percentile form, averaged over 3 years, set at a level of 30 dv, would be requisite to protect public welfare with regard to visibility impairment (88 FR 5660, January 27, 2023).

In defining this target level of protection, the Administrator first considered the indicator of such an index. He noted that, given the lack of availability of methods and an established network for directly measuring light extinctions, a visibility index based on estimates of light extinction by $PM_{2.5}$ components derived from an adjusted version of the original IMPROVE algorithm would be most appropriate, consistent with the 2012 and 2020 reviews. As described in the proposal (88 FR 5649, January 27, 2023) and above (section V.A.2), the IMPROVE algorithm estimates light extinction using routinely monitored components of $PM_{2.5}$ and $PM_{10–2.5}$, along with estimates of relative humidity. The

Administrator, while recognizing that some revisions to the IMRPOVE algorithm were newly available in the 2020 review, noted that the fundamental relationship between ambient PM and light extinction has changed very little and the different versions of the IMPROVE algorithms can appropriately reflect this relationship across the U.S. (88 FR 5658–5659, January 27, 2023). As such, he judged that defining a target level of protection in terms of estimated light extinction continues to be a reasonable approach in this reconsideration.

Some commenters who criticized the EPA's interpretation and application of the Malm et al. (2019) study also contend that an indicator based on the contrast of distance would be a significant improvement over the current indicator for the visibility index and would more accurately evaluate public preferences. However, as described in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.1), while scene-dependent metrics, such as contrast, may be useful alternative predictors of preferences compared to universal metrics like light extinction, there are a very limited number of studies that use such metrics to evaluate public preferences of visibility impairment and there is a lack of scientific evidence that supports one metric over another. Moreover, the EPA finds that even if the Administrator agreed that the contrast of distance methodology was an improvement over light extinction, there is insufficient information available to evaluate and adopt contrast of distance as an indicator for a national visibility target at this time. While, in its review of the 2021 draft PA the CASAC suggested that the EPA consider this method in developing the secondary PM standards, the CASAC also noted that ''more extensive technical evaluation of the alternatives for visibility indicators and practical measurement methods'' is needed to inform future reviews of the secondary PM standards (Sheppard, 2022a, p. 22 of consensus responses). The CASAC did not recommend using a different indicator for this reconsideration, with the majority of CASAC members reiterated past advice recommending development of a visibility FRM for a directly measured $PM_{2.5}$ light extinction indicator (Sheppard, 2022a, p. 22 of consensus responses), a recommendation that was supported by other public commenters as well, and the minority of the CASAC suggested that such an FRM is not necessary. For these reasons, the EPA does not consider it feasible or appropriate to define the visibility index in terms of a contrast of distance indicator at this time.

With regard to averaging time, some commenters suggested to the EPA that a secondary standard with a different form than the primary standard may be a more relevant for welfare effects. While they do not recommend a specific alternative form, the commenters point to CASAC advice in past reviews where the CASAC stated that a subdaily standard based on daylight hours better reflects visibility impairment.

In defining the characteristics of a visibility index, the EPA continues to believe that a 24-hour averaging time is reasonable. This is in part based on analyses conducted in the 2012 review that showed relatively strong correlations between 24-hour and subdaily (*i.e.,* 4-hour average) $PM_{2.5}$ light extinction (88 FR 5659, January 27, 2023; 85 FR 82740, December 18, 2020; 78 FR 3226, January 15, 2013), indicating that a 24-hour averaging time is an appropriate surrogate for the subdaily time periods relevant for visual perception. The EPA believes that these analyses continue to provide support for a 24-hour averaging time for the visibility index in this reconsideration. The EPA also recognizes that the longer averaging time may be less influenced by atypical conditions and/or atypical instrument performance (88 FR 5659, January 27, 2023; 85 FR 82740, December 18, 2020; 78 FR 3226, January 15, 2013). When taken together, the available scientific information and updated analyses of calculated light extinction available in this reconsideration continue to support that a 24-hour averaging time is appropriate when defining a target level of protection against visibility impairment in terms of a visibility index.

Moreover, the EPA disagrees with commenters that a secondary $PM_{2.5}$ standard with a 24-hour averaging time does not provide requisite protection against the public welfare impacts of visibility impairment. At the time of the 2012 review, the EPA recognized that hourly or subdaily (*i.e.,* 4- to 6-hour) averaging times, within daylight hours and excluding hours with high relative humidity, are more directly related to the short-term nature of visibility impairment and the relevant viewing periods for segments of the viewing public than a 24-hour averaging time. At the time of the 2012 review, the EPA agreed that a subdaily averaging time would generally be preferable. However, the Agency noted significant data quality uncertainties associated with the instruments that would provide hourly $PM_{2.5}$ mass concentrations necessary to inform a subdaily averaging time. These uncertainties, as described in the 2012 review, included short-term variability in hourly data from available continuous monitoring methods, which would prohibit establishing a subdaily averaging time (78 FR 3209, January 15, 2013). For all of these reasons, and consistent with the 2020 review, the EPA continues to believe that a subdaily averaging time is not supported by the information available in this reconsideration.

With regard to the form of the visibility index, some commenters contend that the form used in evaluating visibility impairment is not appropriate. First, commenters contend that the EPA incorrectly stated that the CASAC did not provide advice on the 3-year, 90th percentile form of the visibility index and that the CASAC specifically recommended that the EPA further justify the metric and form, and by not doing so, the proposal arbitrarily departs from the CASAC's recommendations. The commenters also contend that the EPA fails to explain how averaging the form over three years is protective given that the public does not perceive visibility in three-year averages.

We disagree with the commenters that the EPA departed from the CASAC's recommendations that ''[t]he final PA should provide a robust justification for the daily light extinction percentile used in the analysis'' (Sheppard, 2022a, p. 22 of consensus responses). In this statement, the CASAC did not make explicit recommendations for revisions to the form of the visibility index, as the commenters assert, but rather requested additional justification for the percentile selected for the visibility index in the 2022 PA. In response to the CASAC's recommendation after reviewing the 2021 draft PA, the EPA included a new section in the 2022 PA that explicitly discusses the elements (*i.e.,* indicator, averaging time, form, and level) of the visibility index, including additional justification for the conclusions regarding the appropriate elements for the index (U.S. EPA, 2022b, pp. 5–27–5–29). In so doing, the 2022 PA recognizes that there is no new information available in this reconsideration to inform selection of an alternative form of the visibility index, and therefore, relied on the analyses presented in the 2010 UFVA that evaluated the different statistical forms of the visibility index. The 2022 PA also discusses the approach to improving visual air quality in Federal Class I areas as a part of the Regional Haze Program (U.S. EPA, 2022b, p. 5–28). Furthermore, as reflected in responding to public comments below, and in

reaching his final conclusions in section V.B.4 below, the Administrator further considers the available scientific and quantitative information, the CASAC's advice, and public comments in informing his final conclusions regarding the appropriate target level of protection for the visibility index. With regard to the commenters' assertion that the EPA did not justify why averaging the form over three years is protective, we agree with the commenters that people do not perceive visibility impairment in three year averages. As described in the 2022 PA, visibility-related effects and perceived impairment are often associated with short-term PM concentrations, and therefore, the focus of the visibility analyses is centered on the adequacy of the 24-hour $PM_{2.5}$ standard (U.S. EPA, 2022b, p. 5–29). However, as described in the 2022 PA, the 3-year average form provides stability from the occasional effect of inter-annual meteorological variability that can result in unusually high pollution levels for a particular year (U.S. EPA, 2022b, p. 5–28). Occasional meteorological variability is of particular concern for the visibility index, which can be impacted by not only PM concentrations in ambient air but also relative humidity. The D.C. Circuit has previously recognized that it is legitimate for the EPA to consider overall stability of the standard and its resulting promotion of overall effectiveness of NAAQS control programs in setting a standard. See *American Trucking Ass'ns* v. *Whitman,* 283 F.3d 355, 375–76 (D.C. Cir. 2002). The 2022 PA concluded that the available information continues to provide support for a 90th percentile form, averaged over three years, and the inclusion of additional justification for the elements of the visibility index responds to the CASAC's recommendation (U.S. EPA, 2022b, section 5.3.1.2).

Some commenters suggest that the 90th percentile form is too low and would result in 36 days being excluded annually, presuming that the public only finds it objectionable when visibility is worse than the standard on 37 or more days per year. The commenters also contend that the EPA's approach of using a 90th percentile form for the visibility index is inconsistent with the goals of the Regional Haze Program. In so doing, the commenters note that the Regional Haze Rule focuses on improving conditions on the worst days, while they argue that a 90th percentile form for the visibility index would ignore the 36 worst visibility days, rather than identifying them and reducing pollution on those days.

In reaching conclusions regarding the appropriate form of the visibility index, the EPA is following the same approach employed in past reviews of the secondary PM NAAQS, including those in the 2012 and 2020 rulemakings. In reaching conclusions regarding the appropriate form of the visibility index in the 2011 PA, the EPA considered the percentile forms of the visibility index assessed in the 2010 PA (*i.e.,* 90th, 95th, 98th) along with the approach for improving visual air quality under the Regional Haze Program. In so doing, the 2011 PA notes that the Regional Haze Program targets the 20% most impaired days for improvements in visual air quality in Federal Class I areas (*i.e.,* the days more impaired than the 80th percentile). The 2011 PA recognized that to increase the likelihood of improving visual air quality on the worst days, the form of the visibility index should be set well above the 80th percentile. The 2011 PA further concluded that a 90th percentile form would represent the median of the distribution of the 20% most impaired days, and meeting a visibility index with a 90th percentile form would mean that 90% of the days have visual air quality that is at or below the level of the visibility index and would reasonably expected to lead to improvements in visual air quality for the 20% most impaired days (U.S. EPA, 2011, p. 4–59). The 2022 PA noted that there is no new information from public preference studies that would inform the Administrator's consideration of the appropriate form for the visibility target index, and reached conclusions consistent with those of 2011 PA. However, as discussed below, the EPA disagrees that a focus on the 90th percentile ''ignores'' any days with worse visibility. It is possible to examine past patterns of air quality to judge the relationship between the 90th percentile and higher percentiles, and to assess whether achieving a 90th percentile visibility target will also result in air quality improvements, where necessary, at higher percentiles. Based on its assessment of past air quality and potential alternative percentiles for the form, the EPA judged that a 90th percentile would appropriately achieve improved air quality both above and below that percentile.

Some commenters suggest that the analyses conducted in the 2010 UFVA are based on a different metric than the 24-hour average being considered in the reconsideration, that the analyses are outdated and irrelevant. Therefore, the commenters assert that relying on the analyses in the 2010 UFVA is not a rational justification for the use of a 90th percentile for the visibility index in this reconsideration. Moreover, these commenters state that, in past reviews, both the EPA and the CASAC have considered and recommended a 98th percentile form, but the proposal does not consider the 98th percentile.

These commenters assert that the 2010 UFVA was not considering the same metric under consideration here. However, the EPA was citing to the 2010 UFVA for the conclusion that there are correlations between different statistical forms of the visibility index. To confirm whether these correlations occur under recent air quality, we conducted additional air quality analyses evaluating the visibility index using the current percentile form (*i.e.,* 90th) and two alternative forms (*i.e.,* 95th and 98th).[172] While a higher percentile form would further limit the number of days with peak PM-related light extinction, the analyses confirm that a 90th percentile form is effective in limiting visibility impairment at higher percentiles. Based on these analyses, depending on which version of the IMPROVE equation is used to estimate light extinction, the differences in the 3-year averages of estimated light extinction for the 90th, 95th, and 98th percentile forms are small. For example, in areas that meet the current 24-hour $PM_{2.5}$ standard, for light extinction estimated using the original IMPROVE equation, all sites have light extinction estimates for a 90th percentile form at or below 26 dv, for a 95th or 98th percentile form at or below 29 dv.[173] In most locations, when estimating light extinction based on the original IMPROVE equation, the difference between a 95th or 98th percentile form and a 90th percentile form is generally less than 3 dv.[174] As noted in previous reviews, a change of 1 to 2 dv in light extinction under many viewing conditions will be perceived as a small, but noticeable, change in the appearance of a scene, regardless of the initial amount of visibility impairment (88 FR 5657, January 27, 2023; U.S. EPA, 2004b; U.S. EPA, 2010b). Thus, differences between a 90th percentile form and a 95th or 98th percentile form remain small, and for any of these forms of the visibility index, the estimated light extinction based on the original IMPROVE equation in areas meeting the current secondary 24-hour $PM_{2.5}$ standard is below the upper end of the range of the levels considered for the visibility index (*i.e.,* below 30 dv).

Some commenters disagree with the EPA's proposed conclusion that a level of 30 dv is appropriate for the visibility index and support a lower level in order to provide increased protection against visibility impairment. Commenters who support a revised level for the visibility index state that a target level of protection of 30 dv would mean that less than 10% of participants in the public preference studies, other than the Washington, DC, study, would accept visibility conditions above 29 dv. These commenters further suggest that a 75% acceptability, rather than 50% acceptability, is requisite to protect visibility sources, which would be on average a level of 21 dv when using the light extinction method or 18 dv when using the contrast of distance method. These commenters argue that, based on the available information, a target level of protection for the visibility index of approximately 20 dv would be more appropriate, and therefore, the level of the secondary 24-hour $PM_{2.5}$ standard should be strengthened to 25 $\mu g/m^3$. Other commenters who support a revised level for the visibility index suggest that public preference studies with longer sight paths to distant landscape features or with lower target levels than those in the Washington, DC study, such as the Phoenix study, would support a lower level. These commenters support revising the target level of protection for the visibility index to a 25 dv, and revising the level of the secondary 24-hour $PM_{2.5}$ standard to a level as low as 25 $\mu g/m^3$, suggesting that in low relative humidity environments, 25 dv is consistent with $PM_{2.5}$ concentrations of less than 25 $\mu g/m^3$.

Some commenters state that EPA's justification for setting a target level of protection at the upper end of the 20 to 30 dv range is arbitrary. These commenters state that the EPA's reliance on the standard operating in many regions and circumstances as support for the upper end of the range is irrational and illegal. Moreover, these commenters contend that EPA provided no rational connection between the Regional Haze Program and the proposed decision to set the target level of protection at the upper end of the range. They suggest that the EPA proposed to rely exclusively on the Regional Haze Program to protect visibility in Class I areas and to give visibility in these areas no weight in considering the secondary PM standard and that it is not rational to entirely ignore visibility in Class I areas when setting the secondary standard. These commenters assert that the Regional Haze Program provides no rational basis for a target level of protection at the upper end of the range, nor does the EPA identify one.

Some commenters contend that the EPA failed to justify the adequacy of the current secondary annual $PM_{2.5}$ standard, noting that the secondary 24-hour and annual $PM_{2.5}$ standards work together to provide protection against short- and long-term effects of $PM_{2.5}$. These commenters point to CASAC comments on the 2021 draft PA and the comments of an individual CASAC member's support for strengthening the secondary annual $PM_{2.5}$ standard to provide increased protection against climate and materials effects over time. They contend that EPA arbitrarily failed to discuss the secondary annual $PM_{2.5}$ standard not only in the proposal, but also in the 2022 PA and in the 2020 final decision.

The EPA recognizes that the selection of the target level of protection for the visibility index is fundamentally a public welfare policy judgment for the Administrator. The Administrator is tasked by the CAA to judge when visibility impairment becomes an adverse effect on public welfare. It is clear that visibility impairment can become adverse to public welfare, but the Administrator does not consider that every deciview of impairment is adverse to public welfare. In considering the point at which visibility impairment becomes adverse to public welfare, such that the attainment of the secondary PM NAAQS would prevent the adverse effect, the Administrator gives weight to the public preference studies as to when visibility impairment is unacceptable. At the same time, the Administrator recognizes the limitations of these studies, which have been detailed in the proposal and the 2022 PA. Similarly, the EPA discussed the Regional Haze program in the proposal to highlight that there is a distinct program to protect against visibility impairment in Class I areas, and the existence of that program is relevant to the Administrator's judgment about the level of visibility impairment that is adverse to public welfare under CAA 109(d), because in determining what is requisite the Administrator is primarily considering visibility impairment outside of Class I areas.

[172] Gantt, B., and Hagan, N. (2023). Analysis of Percentile Forms of the Visibility Index. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072*.

[173] Gantt, B., and Hagan, N. (2023). Analysis of Percentile Forms of the Visibility Index. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072*.

[174] Gantt, B., and Hagan, N. (2023). Analysis of Percentile Forms of the Visibility Index. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072*.

In considering how to use the results of the public preference studies, the Administrator concludes that a 50th acceptability criterion is an appropriate tool. The Administrator's task is to set standards that are neither more stringent nor less stringent than necessary, and a 50% acceptability criterion seems most appropriate to use in judging when visibility impairments become adverse, because it should more closely represent when the median person would find the impairment to be adverse. The Administrator notes this conclusion is consistent with the approach adopted in the Denver study by Ely et al. (1991) where the 50% acceptability criterion for urban visibility was first presented. This study discussed the use of the 50% acceptability criteria as a reasonable basis for setting a standard to protect visibility in urban areas. In doing so, Ely et al. (1991) noted that the 50% acceptability criterion divided the slides into two groups—those judged acceptable and those judged unacceptable by a majority of people in the study—and therefore, was reasonable since it defines the point where the majority of the study participants began to judge levels of visibility impairment as unacceptable (Ely et al., 1991).

In considering the appropriate target level of protection, we next look to the available public preference studies, noting that the selecting of the range of 20 to 30 dv for the target level of protection for the visibility index is informed by the 50% acceptability values from these studies. The Denver, CO, (Ely et al., 1991) and British Columbia, Canada, (Pryor, 1996) studies met the 50% acceptability criteria at 20 dv and 19–23 dv, respectively (U.S. EPA, 2022b, Table D–8). As described in the proposal, these studies used photographs that were taken at different times of the day and on different days to capture a range of light extinction levels needed for the preference studies (88 FR 5652, January 27, 2023). Compared to studies that used computer-generated images (*i.e.,* those in Phoenix, AZ, and Washington, DC) there was more variability in scene appearance in these older studies that could affect preference rating and includes uncertainties associated with using ambient measurements to represent sight path-averaged light extinction values rather than superimposing a computer-generated amount of haze onto the images. When using photographs, the intrinsic appearance of the scene can change due to meteorological conditions (*i.e.,* shadow patterns and cloud conditions) and spatial variations in ambient air quality that can result in ambient light extinction measurement not being representative of the sight-path-averaged light extinction. Computer-generated images, such as those generated with WinHaze, do not introduce such uncertainties, as the same base photograph is used (*i.e.,* there is no intrinsic change in scene appearance) and the modeled haze that is superimposed on the photograph is determined based on uniform light extinction throughout the scene. Because of the uncertainties and limitations associated with the Denver, CO, and British Columbia, Canada, the EPA concludes that it is appropriate to place less weight on these studies, and to instead focus on the public preference studies that were designed to reduce these uncertainties and limitations.

In so doing, we focus on the public preference studies that use computer-generated images (*i.e.,* those in the Phoenix, AZ, and Washington, DC) studies. As described in the proposal, the use of computer-generated images have less variability in scene appears than in those studies that use photographs taken on different days and at different times of the days (*i.e.,* those in the Denver, CO, study) that would be likely to influence preference rating and introduces uncertainties associated with using ambient measurements to present sight path-averaged light extinction values rather than superimposing a computer-generated amount of haze onto the images (88 FR 5652, January 27, 2023).

The Phoenix, AZ, public preference study (BBC Research & Consulting, 2003) had several strengths compared to some of the other public preference studies. The Phoenix, AZ, study had the largest number of participants (385 in 27 separate focus group sessions) of all of the public preference studies, with a sample group designed to be demographically representative of the Phoenix population at that time. The age range in the Phoenix study was also more inclusive (18–65+), with the distribution of the study participants corresponding reasonably well to the overall age distribution in the 2000 U.S. Census for the Phoenix area (BBC Research & Consulting, 2003). Furthermore, the 21 images used in the Phoenix, AZ, study were developed using the WinHaze software with visual air quality ranging from 15 to 35 dv, and the view was toward the southwest, including downtown Phoenix, with the Sierra Estrella Mountains in the background at a distance of 25 miles. This study had the least noisy preference results, perhaps because a larger, more representative group of participants combined with the use of computer-generated images resulted in the smoother distribution of responses of ''acceptable'' visual air quality. Based on the EPA's evaluation of the public preference studies in the 2012 review, the 50% ''acceptable'' criteria was met at approximately 24 dv (U.S. EPA, 2010, Table 2–3).

We also consider the public preferences for the Washington, DC, studies (Abt Associates, 2001; Smith and Howell, 2009). The 2001 Washington, DC study included nine participants, and the 2009 Washington, DC, study replicated the 2001 study with 26 additional participants. Similar to the Phoenix study, the Washington, DC, studies also had the strength of having the 20 images included in the study generated using WinHaze with visual air quality ranging from 9 to 45 dv. The study depicted a scene of a panoramic view of the Potomac River, the National Mall, and downtown Washington, DC. All of the distinct buildings in the scene were within four miles and the higher elevations in the background were less than 10 miles from where the image was taken from the Arlington National Cemetary in Virginia. The 50% ''acceptable'' criteria was met at approximately 29 dv (U.S. EPA, 2010, Table 2–3).

As described in more detail in the proposal, visibility preferences can vary by location, and such differences may arise based on the differences in the cityscape scene that is depicted in the images (88 FR 5652, January 27, 2023). In considering the geographical differences between the public preference studies, we recognize that the methodological differences between the studies may influence the resulting ''acceptable'' level of visibility impairment. In the Phoenix, AZ, study, the image depicted mountains in the background and urban features in the foreground, whereas the Washington, DC, study depicted nearby buildings in the image without mountains in the distance. As an initial matter, we note that the object of interest to the study participant could differ across the studies based on the scenes included in the images being evaluated—with the mountains being of greater interest in the images in the Phoenix, AZ, study, despite also depicting buildings that are similar to those shown and presumed to be of interest in the images in the Washington, DC, study (88 FR 5652, January 27, 2023). We also agree with the commenters that the distance between the object of interest and the camera is an important consideration in

evaluating the public preference studies. Objects at greater distances from the camera location (such as those in the Phoenix, AZ, study which had a maximum distance of 42 km (U.S. EPA, 2022b, Table D–8)) have a greater sensitivity to light extinction, which alone could explain differences in preferences but coupled with an object of greater interest results in lower acceptable levels of visibility impairment. Conversely, objects at closer distances from the camera location (such as those in the Washington, DC, study which had a maximum distance of 8 km (U.S. EPA, 2022b, Table D–8)) have less sensitivity to light extinction, which coupled with objects of interest (compared to the mountainous views in the Phoenix, AZ, study) result in higher acceptable levels of visibility impairment. These studies clearly demonstrate that there are differences in the public preferences across the studies depending on the images that are used, in particular the object of interest to the study participant depicted in the image and the distance of the sight path to the object, and that such differences can influence preference results.

However, we note that these uncertainties and limitations have persisted from past reviews, and there is very little new information to inform conclusions regarding the interpretation of these results with regard to the target level of protection. In selecting a target level of protection, and in considering the CASAC's advice in their review of the 2021 draft PA and public comments, we conclude that it is appropriate to consider the information from the public preference studies in Washington, DC, and Phoenix, AZ, and in so doing, that it is appropriate to place weight on both of these studies in reaching conclusions on the appropriate target level of protection. The EPA recognizes that the scenes depicted in these two studies are different and may influence public preferences of visibility impairment, but notes these studies can be considered together as providing information about different areas across the U.S. with variations in the scenes that people are likely to most commonly encounter. The scene depicted in the images used in the Washington, DC, study have a mix of buildings, landmarks, and open space. On the other hand, the scene depicted in the Phoenix, AZ, study included a mix of buildings in the foreground and with more distant mountains in the background. The Administrator considers it appropriate to consider these studies together because in combination, they provide a greater diversity of scenes, which is more likely to be representative of scenes people typically experience around the country (*e.g.,* not only in eastern metropolitan statistical areas, but also in western areas with different vistas). In considering these two studies together, the EPA recognizes that, first, the ''object of interest'' is a subjective judgment left to the participants of the public preference studies, and second, the images in these two studies may differ in terms of sensitivity to changes in light extinction because of the distance between the object of interest in the scene and the camera. As noted by the public commenters, the sight path for the images in the public preference studies is an important consideration in reaching conclusions regarding the appropriate target level of protection for the visibility index. In addition, the Administrator judges that giving weight to multiple studies is a more appropriate approach than focusing on a single study, particularly where the study design (including the representativeness of the participants and the scenes depicted in the images) may be important for interpreting the results of the public preference studies for informing conclusions regarding the visibility index. Given these considerations and taking into consideration public comments on the target level of protection for the visibility index, the Administrator recognizes that it is more appropriate to consider a broader range of public preferences, reflecting a broader range of scenes, by putting significant weight on both the Washington, DC, and Phoenix, AZ, studies. In so doing, he reaches the conclusion that it would be appropriate to identify secondary PM standards that generally limit visibility impairment to a level between the two studies.

The Administrator next considers what target level of protection would be appropriate based on the available information from these public preference studies. He first recognizes that, in the 2012 and 2020 final decisions, the then-Administrators selected a target level of protection of 30 dv, based on the upper end of the range. In so doing, the then-Administrators judged that it was appropriate to place more weight on the uncertainties associated with the public preference studies in reaching their conclusions. However, in this reconsideration, the current Administrator, while continuing to recognize that substantial uncertainties remain and that there is relatively limited new information regarding public preferences of visibility impairment, judges that it is important to balance the weight placed on uncertainties with the strength of the scientific evidence. As such, the Administrator concludes that it is appropriate to consider a target level of protection within the range of 20 to 30 dv. He further concludes that in selecting a target level within that range it is appropriate to place weight on both the mid-point of the range, as supported by the study in Phoenix, AZ, as well as the upper end, as supported by the Washington, DC, study. The Administrator notes that these two studies both employ similar methodologies that are subject to fewer uncertainties than older public preference studies (including their use of WinHaze to reduce uncertainties in the preference solicitations) although he notes that the Phoenix, AZ, study yielded the best results of the four public preference studies in terms of the least noisy preference results and the most representative selection of participants. Furthermore, he notes the differences between the scenes used for each study and finds that consideration of these studies together is more appropriate in selecting a national target for visibility protection than considering either study alone. Thus, in considering this information, along with the uncertainties and limitations of the public preference studies, the Administrator judges that it would be appropriate to select a target level of protection based on placing equal weight on the upper end of the range (*i.e.,* 30 dv) and the middle of the range (*i.e.,* 24 dv based on the Phoenix, AZ, study) in order to identify a nationwide target for protection against visibility impairment. In so doing, the Administrator concludes that a visibility index with a target level of protection of 27, defined in terms of estimated light extinction, with a 24-hour averaging time and a 3-year, 90th percentile form, would provide adequate protection against PM-related visibility effects on public welfare. Such a target level of protection balances the information from two key studies reflecting different participant preferences for different vistas in different parts of the country, appropriately weighting both near-field and more distant landscape features that may be of importance to public perceptions of visibility.

The Administrator notes that the available evidence indicates that the relationship between PM and light extinction is complex, depending on factors such as PM composition, size fraction, and age of the particles in ambient air, as well as relative

humidity. These factors can vary across the country based on differences in regional influences, as well as meteorological conditions that can vary spatially and temporally in different areas. The Administrator also recognizes that this variability, coupled with the age of the PM depending on the distance from the source to the monitor location, also complicates the selection of which IMPROVE equation is most appropriate in different areas, although he notes that different IMPROVE equations will yield similar, but not identical, results. In so doing, the Administrator takes note of the figures presented in the 2022 PA, which depict the comparisons using the original IMPROVE equation (Figure 5–3), the revised IMPROVE equation (Figure 5–4), and the Lowenthal & Kumar equation (Figure 5–6), as well as the estimated light extinction values for the three different equations presented in Table D–7.

The Administrator notes that when light extinction is calculated using the original IMPROVE equation, all 60 sites have 3-year visibility metrics below 28 dv, 58 sites are at or below 25 dv, 26 sites are at or below 20 dv, and of the two sites above 25 dv one is at 26 dv and the other has a 24-hour $PM_{2.5}$ design value of 56 μg/m³ (*i.e.,* well above the current 24-hour standard). Results are similar for other IMPROVE equations.[175] Based on these analyses, and consistent with the results of similar analyses in the 2012 review and the 2020 PA, the Administrator concludes that the current secondary 24-hour $PM_{2.5}$ standard, with its level of 35 μg/m³, maintains the visibility index below 27 dv, and in fact, the current standard maintains air quality such that many areas have visibility index values that range between 15 and 25 dv for all three IMPROVE equations. In the areas that meet the secondary 24-hour $PM_{2.5}$ standard, all locations were below 27 dv when using the original and revised IMPROVE equation and all but three locations were at or below 27 dv when using the Lowenthal & Kumar IMPROVE equation. Three locations (two in California and one in Utah) had air quality that was at 28 dv when the Lowenthal & Kumar IMPROVE equation was used. As described in more detail in section V.A.1.3, we recognize that there are differences in the inputs for the three IMPROVE equations that can influence the resulting estimated light extinction values. The higher multiplier for converting OC to OM in the Lowenthal & Kumar IMPROVE equation (*i.e.,* a multiplier of 2.1) may be more appropriate in more remote locations where there is more aged and oxygenated organic PM than in urban locations. The three locations with air quality at 28 dv are all in urban areas (downtown Los Angeles, CA; Rubidoux, CA; Salt Lake City, UT) and tend to have higher levels of nitrate and OC, especially during the wintertime when peak $PM_{2.5}$ concentrations typically occur. In these locations, it may be more appropriate to use either the original or revised IMPROVE equation, which have multipliers of 1.4 and 1.8, respectively, in order to refine the inputs such that estimated light extinction in these locations is more accurately characterized based on site-specific characteristics.

We also note that the four areas that exceed the secondary 24-hour $PM_{2.5}$ standard also generally had air quality that was below 27 dv in terms of the visibility index, with only two locations experiencing a visibility index above 27 dv. One location that exceeds the secondary 24-hour $PM_{2.5}$ standard had a visibility index of 29 dv using the original IMPROVE equation, while two locations were 30 and 32 dv using the Lowenthal & Kumar IMPROVE equation. We believe attainment and maintenance of the secondary 24-hour $PM_{2.5}$ standard will result in improved air quality in these areas, such that the visibility index values for these areas will decrease even further.

The Administrator recognizes that in concluding that it is appropriate to identify secondary PM standards that generally limit visibility impairment to as low as 27 dv in terms of the visibility index, the current secondary PM standards continue to provide protection against visibility impairment associated with a visibility index as low as, or even lower than, 27 dv. In so doing, he notes that when meeting the current 24-hour $PM_{2.5}$ standard, all sites have a visibility index at or below 27 dv with the original and revised IMPROVE equations, and all but three sites at or below 27 dv with the Lowenthal and Kumar IMPROVE equation. Furthermore, the Administrator notes that this conclusion is consistent with the CASAC's advice who, in their review the 2021 draft PA, stated that ''[i]f a value of 20–25 deciviews is deemed to be an appropriate visibility target level of protection, then a secondary 24-hour $PM_{2.5}$ standard in the range of 25–35 μg/m³ should be considered'' (Sheppard, 2022a, p. 21 of consensus responses).

Thus, the Administrator concludes that weight on both the upper end of the range of target levels of protection for the visibility index identified in previous reviews and the mid-point of the range, as presented by the Phoenix, AZ, public preference study, and focusing on a target level of protection of 27 dv, he still judges the current secondary 24-hour $PM_{2.5}$ standard requisite to achieve that target because the standard generally maintains the visibility index at or below 27 dv such that more stringent standards are not warranted.

The EPA agrees with the commenters that the secondary PM standards work together to provide protection against short- and long-term effects of both fine and coarse particles (U.S. EPA, 2022b, section 5.5; 88 FR 5661, January 27, 2023). However, the EPA disagrees with commenters that we failed to discuss the secondary annual $PM_{2.5}$ standard in the proposal, 2022 PA, and the 2020 final notice and that we failed to justify the adequacy of the secondary annual $PM_{2.5}$ standard. As described in the 2022 PA and the proposal, we recognize that $PM_{2.5}$ is the size fraction of PM responsible for most of the visibility impairment in urban areas (U.S. EPA, 2022b, section 5.3.1.2; 88 FR 5654, January 27, 2023). Analyses in the 2019 ISA found that mass scattering from $PM_{10-2.5}$ was relatively small (less than 10%) in the eastern and northwestern U.S., whereas mass scattering was much larger in the Southwest (more than 20%), particularly in southern Arizona and New Mexico (U.S. EPA, 2019, section 13.2.4.1, p. 13–36). Given the relationship between visibility and $PM_{2.5}$ along with the short-term nature of visibility effects, we focus more on the adequacy of the secondary 24-hour $PM_{2.5}$ standard for providing protection against visibility impairment (U.S. EPA, 2022b, section 5.3.1.2; 88 FR 5653, January 27, 2023). In reaching his proposed conclusions, the Administrator clearly states that he ''recognizes that the current suite of secondary standards (*i.e.,* the 24-hour $PM_{2.5}$, 24-hour PM_{10}, and annual $PM_{2.5}$ standards) together provide . . . control for both fine and coarse particulates and long- and short-term visibility and non-visibility (*e.g.,* climate and materials) effects related to PM in ambient air'' (88 FR 5661, January 27, 2023). Thus, by explaining how the secondary standards work together to provide protection from adverse effects, why we focus on the secondary 24-hour $PM_{2.5}$ standard as

[175] When light extinction is calculated using the revised IMPROVE equation, all 60 sites have 3-year visibility metrics below 28 dv, 56 sites are at or below 25 dv, and 26 sites are at or below 20 dv. When light extinction is calculated using the Lowenthal and Kumar IMPROVE equation, 59 sites have 3-year visibility metrics below 28 dv, 45 sites are at or below 25 dv, and 15 sites are at or below 20 dv. The one site with a 3-year visibility metric of 32 dv exceeds the secondary 24-hour $PM_{2.5}$ standard, with a design value of 56 μg/m³ (see U.S. EPA, 2022b, Appendix D, Table D–3).

most relevant to visibility impairment, and how the Administrator selected the target level of protection for the visibility index, we have addressed the CASAC's request to support the proposed decision to revise the secondary 24-hour $PM_{2.5}$ standard while retaining the secondary annual $PM_{2.5}$ standard. The commenters also cite to an individual CASAC member's comments for the review of the 2021 draft PA who stated ''[f]or the limited scope of this reconsideration review, I see no reason to not simply set the Secondary equal to the Primary PM Standards, whatever they may be'' (Sheppard, 2022a, p. A–3). This CASAC member did not provide a supporting rationale for revising the secondary standards to levels equal to the primary standards. Although areas across the country are required to attain both the primary and secondary $PM_{2.5}$ standards so air quality is unaffected by the Administrator's decision not to revise the secondary standards to be equal to the primary standards, as described in responding to comments above, the CAA provisions require the Administrator to establish secondary standards that, in the judgment of the Administrator, are requisite to protect public welfare from known or anticipated adverse effects associated with the presence of the pollutant in ambient air. In so doing, the Administrator seeks to establish standards that are neither more nor less stringent than necessary for this purpose. The Act does not require that standards be set at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect the public welfare from known or anticipated adverse effects. The final decision on the adequacy of the current secondary standards is a public welfare policy judgment to be made by the Administrator. In reaching his proposed and final decisions regarding the adequacy of the current secondary PM standards, the Administrator considered the available scientific information and analyses about welfare effects, and associated public welfare significance, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the scientific evidence and analyses. In so doing, the Administrator concluded that the currently available scientific evidence and quantitative analyses, including uncertainties and limitations, do not call into question the adequacy of the current secondary PM standards and that the current secondary PM standards should be retained, without revision. The Administrator's judgments and decisions on the primary and secondary standards are independent and consider different aspects of the available scientific evidence and information in reaching conclusions regarding the adequacy of the standards in protecting against PM-related health and welfare effects.

4. Administrator's Conclusions

This section summarizes the Administrator's considerations and conclusions related to the current secondary $PM_{2.5}$ and PM_{10} standards and presents the rationale for his decision that no change is required for those standards at this time. The CAA provisions require the Administrator to establish secondary standards that, in the judgment of the Administrator, are requisite to protect public welfare from known or anticipated adverse effects associated with the presence of the pollutant in the ambient air. In so doing, the Administrator seeks to establish standards that are neither more nor less stringent than necessary for this purpose. The Act does not require that standards be set at a zero-risk level, but rather at a level that reduces risk sufficiently so as to protect the public welfare from known or anticipated adverse effects. The final decision on the adequacy of the current secondary standards is a public welfare policy judgment to be made by the Administrator. The decision should draw on the scientific information and analyses about welfare effects, and associated public welfare significance, as well as judgments about how to consider the range and magnitude of uncertainties that are inherent in the scientific evidence and analyses. This approach is based on the recognition that the available evidence generally reflects a continuum that includes ambient air exposures at which scientists agree that effects are likely to occur through lower levels at which the likelihood and magnitude of responses become increasingly uncertain. This approach is consistent with the requirements of the provisions of the Clean Air Act related to the review of NAAQS and with how the EPA and the courts have historically interpreted the Act.

Given these requirements, the Administrator's final decision in this reconsideration is a public welfare policy judgment that draws upon the scientific and technical information examining PM-related visibility impairment, climate effects and materials effects, including how to consider the range and magnitude of uncertainties inherent in that information. The Administrator recognizes that his final decision is based on an interpretation of the scientific evidence and technical analyses that neither overstates nor understates their strengths and limitations, or the appropriate inferences to be drawn. In particular, the Administrator notes that the assessment of when visibility impairment is adverse to public welfare requires a public welfare policy judgment informed by available scientific and quantitative information.

In considering the adequacy of the current secondary PM standards in this reconsideration, the Administrator has carefully considered the: (1) Policy-relevant evidence and conclusions contained in the 2019 ISA and 2022 ISA Supplement; (2) the quantitative information presented and assessed in the 2022 PA; (3) the evaluation of this evidence, the quantitative information, and the rationale and conclusions presented in the 2022 PA; (4) the advice and recommendations from the CASAC; and (5) public comments. In the discussion below, the Administrator gives weight to the 2022 PA conclusions, with which the CASAC generally concurred during their review of the 2019 draft PA and 2021 draft PA, as summarized in section IV.B.1 of the 2020 final notice and section V.D.1 of the 2022 proposal, and takes note of key aspects of the rationale for those conclusions that contribute to his decision in this reconsideration. After giving careful consideration to all of this information, the Administrator judges that no change is required for the secondary PM standards at this time.

In considering the 2022 PA evaluations and conclusions, the Administrator takes note of the overall conclusions that the non-ecological welfare effects evidence and quantitative information are generally consistent with what was considered in the 2020 final decision and in the 2012 review (U.S. EPA, 2022b, section 5.5). The scientific evidence for non-ecological welfare effects in this reconsideration is largely the same as that available in the 2019 ISA and 2020 PA. As described in section I.C.5.b above, the 2022 ISA Supplement included a limited number of newly available studies on PM-related visibility effects. This newly available evidence on visibility effects, along with the full body of non-ecological welfare effects evidence assessed in the 2019 ISA, reaffirms conclusions on the visibility, climate, and materials effects recognized in the 2020 final decision and in the 2012 review, including key conclusions on which the standards are based. Further, as discussed in more

detail above, the updated quantitative analyses of visibility impairment for areas meeting the current standards in the 2022 PA support the adequacy of the current secondary PM standards to protect against PM-related visibility impairment. The Administrator also recognizes that uncertainties and limitations continue to be associated with the available scientific evidence and quantitative information.

With regard to the current evidence on visibility effects, as summarized in the 2022 PA and discussed in detail in the 2019 ISA and ISA Supplement, the Administrator notes the long-standing body of evidence for PM-related visibility impairment. As in previous reviews, this evidence continues to demonstrate a causal relationship between PM in ambient air and effects on visibility (U.S. EPA, 2019a, section 13.2). The Administrator recognizes that visibility impairment can have implications for people's enjoyment of daily activities and for their overall sense of well-being. Therefore, as in previous reviews, he considers the degree to which the current secondary standards protect against PM-related visibility impairment and the degree to which PM-related visibility impairment is adverse to public welfare. In particular, in recognizing the short-term nature of visibility impairment along with the fact that $PM_{2.5}$ is the size fraction that contributes most to light extinction, the Administrator especially focuses on the adequacy of the current secondary 24-hour $PM_{2.5}$ standard in providing protection against PM-related visibility effects judged to be adverse. The Administrator also considers the protection provided by the current secondary 24-hour $PM_{2.5}$ standard against PM-related visibility impairment in conjunction with the Regional Haze Program as a means of achieving appropriate levels of protection against PM-related visibility impairment in urban, suburban, rural, and Federal Class I areas across the U.S. Programs implemented to meet the secondary PM standards, along with the requirements of the Regional Haze Program established for protecting against visibility impairment in Class I areas, would be expected to improve visual air quality across all areas of the country.

As described in the proposal (88 FR 5658, January 27, 2023), the Administrator recognizes that the Regional Haze Program was established by Congress specifically to achieve ''the prevention of any future, and the remedying of existing, impairment of visibility in mandatory Class I areas, which impairment results from man-made air pollution,'' and that Congress established a long-term program to achieve that goal (CAA section 169A). In adopting section 169, Congress set a goal of eliminating anthropogenic visibility impairment at Class I areas, as well as a framework for achieving that goal which extends well beyond the planning process and timeframe for attaining the secondary PM NAAQS. Recognizing that the Regional Haze Program will continue to contribute to reductions in visibility impairment in Class I areas, consistent with his proposed conclusions, the Administrator concludes that addressing visibility impairment in Class I areas is largely beyond the scope of the secondary PM standards and that setting the secondary 24-hour $PM_{2.5}$ standard at a level that would remedy visibility impairment in Class I areas would result in standards that are more stringent than is requisite.

In further considering what standards are requisite to protect against adverse public welfare effects from visibility impairment, the Administrator concludes that it is appropriate to use an approach consistent with the approach used past reviews (88 FR 5650, January 27, 2023). He first identifies an appropriate target level of protection in terms of a PM visibility index that takes into account the factors that influence the relationship between PM in ambient air and visibility (*i.e.,* size fraction, species composition, and relative humidity). He then considers the air quality analyses conducted in the 2022 PA that examine the relationship between the PM visibility index and the current secondary 24-hour $PM_{2.5}$ standard in locations that meet the current 24-hour $PM_{2.5}$ and PM_{10} standards (U.S. EPA, 2022b, section 5.3.1.2).

In reaching conclusions regarding the target level of protection, the Administrator first considers the characteristics of the visibility index and defines its elements (indicator, averaging time, form, and level). With regard to the indicator for the visibility index, the Administrator continues to recognize that, consistent with the conclusions of the 2022 PA and the CASAC's advice in their review of the 2021 draft PA, there is a lack of availability of methods and an established network for directly measuring light extinction. Therefore, the Administrator concludes that it continues to be appropriate to using an index based on estimates of light extinction by $PM_{2.5}$ components based on the IMPROVE algorithm. In so doing, the Administrator recognizes that the fundamental understanding of the relationship between ambient PM and light extinction has generally changed very little over time; however, several versions of the IMPROVE equation have been developed and evaluated that could be used to estimate light extinction. As at the time of the proposal, the Administrator recognizes that the results of the quantitative analyses in the 2022 PA that examined three versions of the IMPROVE equation indicate that there are very small differences in estimates of light extinction between the equations, and that it is not always clear that one version of the IMPROVE equation is more appropriate for estimating light extinction across the U.S. than other versions of the IMPROVE algorithm (88 FR 5659, January 27, 2023). He also recognizes that the selection of inputs to the IMPROVE equation (*e.g.,* the multiplier for OC to OM) may be more appropriate on a regional basis rather than a national basis when calculating light extinction, and notes the CASAC's advice that PM-visibility relationships are region specific (Sheppard, 2022a, p. 21 of consensus responses). The Administrator further notes that neither the CASAC nor public commenters recommended a specific IMPROVE equation or an approach for using different IMPROVE equations across the U.S. Therefore, given the absence of a robust monitoring network to directly measure light extinction, the Administrator concludes that light estimated light extinction, as calculated using one or more versions of the IMPROVE algorithms, continues to be the most appropriate indicator for the visibility index.

Having reached the conclusion that estimated light extinction is the appropriate indicator for the visibility index, the Administrator next considers the appropriate averaging time and form of the index. With regard to the averaging time and form, the Administrator notes that in previous reviews, a 24-hour averaging time was selected and the form was defined as the 3-year average of annual 90th percentile values. As at the time of proposal, the Administrator recognizes that the available information continues to provide support for the short-term nature of visibility effects. He further recognizes that no new information is available in this reconsideration to inform his conclusions regarding averaging time, and therefore, he considers past analyses of 24-hour and subdaily $PM_{2.5}$ light extinction to inform his conclusions on averaging time. As described in the proposal (88 FR 5659, January 27, 2023) and in responding to comments in section V.B.3 above, prior

analyses demonstrated that there are strong correlations between 24-hour and subdaily (*i.e.,* 4-hour average) $PM_{2.5}$ light extinction, indicating that a 24-hour averaging time is an appropriate surrogate for the subdaily time periods associated with when individuals experience visibility impairment and that a longer averaging time may also be less influenced by atypical conditions and/or atypical instrument performance. The Administrator also notes that the CASAC did not provide advice or recommendations with regard to the averaging time of the visibility index, although some public commenters referenced CASAC advice in past reviews that a subdaily standard based on daylight hours would better reflect the public welfare effects of public perceptions of visibility impairment than a 24-hour standard. However, in considering the available scientific and quantitative information, as well as the CASAC's advice in their reviews of the 2019 draft PA and 2021 draft PA, the Administrator concludes that the 24-hour averaging time continues to be appropriate for the visibility index because it is an appropriate surrogate for subdaily time periods and results in a more stable target.

With regard to the form of the visibility index, the Administrator notes the approach in other NAAQS that a multi-year percentile form offers greater stability to the air quality management process by reducing the possibility that statistically unusual indicator values will lead to transient violations of the standard. He recognizes that using a 3-year average provides stability from the occasional effects of inter-annual meteorological variability (including relative humidity) that can result in unusually high pollution levels for a particular year (88 FR 5659, January 27, 2023) and recognizes that a stable standard contributes to the benefits of the NAAQS by ensuring that attainment strategies are designed to address non-transient problems and achieve durable air quality improvements. For these reasons, he concludes that a 3-year average continues to be appropriate.

In considering the percentile that would be appropriate with the 3-year average, the Administrator recognizes that there is very little new information available in this reconsideration to inform selection of an alternative form of the visibility index and that the appropriate form requires the exercise of public welfare policy judgment. In selecting the appropriate target level of protection for the visibility index, the Administrator is required to assess when visibility impairment becomes adverse to public welfare, weighing both the degree of visibility impairment (in dv) and the frequency of such impairment (through the form). As with the mass-based PM air quality standard, the target level of protection for the visibility index must be selected in conjunction with the form to determine the appropriate stringency. In so doing, consistent with approaches in past reviews, the Administrator first notes that the Regional Haze Program targets the 20% most impaired days for improvements in visual air quality in Class I areas, which are the days above the 80th percentile form of the visibility index. The Administrator concludes that a percentile form set at the 80th percentile would not be likely to sufficiently improve visual air quality on the worst days based on the visibility index. In considering the information available in past reviews regarding the form of the visibility index, as well as the analysis of alternative forms based on recent air quality discussed above, the Administrator notes that a 90th percentile form would represent the median of the distribution of the 20% most impaired days, and meeting a visibility index with a 90th percentile form would reasonably be expected to lead to improvements in visual air quality for days both above and below the 90th percentile (88 FR 5660, January 27, 2023). In reaching his conclusion that a 90th percentile would appropriately achieve improved air quality both above and below that percentile, the Administrator took into consideration assessments of air quality data and potential alternative percentiles for the form. The Administrator further notes that, consistent with the conclusions in the 2011 PA and 2020 PA, the 2022 PA concluded that there is no new information from public preference studies that would suggest that a 90th percentile form is not appropriate. The Administrator also considers air quality analyses described above in responding to public comments regarding the percentile form of the visibility index. In particular, the Administrator notes that while a higher percentile form (*i.e.,* 95th or 98th) would somewhat further limit the number of days with peak PM-related light extinction, the differences in the 3-year averages of estimated light extinction for the 90th, 95th, and 98th percentile forms are small. For example, he notes that for the original IMPROVE equation, in areas that meet the current 24-hour $PM_{2.5}$ standard, all sites have light extinction estimates for a 90th percentile form at or below 26 dv, and for a 95th or 98th percentile form light extinction estimates are at or below 29 dv.[176] He further notes that, in most locations when estimating light extinction based on the original IMPROVE equation, the difference between a 95th or 98th percentile form and a 90th percentile form is generally less than 3 dv.[177] Moreover, the Administrator concludes that a 90th percentile form achieves a very high degree of control but appropriately targets the group of worst days, rather than the few very worst days. Based on the available information and these analyses, the Administrator concludes that the information does not indicate that it would be appropriate to consider limiting the occurrence of days with peak PM-related light extinction to a greater degree, nor did the CASAC provide advice or recommendations related to the form of the visibility index. Therefore, the Administrator judges that it remains appropriate to define a visibility index in terms of a 24-hour averaging time and form based on the 3-year average of annual 90th percentile values.

With regard to the level of the visibility index, as at the time of proposal, the Administrator continues to recognize that there is very little new information available to inform his judgment regarding the range of levels of visibility impairment judged to be acceptable by at least 50% of study participants in the visibility preference studies,[178] and therefore, the range of 20 to 30 dv identified in the 2022 PA remains appropriate for considering the level of the visibility index. The Administrator also recognizes that the uncertainties and limitations associated with the public preferences identified in the 2012 and 2020 reviews continue to persist, and that these limitations and uncertainties contributed to the decisions in 2012 and 2020 that a level at the upper end of the range (*i.e.,* 30 dv) was selected. The Administrator specifically notes that, while the studies

[176] Gantt, B., and Hagan, N. (2023). Analysis of Percentile Forms of the Visibility Index. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

[177] Gantt, B., and Hagan, N. (2023). Analysis of Percentile Forms of the Visibility Index. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

[178] For reasons stated above and described in the 2022 PA and proposal, the Administrator does not find it appropriate to use the most recent preference study based on the Grand Canyon study area (Malm et al., 2019) for purposes of identifying a target level of protection for the visibility index.

are methodologically similar, there are a number of factors that can influence comparability across the studies and that the available studies may not capture the full range of visibility preferences in the U.S. population, as described in more detail in section V.D.3 of the 2022 proposal (88 FR 5659–5660, January 27, 2023). The Administrator also notes the CASAC's advice in their review of the 2021 draft PA that there are a limited number of visibility preference studies available to inform the Administrator's judgment regarding the appropriate target level of protection for the visibility index (Sheppard, 2022a, p. 21 of consensus responses). In considering the available information, including uncertainties and limitation, and the CASAC's advice, the Administrator proposed to conclude that it is appropriate to consider a target level of protection for the visibility index within the range of 20 to 30 dv, and that establishing a target level of protection at the upper end of the range was appropriate. In so doing, the Administrator proposed to conclude that the protection provided by a visibility index based on estimated light extinction, a 24-hour averaging time, and a 90th percentile form, averaged over 3 years, set to a level of 30 dv would be requisite to protect public welfare with regard to visibility impairment.

However, at the time of proposal, the Administrator recognized that the available evidence on visibility impairment generally reflects a continuum and that the public preference studies do not provide information about the specific level for which visibility impairment would be ''acceptable'' or ''unacceptable'' across the country, and that alternative target levels of protection could be supported. At that time, in soliciting public comments, the Administrator recognized that other interpretations, assessments, and judgments based on the available welfare effects evidence for this reconsideration could be possible (88 FR 5662, January 27, 2023).

With regard to the appropriate target level of protection for the visibility index, the Administrator first notes that while the public preference studies were conducted in several geographical areas across the U.S., and they provide insight into regional preferences for visibility impairment, none of the studies identify a specific level of visibility impairment that would be perceived as ''acceptable'' or ''unacceptable'' across the whole U.S. population. He also noted that there have been significant questions about how to set a standard for visibility that is neither overprotective nor underprotective for some areas of the U.S. As described in the proposal (88 FR 5660, January 27, 2023), in establishing the Regional Haze Program to improve visibility in Class I areas, Congress noted that ''as a matter of equity, the national ambient air quality standards cannot be revised to adequately protect visibility in all areas of the country.'' H.R. Rep. 95–294 at 205. For the reasons noted above, in reaching his proposed decision regarding visibility impairment, the Administrator recognized that he is not seeking to set a standard that would eliminate visibility impairment in Class I areas, but significant uncertainties remain regarding how to judge when visibility impairment becomes adverse to public welfare across the range of daily outdoor activities for Americans across the country.

In reaching final conclusions regarding the available information, along with the CASAC's advice and public comments, the Administrator again considers what constitutes an appropriate target level of protection, and in particular considers whether a target level of protection below 30 dv is warranted. In so doing, he first notes the variability in public preferences of visibility impairment as demonstrated by the available public preferences, which support a range of potential target levels of protection for the visibility index from 20 to 30 dv. He also notes that this range informed the 2012 and 2020 then-Administrators final decisions that a target level of protection at the upper end of the range (*i.e.,* 30 dv) would be most appropriate, given the uncertainties and limitations associated with the public preference studies. As described in in section V.B.3 above in responding to public comments, the Administrator recognizes that a number of factors can influence public preferences across studies, in particular due to the types of scenes depicted in the images as well as the distances at which the objects of interest are located from the camera. Furthermore, the Administrator recognizes the small number of public preference studies currently available makes precise interpretations of their results challenging for determining a nationally appropriate target level of visibility protection. The Administrator also recognizes that the CASAC, in their review of 2021 draft PA, reiterated that PM-visibility relationships are region-specific based on aerosol composition, and that several public commenters emphasized the importance of the sight path distance in the images when considering how to interpret the public preference studies.

In this reconsideration, the Administrator judges that in determining when visibility impairment becomes adverse to public welfare for purposes of the secondary NAAQS, while continuing to recognize that substantial uncertainties remain and that there is relatively limited new information regarding public preferences of visibility impairment, it is important to balance the weight placed on uncertainties with the strength of the scientific evidence. In so doing, the Administrator first concludes that, consistent with previous reviews and his proposed decision, it remains appropriate to consider a target level of protection within the range of 20 to 30 dv. However, in further considering the available scientific and quantitative information, CASAC advice, and public comments, he further concludes that in selecting a target level within that range it is appropriate to place weight on both the middle of the range, as supported by the study in Phoenix, AZ, as well as the upper end, as supported by the Washington, DC, study. In so doing, he notes that the Washington, DC, and Phoenix, AZ, studies employ similar methodologies that are subject to fewer uncertainties than older public preference studies (including their use of WinHaze to reduce uncertainties in the preference solicitations) although he does note that the Phoenix, AZ, study yielded the best results of the four public preference studies in terms of the least noisy preference results and the most representative selection of participants. Further, the Administrator judges that this approach would take into account scenes that are similar to both the Washington, DC, study and Phoenix, AZ, study, which would be more representative of the ''typical'' scenes encountered across more areas of the U.S. than an approach that places weight on just one study or on studies conducted in certain geographical areas of the country. In considering this information, along with the uncertainties and limitations of the public preference studies, the Administrator judges that it would be appropriate to select a target level of protection based on placing equal weight on the upper end of the range (*i.e.,* 30 dv) and the middle of the range (*i.e.,* 24 dv based on the Phoenix, AZ, study) in order to provide protection against visibility impairment in different geographical areas of the U.S. For these reasons, the Administrator concludes that a visibility index with a target level of protection of 27 dv,

defined in terms of estimated light extinction, with a 24-hour averaging time and a 3-year, 90th percentile form, would provide adequate protection against PM-related visibility effects. In reaching this conclusion, the Administrator judges that such a target level of protection balances the information from these two key public preference studies in such a way appropriately weighs both near-field and more distant landscape features that may be of importance to public perceptions of visibility.

In further considering the appropriate target level of protection for the visibility index, the Administrator again recognizes the complexity of the relationship between PM and light extinction which is dependent on a number of factors, including PM composition, size fraction, and age of the particles in ambient air, as well as relative humidity. As noted in responding to comments above, these factors can vary geographically across the U.S. and local or regional meteorological conditions can also vary spatially and temporally. These factors are critical inputs to the IMPROVE equation and can influence the resulting estimated light extinction such that it is not a straightforward comparison between estimated light extinction in one area of the country versus another. Moreover, the Administrator recognizes that there is variability in estimated light extinction depending on the version of the IMPROVE equation that is used. As described in more detail in the 2022 PA and the proposal, and in reaching his decisions on the indicator of the visibility index above, the Administrator notes that the 2022 PA concluded that one version of the IMPROVE equation is not more accurate or precise in estimating light extinction, and that difference in locations may support the selection of inputs into the IMPROVE equation or of the appropriate IMPROVE equation to estimate light extinction on a regional basis rather than on a national basis.

In considering the available information, including variations in both public preferences of visibility impairment and estimates of light extinction using one or more IMPROVE equation, as well as the CASAC's advice in their review of the 2019 draft PA and 2021 draft PA and public comments, the Administrator judges that a target level of protection of 27 dv would be appropriate. In so doing, he concludes that a target level of protection above 27 dv would not provide adequate protection against PM-related visibility impairment based on the 50% acceptability values when both the Washington, DC, and Phoenix, AZ, studies are considered. However, he also notes that when considering the 50% acceptability values from studies conducted in different areas of the U.S. and with different scenes and images depicted, the available public preference studies do not provide a ''bright line'' at and above which visibility impairment is considered adverse to public welfare. He further recognizes that, as discussed just above, there are a number of region-specific factors that can influence light extinction, and thereby influence visibility impairment, as well as variations in public preferences of visibility impairment based on the available studies, that complicate selection of a single target level of protection that would be appropriate for a national visibility index. While the Administrator recognizes that the uncertainties and limitations associated with public preferences of visibility and estimating light extinction have persisted over the last several PM NAAQS reviews, he also recognizes that in reaching conclusions regarding the appropriate target level of protection for the visibility index also involves public welfare policy judgments regarding how to appropriately consider the particular uncertainties around identifying when visibility impairment becomes adverse to public welfare, and the limitations on relying on the public preference studies.

The Administrator also places weight on the high degree of spatial and temporal variability in PM composition and relative humidity across the U.S. in considering a target level of protection. This approach of establishing a target level of protection that takes into account 50% acceptability values from both eastern and western sites is a more appropriate basis for determining the requisite level of protection against known or anticipated adverse effects on public welfare across diverse locations, *i.e.,* a standard that is neither more nor less stringent than necessary nationwide. Specifically, the Administrator judges that a target level of protection for the visibility index focused on maintaining estimated light extinction between the upper end of the range of the target levels of protection (*i.e.,* 30 dv based on the Washington, DC, study) and the middle of the range (*i.e.,* 24 dv based on the Phoenix, AZ, study) to be more appropriate for a nationwide standard to protect against visibility impairment compared to a value derived from one location or one type of scene alone. For these reasons, in selecting a target level of protection, the Administrator concludes that a target level of protection somewhere between the upper end and middle of the range is appropriate because he judges that this approach, in conjunction with the Regional Haze program, is sufficient, but not more stringent than necessary, to protect against adverse effects on public welfare. Thus, he concludes a secondary 24-hour $PM_{2.5}$ NAAQS should be evaluated based on its ability to provide protection against visibility impairment associated with estimated light extinction of 27 dv based on estimated light extinction, a 24-hour averaging time, and a 90th percentile form, averaged over 3 years.

Having concluded that it is appropriate to identify a target level of protection in terms of a visibility index based on estimated light extinction as described above, the Administrator next considers the degree of protection from visibility impairment afforded by the current secondary PM standards. He considers the updated analyses of PM-related visibility impairment presented in the 2022 PA (U.S. EPA, 2022b, section 5.3.1.2) and described in section V.B.1.a of the proposal, and notes that the results of the analyses are consistent with the results from the 2012 and 2020 reviews.

Taking into consideration the full body of scientific evidence and technical information concerning the known and anticipated effects of PM on visibility impairment, the Administrator concludes that the current secondary $PM_{2.5}$ and PM_{10} standards are requisite to protect against PM-related visibility impairment. While the inclusion of the coarse fraction had a relatively modest impact on calculated light extinction in the analyses presented in the 2022 PA, he recognizes the continued importance of the PM_{10} standard given the potential for larger impacts in locations with higher coarse particle concentrations, such as in the southwestern U.S., for which only a few sites met the criteria for inclusion in the analyses in the 2022 PA (U.S. EPA, 2019a, section 13.2.4.1; U.S. EPA, 2022b, section 5.3.1.2).

With regard to the adequacy of the secondary 24-hour $PM_{2.5}$ standard, the Administrator notes that, in their review of the 2021 draft PA, the CASAC stated that ''[i]f a value of 20–25 deciviews is deemed to be an appropriate visibility target level of protection, then a secondary 24-hour $PM_{2.5}$ standard in the range of 25–35 $\mu g/m^3$ should be considered'' (Sheppard, 2022a, p. 21 of consensus responses). The Administrator recognizes that the CASAC recommended that the Administrator provide additional justification for a visibility index target

of 30 dv but did not specifically recommend that he choose an alternative level for the visibility index. The Administrator carefully considered the advice of CASAC and the public comments and concluded that a lower target level of visibility was appropriate in order to properly reflect both a broader set of studies and a broader range of vistas that were the subject of those studies. However, in their review of the 2021 draft PA, the CASAC recognized that even a visibility index target in the range of 20–25 dv could still warrant retention of the current secondary 24-hour $PM_{2.5}$ standard. The Administrator also considers the advice from the CASAC in their review of the 2019 draft PA, who ''recogniz[ed] that uncertainties. . .remain about the best way to evaluate'' PM-related visibility effects (Cox, 2019b, p. 13 consensus responses). The Administrator considered the CASAC's advice, together with the available scientific evidence and quantitative information, in reaching his conclusions.

The Administrator recognizes that conclusions regarding the appropriate weight to place on the scientific and technical information examining PM-related visibility impairment, including how to consider the range and magnitude of uncertainties inherent in that information, is a public welfare policy judgment left to the Administrator. In reaching his final decision in 2020, the then-Administrator noted that the available evidence regarding visibility effects had changed very little since the 2012 review, specifically recognizing that, as evaluated in the 2019 ISA, there were no new visibility studies that were conducted in the U.S. and there was little new information available with regard to acceptable levels of visibility impairment in the U.S. (85 FR 82742, December 18, 2020). As such, the then-Administrator concluded that the protection provided by a standard defined in terms of a $PM_{2.5}$ visibility index, with a 24-hour averaging time, a 90th percentiles form averaged over three years, set at a level of 30 dv, was requisite to protect public welfare against visibility impairment (85 FR 82743, December 18, 2020). He also recognized that there was some new information to inform quantitative analyses of light extinction, but that the results of the analyses conducted in the 2020 PA were consistent with those from the 2012 review. The then-Administrator recognized that the analyses demonstrated that the 3-year visibility metric was at or below about 30 dv in all areas that met the current secondary 24-hour $PM_{2.5}$ standard, and was below 25 dv in most of those areas (85 FR 82743, December 18, 2020). Therefore, the Administrator judged that the secondary 24-hour $PM_{2.5}$ standard provided sufficient protection for visual air quality of 30 dv, which he judged appropriate (88 FR 82744, December 18, 2020). In this reconsideration, the ISA Supplement evaluated newly available studies on public preferences for visibility impairment and/or development methodologies or conducted quantitative analyses of light extinction. In considering the available scientific and quantitative information, including that newly available in this reconsideration, the current Administrator reached the same preliminary conclusions in the notice of proposed rulemaking regarding the 3-year visibility index and the current secondary PM standards as the then-Administrator in the 2020 final decision. However, in light of public comments on the proposal, the Administrator has further considered the available scientific evidence and information, as well as the CASAC's advice regarding visibility effects in their review of the 2021 draft PA. In so doing, the Administrator judges that it is appropriate to place more weight on certain aspects of the evidence that he had placed less weight on in reaching his proposed conclusions (*i.e.,* he focused on the both the middle and the upper end of the range of the 50% acceptability values from the available public preference studies). As such, the Administrator notes his conclusion on the appropriate visibility index (*i.e.,* with a 24-hour averaging time; a 3-year, 90th percentile form; and a level of 27 dv), which takes into account the regional variations in public preferences and equations for estimating light extinction, and his conclusions regarding the quantitative analyses of the relationship between the visibility index and the current secondary 24-hour $PM_{2.5}$ standard. In so doing, the Administrator concludes that the current secondary standards provide requisite protection against PM-related visibility effects.

With respect to climate effects, as at the time of proposal, the Administrator recognizes that a number of improvements and refinements have been made to climate models since the time of the 2012 review. However, despite continuing research and the strong evidence supporting a causal relationship with climate effects (U.S. EPA, 2019a, section 13.3.9), the Administrator notes that there are still significant limitations in quantifying the contributions of the direct and indirect effects of PM and PM components on climate forcing (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). He also recognizes that models continue to exhibit considerable variability in estimates of PM-related climate impacts at regional scales (*e.g.,* ~100 km), compared to simulations at the global scale (U.S. EPA, 2022b, sections 5.3.2.1.1 and 5.5). Moreover, the effects of PM on climate are diverse as well as uncertain. Depending on the circumstances, the radiative forcing effects of PM in the atmosphere can vary, such that positive forcing could result in warming of the Earth's surface, whereas a negative forcing could result in cooling (U.S. EPA, 2019a, section 13.3.2.2). The resulting uncertainty leads the Administrator to conclude that the scientific information available in this reconsideration remains insufficient to quantify, with confidence, the impacts of ambient PM on climate in the U.S. (U.S. EPA, 2022b, section 5.3.2.2.1) and that there is not an adequate scientific basis to link attainment of any particular PM concentration in ambient air in the U.S. to specific climate effects. Consequently, the Administrator judges that there is insufficient information at this time to revise the current secondary PM standards or to promulgate a distinct secondary standard to address PM-related climate effects.

With respect to materials effects, the Administrator notes that the available evidence continues to support the conclusion that there is a causal relationship with PM deposition (U.S. EPA, 2019a, section 13.4). He recognizes that deposition of particles in the fine or coarse fractions can result in physical damage and/or impaired aesthetic qualities. Particles can contribute to materials damage by adding to the effects of natural weathering processes and by promoting the corrosion of metals, the degradation of painted surfaces, the deterioration of building materials, and the weakening of material components. While some recent evidence on materials effects of PM is available in the 2019 ISA, the Administrator notes that this evidence is primarily from studies conducted outside of the U.S. in areas where PM concentrations in ambient air are higher than those observed in the U.S. (U.S. EPA, 2019a, section 13.4). Given the limited amount of information on the quantitative relationships between PM and materials effects in the U.S., and uncertainties in the degree to which those effects could be adverse to the public welfare, the Administrator judges that the available scientific information

remains insufficient to quantify, with confidence, the public welfare impacts of ambient PM on materials and that there is insufficient information at this time to revise the current secondary PM standards or to promulgate a distinct secondary standard to address PM-related materials effects.

Taken together, the Administrator concludes that the scientific and quantitative information for PM-related non-ecological welfare effects (*i.e.,* visibility, climate, and materials),[179] along with the uncertainties and limitations, supports the current level of protection provided by the secondary PM standards as being requisite to protect against known and anticipated adverse effects on public welfare. For visibility impairment, this conclusion reflects his consideration of the evidence for PM-related light extinction, together with his consideration of updated air quality analyses of the relationship between the visibility index and the current secondary 24-hour $PM_{2.5}$ standard and the protection provided by the current secondary $PM_{2.5}$ and PM_{10} standards. For climate and materials effects, this conclusion reflects his judgment that, although it remains important to maintain secondary $PM_{2.5}$ and PM_{10} standards to provide some degree of control over long- and short-term concentrations of both fine and coarse particles, it is appropriate not to change the existing secondary standards at this time and that it is not appropriate to establish any distinct secondary PM standards to address PM-related climate and materials effects at this time. As such, the Administrator recognizes that current suite of secondary standards (*i.e.,* the 24-hour $PM_{2.5}$, 24-hour PM_{10}, and annual $PM_{2.5}$ standards) together provide such control for both fine and coarse particles and long- and short-term visibility and non-visibility (*e.g.,* climate and materials) effects related to PM in ambient air. His conclusions on the secondary standards are consistent with advice from the CASAC, which noted substantial uncertainties remain in the scientific evidence for climate and materials effects, as well as the majority of public comments on the secondary PM standards. Thus, based on his consideration of the evidence and analyses for PM-related welfare effects, as described above, and his consideration of CASAC advice and public comments on the secondary standards, the Administrator concludes that it is appropriate not to change those standards (*i.e.,* the current 24-hour and annual $PM_{2.5}$ standards, 24-hour PM_{10} standard) at this time.

[179] As noted earlier, other welfare effects of PM, such as ecological effects, are being considered in the separate, on-going review of the secondary NAAQS for oxides of nitrogen, oxides of sulfur and PM.

C. Decision on the Secondary PM Standards

For the reasons discussed above and taking into account information and assessments presented in the 2019 ISA, ISA Supplement, and 2022 PA, advice from the CASAC, and consideration of public comments, the Administrator concludes that the current secondary PM standards are requisite to protect public welfare from known or anticipated adverse effects and is not changing the standards at this time.

VI. Interpretation of the NAAQS for PM

The EPA is finalizing revisions on data calculations in appendix K for PM_{10} and appendix N for $PM_{2.5}$. Revisions to appendix K make the PM_{10} data handling procedures for the 24-hour PM_{10} standards more consistent with those of other NAAQS pollutants and codify existing practices. Revisions to appendix N update references to the revision(s) of the standards and change data handling provisions related to combining data from nearby monitoring sites to codify existing practices that are currently being implemented as the EPA standard operating procedures.

A. Amendments to Appendix K: Interpretation of the NAAQS for Particulate Matter

The EPA proposed to modify its data handling procedures for the 24-hour PM_{10} standard in appendix K to part 50 (88 FR 5662, January 27, 2023). The proposed modifications include: (1) Revising design value calculations to be on a site-level basis, (2) codifying site combinations to maintain a continuous data record, and (3) clarifying daily validity requirements for continuous monitors. The purpose of these modifications is to make the data handling procedures for the 24-hour PM_{10} standard more consistent with those of other NAAQS pollutants and codify existing practices that are currently being implemented as EPA standard operating procedures.

The EPA received few comments on these proposed appendix K revisions, the majority of which were supportive.

One commenter was not supportive of the proposed appendix K revision to site-level PM_{10} design values, asserting that it would amount to an imposition of a more stringent PM_{10} standard due to the potential high bias of FEMs. The EPA disagrees with this assertion because site-level design values would combine data from any high biased FEM with other monitors at the site rather than calculate a monitor-level design value with data solely from that high-biased FEM. The EPA tested the impact of calculating site-level PM_{10} design values for the 2019–2021 period by assigning the lowest parameter occurrence code as the primary monitor and calculating site-level design values. Most resulting site-level design values were either identical to or in-between the multiple monitor-level design values at the site. Combining data from two or more monitors also has the benefit of increasing the number of valid sample days at many sites. For the 2019–2021 test period, approximately 10% of the sites with more than one monitor went from having multiple invalid design values to a single valid design value.

One commenter was not supportive of a footnote in the preamble of the NPRM stating that in the absence of a designated primary monitor at a given site, the default primary monitor would be one with the most complete data record (88 FR 5662, January 27, 2023). Because the procedure for calculating PM_{10} design values on a site-level basis being finalized here will require monitoring agencies to designate a primary monitor for each site in their annual network plans (88 FR 5694, January 27, 2023; App. K, 1.0(b)), the EPA agrees with the commenter that this footnote was unnecessary.

Therefore, the EPA is finalizing these appendix K revisions as proposed.

B. Amendments to Appendix N: Interpretation of the NAAQS for $PM_{2.5}$

The EPA proposed to modify its data handling procedures for the annual and 24-hour $PM_{2.5}$ standards in appendix N to part 50 (88 FR 5663, January 27, 2023). These proposed revisions include: (1) Updating references to the revisions of the standards rather than stating the specific level, and (2) codifying site combinations to maintain a continuous data record. The purpose of both modifications is to codify existing practices that are currently being implemented as the EPA standard operating procedures.

The EPA received few comments on these revisions in the proposed rule, with most supportive of the appendix N revisions.

Although the EPA did not propose or request comment on this issue, one commenter suggested that appendix N be revised to only allow data from the primary monitor to be used in $PM_{2.5}$ NAAQS designations asserting that it would add flexibility. The EPA disagrees with the commenter's assertion that this would add flexibility because it could force agencies to run

their FRMs on a daily schedule or potentially lead to invalid design values if manual sampling interruptions or laboratory issues impact FRM data completeness. This change would also be undesirable because it could reduce by two-thirds the number of days used in calculations for the annual and 24-hour $PM_{2.5}$ design values at many sites.

Therefore, the EPA is finalizing these appendix N revisions as proposed.

VII. Amendments to Ambient Monitoring and Quality Assurance Requirements

The EPA is finalizing revisions to ambient air monitoring requirements for PM to improve the usefulness of and appropriateness of data used in regulatory decision making. These changes focus on ambient monitoring requirements found in 40 CFR parts 50 (appendix L), 53, and 58 with associated appendices (A, B, C, D, and E). These changes include addressing updates in the approval of reference and equivalent methods, updates in quality assurance statistical calculations to account for lower concentration measurements, updates to support improvements in PM methods, a revision to the $PM_{2.5}$ network design to account for at-risk populations, and updates to the Probe and Monitoring Path Siting Criteria for NAAQS pollutants. The EPA also took comment on how to incorporate data from next generation technologies into Agency efforts. A summary of the comments received is included in this section.

A. Amendment to 40 CFR Part 50 (Appendix L): Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere—Addition of the Tisch Cyclone as an Approved Second Stage Separator

The EPA proposed a change to the FRM for $PM_{2.5}$ (40 CFR part 50, appendix L), the addition of an alternative $PM_{2.5}$ particle size separator to that of the Well Impactor Ninety-Six (WINS) and the Very Shape Cut Cyclone (VSCC) size separators (88 FR 5663, January 27, 2023). The new separator is the TE–$PM_{2.5}$C cyclone manufactured by Tisch Environmental Inc.,[180] Cleves Ohio, which has been shown to have performance equivalent to that of the originally specified WINS impactor with regards to aerodynamic cutpoint and $PM_{2.5}$ concentration measurement. In addition, the new TE–$PM_{2.5}$C has a significantly longer service interval than the WINS and is comparable to that of the VSCC separator. Generally, the TE–$PM_{2.5}$C is also physically interchangeable with the WINS and VSCC where both are manufactured for the same sampler. The proposed change would allow either the WINS, VSCC, or TE–$PM_{2.5}$C to be used in a $PM_{2.5}$ FRM sampler. As is the case for the WINS and VSCC, the TE–2.5C is now also an approved size separator for candidate $PM_{2.5}$ FEMs. Currently, the EPA has designated one $PM_{2.5}$ sampler configured with TE–$PM_{2.5}$C separator as a Class II $PM_{2.5}$ equivalent method and one as a $PM_{10\text{-}2.5}$ equivalent method. Upon promulgation of this change to appendix L, these instruments would be redesignated as $PM_{2.5}$ and $PM_{10\text{-}2.5}$ FRMs, respectively. Owners of such samplers should contact the sampler manufacturer to receive a new reference method label for the samplers.

The EPA received only one comment regarding this proposed change, which was supportive. Therefore, the EPA is finalizing this change to Appendix L as proposed.

B. Issues Related to 40 CFR Part 53 (Reference and Equivalent Methods)

The EPA proposed to clarify the regulations associated with FRM and FEM applications for review by the EPA (88 FR 5664, January 27, 2023). Revisions were also proposed in instances where current regulatory specifications are no longer pertinent and require updating. In addition, the EPA proposed to correct a compiled a list of noted minor errors in the regulations associated with the testing requirements and acceptance criteria for FRMs and FEMs in part 53. These errors are typically not associated with the content of **Federal Register** documents but often relate to transcription errors and typographical errors in the electronic CFR (eCFR) and printed versions of the CFR.

1. Update to Program Title and Delivery Address for FRM and FEM Applications

The EPA proposed a change to 40 CFR 53.4(a) to update the delivery address for FRM and FEM Applications and Modification Requests, as well as update the name of the program responsible for their review (88 FR 5664, January 27, 2023). These revisions are due solely to organizational changes and do not affect the structure or role of the Reference and Equivalent Methods Designation Program in reviewing new FRM and FEM application requests and requests to modify existing designated instruments. The EPA received no comments on this revision and, therefore, the EPA is finalizing this revision as proposed.

2. Requests for Delivery of a Candidate FRM or FEM Instrument

The EPA proposed a change to 40 CFR 53.4(d), which currently allows the EPA to request only candidate $PM_{2.5}$ FRMs and Class II or Class III equivalent methods for testing purposes as part of the applicant review process (88 FR 5664, January 27, 2023). The EPA proposed to revise this section to enable requesting any candidate FRM, FEM, or a designated FRM or FEM associated with a Modification Request, regardless of NAAQS pollutant type or metric. The EPA received no comments on these revisions; therefore, the EPA is finalizing this revision as proposed.

3. Amendments to Requirements for Submission of Materials in 40 CFR 53.4(b)(7) for Language and Format

The EPA proposed a change to 40 CFR 53.4(b)(7) to specify that all written FRM and FEM application materials must be submitted to the EPA in English in MS Word format and that submitted data must be submitted in MS Excel format (88 FR 5664, January 27, 2023). The EPA received no comments on these revisions; therefore, the EPA is finalizing this section as proposed.

4. Amendment to Designation of Reference and Equivalent Methods

The EPA proposed a change to 40 CFR 53.8(a) to clarify the terms of new FRM and FEM methods to ensure that candidate samplers and analyzers are not publicly announced, marketed, or sold until the EPA's approval has been formally announced in the **Federal Register** (88 FR 5664, January 27, 2023). The EPA received no comments on these revisions; therefore, the EPA is finalizing this section as proposed.

5. Amendment to One Test Field Campaign Requirement for Class III $PM_{2.5}$ FEMs

The EPA proposed a change to 40 CFR 53.35(b)(1)(ii)(D) that involves field comparability tests for candidate Class III $PM_{2.5}$ FEMs, including the requirement that a total of five field campaigns must be conducted at four separate sites, A, B, C, and D (88 FR 5664, January 27, 2023). The existing Site D specifications require that the site ''shall be in a large city east of the Mississippi River, having characteristically high sulfate concentrations and high humidity levels.'' However, dramatic decreases in ambient sulfate concentration make it difficult for applicants to routinely meet the high sulfate concentration requirement. Therefore, the EPA proposed to revise the Site D specifications to read ''shall be in a large

[180] Mention of commercial names does not constitute EPA endorsement.

city east of the Mississippi River, having characteristically high humidity levels.'' Only one comment was received on this proposed revision, which was supportive. Therefore, the EPA is finalizing the revision to 40 CFR 53.35(b)(1)(ii)(D), as proposed.

6. Amendment to Use of Monodisperse Aerosol Generator

The EPA proposed a change to 40 CFR 53.61(g), 53.62(e), and Table F–1 that involves the wind tunnel evaluation of candidate PM_{10} inlets and candidate $PM_{2.5}$ fractionators under static conditions, which requires the generation and use of monodisperse calibration aerosols of specified aerodynamic sizes (88 FR 5664, January 27, 2023). In the current regulations, the TSI Incorporated Vibrating Orifice Aerosol Generator (VOAG) is the only monodisperse generator that is approved for this purpose. However, TSI Incorporated no longer manufacturers nor supports the VOAG. Therefore, a commercially available monodisperse aerosol generator (Model 1520 Fluidized Monodisperse Aerosol Generator, MSP Corporation, Shoreview, MN) has been added to list of approved generators for this purpose. No comments were received on this revision; therefore, the EPA is finalizing this revision as proposed.

7. Corrections to 40 CFR Part 53 (Reference and Equivalent Methods)

Certain provisions of 40 CFR 53.14, Modification of a reference or equivalent method, incorrectly state an EPA response deadline of 30 days for receipt of modification materials in response to an EPA notice. Per a 2015 amendment (80 FR 65460, 65416, Oct. 26, 2015), all EPA response deadlines for modifications of reference or equivalent methods are 90 days from day of receipt. Thus, the EPA proposed a correction to specify the correct 90-day deadline (88 FR 5664, January 27, 2023).

Requirements for Reference and Equivalent Methods for Air Monitoring of Criteria Pollutants identifies the applicable 40 CFR part 50 appendices and 40 CFR part 53 subparts for each criteria pollutant. The four rows in the section for $PM_{10-2.5}$ erroneously do not include the footnote instruction that the aforementioned pollutant alternative Class III requirements may be substituted in regard to Appendix O to Part 50—Reference Method for the Determination of Coarse Particulate Matter as $PM_{10-2.5}$ in the Atmosphere.

Table B–1 specifies that the interference equivalent for each interferent is ±0.005 ppm for both the standard-range and lower-range limits, with the exception of nitric oxide (NO) for the lower-range limit per note 4. When testing the lower range of SO_2, the limit for NO is ±0.003 ppm, therefore, an incorrect lower limit (±0.0003) is currently stated in note 4 for this exception to the SO_2 lower range limit. Thus, the EPA proposed a correction to Table B–1 to specify the correct limit in note 4 (88 FR 5664, January 27, 2023).

After the EPA received an inquiry regarding the interaction of NO and O_3, the EPA investigated the interferent testing requirements stated by 40 CFR part 53, subpart B. The EPA has determined that during the 2011 SO_2 amendment and subsequent 2015 O_3 amendment, several typographical errors were introduced into Table B–3, the most significant of which is the omission of note 3, which instructs the applicant to not mix the pollutant with the interferent. Thus, the EPA proposed revisions to Table B–3 to correct these errors (88 FR 5664, January 27, 2023).

Additionally, appendix A to subpart B of part 53 provides figures depicting optional forms for reporting test results. Figure B–3 lists an incorrect formula: the lower detectible limit section is missing the proper operator in the LDL calculation formula and Figure B–5 lists an incorrect calculation metric, and there is a typesetting error in the calculation of the standard deviation. The EPA proposed to correct the typesetting errors and noted other errors to be corrected in several formulas provided throughout § 53.43 (88 FR 5664, January 27, 2023).

The EPA proposed a revision to 40 CFR 53.43(a)(2)(xvi), 53.43(b)(2)(iv), and 53.43(b)(2)(iv) to correct typographical errors in equations.

The EPA proposed a revision to Table C–4 of part 53 Subpart C (88 FR 5700). This change is related to field comparability tests of candidate $PM_{2.5}$, $PM_{10-2.5}$, and PM_{10} FEMs, which requires testing at wide range of ambient concentrations. For this reason, Table C–4 specifies a minimum number of valid sample sets to be conducted at specified high concentrations. However, due to the dramatic decrease in ambient PM concentrations in the past two decades, these number of valid test days at high concentrations has been difficult to achieve. Accordingly, the EPA proposed to revise the testing specifications for high concentration events in Table C–4 to reflect current levels of ambient PM for all three PM metrics. In addition to the revision of the ambient PM concentration specifications to Table C–4, there are also several entry errors that required correction.

The EPA received no comments on these proposed revisions; therefore, the EPA is finalizing the changes as proposed.

C. Changes to 40 CFR Part 58 (Ambient Air Quality Surveillance)

1. Quality Assurance Requirements for Monitors Used in Evaluations for National Ambient Air Quality Standards

In the proposal, the EPA described how we evaluated the quality system as part of the PM NAAQS reconsideration (88 FR 5665, January 27, 2023). In this section, the EPA identified several areas for improvement in steadily declining average ambient $PM_{2.5}$ concentrations across the country and the final decision to revise primary annual $PM_{2.5}$ NAAQS described in section II above. We assessed $PM_{2.5}$ concentration data across a range of values to determine if any changes to the statistical calculations used to evaluate the data quality in the $PM_{2.5}$ network were warranted. This section describes the EPA's assessment, comments received, and the EPA's final decisions on the proposed changes. Other changes in this section include clarifications and other improvements that will facilitate consistency and the operation of quality assurance programs by State, local, and Tribal (SLT) agencies nationwide.

a. Quality System Requirements

The EPA reconsidered the appendix A, section 2.3.1.1 goal for acceptable measurement uncertainty (88 FR 5665, January 27, 2023) for automated and manual $PM_{2.5}$ methods for total bias. The existing total bias goal is an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and ±10 percent for total bias. The intent of the proposal was to investigate if this bias goal is still realistic given updated precision and bias statistic. The EPA received one comment that bias reevaluation may be premature, since the final NAAQS standard had not yet been determined at the time of the proposal. The EPA acknowledges this comment but clarifies that the proposed new bias statistic was evaluated at a range of levels including the range of proposed $PM_{2.5}$ standards in the technical memorandum, ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network.'' [181] Considering the

[181] Noah, G. (2023). Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for

Continued

justification in the technical memorandum and the lack of adverse comments regarding this part of the proposal, the EPA is retaining the appendix A, section 2.3.1.1, goal for acceptable measurement uncertainty for automated and manual $PM_{2.5}$ methods for total bias.

The EPA also proposed to update and clarify ambient air monitoring requirements found in 40 CFR part 58, appendix A, section 2.6.1 pertaining to EPA Protocol Gas standards used for ambient air monitoring and the Ambient Air Protocol Gas Verification Program (PGVP) (88 FR 5665, January 27, 2023). The EPA proposed to revise appendix A to clarify that in order to participate in the Ambient Air PGVP, producers of Protocol Gases must adhere to the requirements of 40 CFR 75.21(g), and only regulatory ambient air monitoring programs may submit cylinders for assay verification to the EPA Ambient Air PGVP. The EPA received mixed comments in support of and in opposition to this proposed revision. The sole commenter opposing the proposed revision indicated that the proposed PGVP requirements would be additional and is concerned with an increased resource burden. But the EPA responds that the PGVP requirements that were proposed to be added are consistent with the existing PGVP requirements in 40 CFR 75.21(g), and PGVP has been defined as a regulatory requirement since 2016 (81 FR 17263, March 28, 2016), so the proposed part 58 changes are not ''additional'' to existing regulations. After consideration of the comments, the EPA is finalizing the update and clarification of ambient air monitoring requirements found in appendix A, section 2.6.1 pertaining to EPA Protocol Gas standards used for ambient air monitoring and the Ambient Air PGVP as proposed.

b. Measurement Quality Check Requirements

The EPA proposed to remove section 3.1.2.2 from appendix A, which allows NO_2 compressed gas standards to be used to generate audit standards (88 FR 5665, January 27, 2023). The EPA received one comment supporting this change. As a result of the comment received and other general supportive comments regarding quality assurance, the EPA is finalizing the removal of section 3.1.2.2 from appendix A as proposed.

The EPA proposed to revise the requirement in Appendix A, section 3.1.3.3 changing the National Performance Audit Program (NPAP) requirement for annual verification of gaseous standards to the ORD-recommended certification periods identified in Table 2–3 of the EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (appendix A, section 6.0(4)) (88 FR 5665). The EPA received one comment supporting this change. As a result of the comment received and other general supportive comments regarding quality assurance, the EPA is finalizing the updated NPAP gaseous certification requirement in section 3.1.3.3 as proposed.

The EPA proposed to adjust the minimum value required by appendix A, section 3.2.4, to be considered valid sample pairs for the $PM_{2.5}$ Performance Evaluation Program (PEP) from 3 $\mu g/m^3$ to 2 $\mu g/m^3$ (88 FR 5665, January 27, 2023). The EPA received comments in support and against the change. In the only opposing comment, the commenter expressed concern that the method detection limit (MDL) for $PM_{2.5}$ is 2 $\mu g/m^3$. The commenter also indicated that the MDL ''typically has minimal value per the definition of the MDL.'' 40 CFR part 50, appendix L states, ''The lower detection limit of the mass concentration measurement range is estimated to be approximately 2 $\mu g/m^3$, based on noted mass changes in field blanks in conjunction with the 24 m^3 nominal total air sample volume specified for the 24-hour sample.'' The EPA notes that field blanks currently average less than 10 µg nationally, and when divided by the 24 m^3 nominal total air sample volume specified for a 24-hour sample, the result is 0.4 $\mu g/m^3$. The appendix L MDL referenced by the commenter was part of the 1997 PM NAAQS rulemaking (62 FR 38652, July 18, 1997); current data shows that the MDL is substantially lower than the EPA's original estimate. After review of the comments, and in consideration of the recently calculated detection limit for the $PM_{2.5}$ FRM that is substantially lower than our original estimate,[182] the EPA is finalizing the revised minimum value for valid sample pairs for the $PM_{2.5}$ Performance Evaluation Program (PEP) from 3 $\mu g/m^3$ to 2 $\mu g/m^3$ in appendix A, section 3.2.4 as proposed.

c. Calculations for Data Quality Assessments

The EPA proposed to change Equations 6 and 7 of appendix A, section 4.2.1 that are used to calculate the *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$ and Pb* (88 FR 5666, January 27, 2023). The proposed new statistics are designed to address the high imprecision values that result from using these calculations to compare low concentrations that are now more routinely observed in the networks. The EPA received several comments in support of this change in general, but some commenters indicated that they believed there was an error in the new calculation that may result in high imprecision from the calculation of the equation. The EPA reviewed the technical memorandum and confirmed that a multiplier of 100 was unintentionally left in the proposed relative difference equation, Equation 6. Also, equation 6 was corrected from a normalized percent difference to a normalized relative percent difference that is appropriate for comparing collocated pairs at low concentrations. The technical memorandum titled ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network'' has been amended to correct the error and is included in the docket for this action.[183]

Equation 6 as proposed at 88 FR 5666 (January 27, 2023) was:

Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

[182] See the EPA's $PM_{2.5}$ Data Quality Dashboard available at *https://sti-r-shiny.shinyapps.io/QVA_Dashboard/.*

[183] Noah, G. (2023). Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

$$s_i = \frac{meas - audit}{\sqrt{audit}} \times 100$$

And the corrected Equation 6 is:

$$t_i = \frac{X_i - Y_i}{\sqrt{(X_i - Y_i)/2}}$$

Equation 7 is below and is unchanged.

$$CV90_{NAAQS} = 100 * \sqrt{\frac{k \times \sum_{i=1}^{k} t_i^2 - (\sum_{i=1}^{k} t_i)^2}{2k(k-1)}} \times \sqrt{\frac{k-1}{NAAQS\ Concentration * X^2_{0.1,k-1}}}$$

As a result of the positive comments received and the correction to the equation made in response to some comments, the EPA is finalizing the updated Equation 6 as described and is finalizing Equation 7 as proposed for the calculation of the *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$, and Pb* in section 4.2.1.

The EPA proposed to update the appendix A, section 4.2.5, Equation 8, calculation for the Performance Evaluation Program Bias Estimate for $PM_{2.5}$ (88 FR 5666–67, January 27, 2023). Because average ambient PM concentrations across the nation have steadily declined since the promulgation of the $PM_{2.5}$ standard, the EPA proposed to replace the current percent difference equation with a relative difference equation. The EPA received several comments in support of this change in general, but some commenters identified a potential error in the new calculation that resulted in an artificially high estimate, which they do not support. The EPA reviewed the technical memorandum and discovered that a multiplier of 100 was left in the new relative difference equation used in the bias equation. The technical memorandum, ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network'' has been amended to correct the error and is included in the docket.[184] The proposed Equation 8 proposed at 88 FR 5667 (January 27, 2023) was:

$$100 * \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}} \times 100$$

and the corrected Equation 8 is:

$$100 \times \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}}$$

As a result of the supportive comments received and the correction to the equation in response to some comments, the EPA is updating and finalizing Equation 8 as described for the calculation for the Performance Evaluation Program Bias Estimate for $PM_{2.5}$, in section 4.2.5.

d. References

The EPA proposed to update the references and hyperlinks in appendix A, section 6 (88 FR 5667, January 27, 2023) to provide accuracy in identifying and locating essential supporting documentation and delete references to historical documents that do not represent current practices. The EPA received only favorable comments, and as a result, the EPA is finalizing the updated the references and hyperlinks in appendix A, section 6, as proposed.

The EPA also proposed to add a footnote to Table A–1 of part 58, appendix A—Minimum Data Assessment Requirements for NAAQS Related Criteria Pollutant Monitors (88 FR 5669, January 27, 2023). The proposed footnote clarifies the allowable time (*i.e.,* every two weeks, once a month, once a quarter, once every six months, or distributed over all four quarters depending on the check) between checks and encourages monitoring organizations to perform data assessments at regular intervals. The EPA received two comments regarding this proposed footnote. One commenter indicated that this change is inconsistent with the QA Handbook for Air Pollution Measurement Systems: ''Volume II: Ambient Air Quality Monitoring Program QA Handbook.'' The EPA agrees with the commenter; because the QA Handbook is guidance,

[184] Noah, G. (2023). Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

the EPA will revise it after this action is finalized to be consistent with the updated CFR provision. Another commenter does not support the addition of the footnote due to concerns about limiting flexibility. In response, the EPA reiterates that the proposed revision is intended to clarify intent and does not make any changes to the required frequencies or acceptance criteria for data assessment. A ''weight of evidence'' narrative is still found in 40 CFR part 58, appendix A, section 1.2.3. As a result of the comments received and the rationale discussed above, the EPA is finalizing the addition of the new footnote to Table A–1 of part 58, appendix A—Minimum Data Assessment Requirements for NAAQS Related Criteria Pollutant Monitors as proposed.

2. Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring

The EPA proposed to revise appendix B, Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring (88 FR 5667, January 27, 2023), in parallel to the proposal to revise appendix A. Thus, this section of the proposal included similar detail and proposed revisions related to evaluating quality system statistical calculations for $PM_{2.5}$, clarifications and other improvements that would facilitate consistency and the operation of quality assurance programs for PSD by SLT agencies nationwide.

a. Quality System Requirements

The EPA reconsidered the goal in appendix B, section 2.3.1.1 for acceptable measurement uncertainty for automated and manual $PM_{2.5}$ methods for total bias (88 FR 5668, January 27, 2023).[185] The current total bias goal is an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and ±10 percent for total bias. The EPA's intent was to investigate if this goal is still realistic given updated precision and bias statistics. The EPA received one comment that bias reevaluation may be premature, since the final NAAQS standard had not yet been determined at the time of the proposal. The EPA acknowledges this comment but clarifies that the proposed new bias statistic was evaluated at a range of levels including the proposed range of $PM_{2.5}$ standards in the technical memorandum, ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network.'' [186] Considering the justification in the technical memorandum and the lack of adverse comments regarding the substantive proposal, the EPA is retaining the appendix B, section 2.3.1.1, goal for acceptable measurement uncertainty for automated and manual $PM_{2.5}$ methods for total bias.

The EPA also proposed to update and clarify ambient air monitoring requirements found in 40 CFR part 58, appendix B, section 2.6.1 pertaining to EPA Protocol Gas standards used for ambient air monitoring and the Ambient Air PGVP (88 FR 5668, January 27, 2023). The EPA proposed to revise appendix B to clarify that in order to participate in the Ambient Air PGVP, producers of Protocol Gases must adhere to the requirements of 40 CFR 75.21(g), and only regulatory ambient air monitoring programs may submit cylinders for assay verification to the EPA Ambient Air PGVP. The EPA received comments in support of and in opposition to this proposed revision. The commenter opposing the revision indicated that the proposed PGVP requirements would be additional and is concerned with an increased resource burden. However, the EPA disagrees with the commenter because that the proposed PGVP requirements are consistent with the existing PGVP requirements in 40 CFR 75.21(g). PGVP has been defined as a regulatory requirement since 2016 (81 FR 17263, March 28, 2016), so the proposed part 58 changes are not ''additional'' to existing regulations. After consideration of the comments, the EPA is finalizing the update and clarification of ambient air monitoring requirements found in appendix B, section 2.6.1 pertaining to EPA Protocol Gas standards used for ambient air monitoring and the Ambient Air PGVP as proposed.

b. Measurement Quality Check Requirements

The EPA proposed to remove section 3.1.2.2 from appendix B, which allows NO_2 compressed gas standards to be used to generate audit standards (88 FR 5668, January 27, 2023). The EPA received one comment supporting this change. As a result of the comment received and other general supportive comments regarding quality assurance, the EPA is finalizing the removal of section 3.1.2.2 from appendix B as proposed.

The EPA proposed to revise the requirement in Appendix B, section 3.1.3.3 changing the National Performance Audit Program (NPAP) requirement for annual verification of gaseous standards to the ORD-recommended certification periods identified in Table 2–3 of the EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (appendix B, section 6.0(4)) (88 FR 5668, January 27, 2023). The EPA received one comment supporting this change. As a result of the comment received and other general supportive comments regarding quality assurance, the EPA is finalizing the updated NPAP gaseous certification requirement in section 3.1.3.3 as proposed.

The EPA proposed to adjust the minimum value required by appendix B, section 3.2.4, to be considered valid sample pairs for the $PM_{2.5}$ Performance Evaluation Program (PEP) from 3 $\mu g/m^3$ to 2 $\mu g/m^3$ (88 FR 5668, January 27, 2023). The EPA received comments in support and against the change. In the only opposing comment, the commenter expressed concern that the method detection limit (MDL) for $PM_{2.5}$ is 2 $\mu g/m^3$. The commenter also indicated that the MDL ''typically has minimal value per the definition of the MDL.'' 40 CFR part 50, appendix L states, ''The lower detection limit of the mass concentration measurement range is estimated to be approximately 2 $\mu g/m^3$, based on noted mass changes in field blanks in conjunction with the 24 m^3 nominal total air sample volume specified for the 24-hour sample''. The EPA notes that field blanks currently average less than 10 µg nationally, and when divided by the 24 m^3 nominal total air sample volume specified for a 24-hour sample, the result is 0.4 $\mu g/m^3$. The appendix L MDL referenced by the commenter was part of the 1997 PM NAAQS rulemaking more than 20 years ago (62 FR 38652, July 18, 1997); current data shows that the MDL is substantially lower than EPA's original estimate. After review of the comments, and in consideration of the recently calculated

[185] In the proposal, in section VII.C.2 Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring (88 FR 5667–69), the EPA inadvertently referred to ''appendix A'' in the section rather than the correct ''appendix B.'' The EPA's intent to have proposed changes to appendix B on these pages is made clear by the section header, the Table of Contents on page 5559, and the proposed regulatory text for appendix B on pages 5707–08. See, *e.g.,* id. at p.5668 (preamble erroneously states that the EPA proposed to change appendix A, section 2.6.1); id. at p.5668 (preamble erroneously states that the EPA proposed to adjust the minimum value required by appendix A, section 3.2.4).

[186] Noah, G. (2023). Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072*.

detection limit for the $PM_{2.5}$ FRM that is substantially lower than our original estimate, the EPA is revising the minimum value for valid sample pairs for the $PM_{2.5}$ Performance Evaluation Program (PEP) from 3 $\mu g/m^3$ to 2 $\mu g/m^3$ in appendix B, section 3.2.4 as proposed.

c. Calculations for Data Quality Assessments

The EPA proposed to change Equations 6 and 7 of appendix B, section 4.2.1 used for calculating the *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$ and Pb* (88 FR 5707, January 27, 2023). These new statistics are designed to address the high imprecision values that result from using these calculations to compare low concentrations that are now more routinely observed in the networks. The EPA received several comments in support of this change in general, but a couple commenters indicated that there could be an error in the new calculation that resulted in high imprecision from the calculation of the equation. The EPA reviewed the technical memorandum and discovered that a multiplier of 100 was unintentionally left in the proposed relative difference equation, Equation 6. Also, equation 6 was corrected from a normalized percent difference to a normalized relative percent difference that is appropriate for comparing collocated pairs at low concentrations. The technical memorandum titled ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network'' was amended to correct the error and is included in the docket.[187]

Equation 6 in the proposal (88 FR 5668, January 27, 2023) was:

$$s_i = \frac{meas - audit}{\sqrt{audit}} \times 100$$

And the corrected Equation 6 is:

$$t_i = \frac{X_i - Y_i}{\sqrt{(X_i - Y_i)/2}}$$

Equation 7 is below and is unchanged.

$$CV90_{NAAQS} = 100 * \sqrt{\frac{k \times \sum_{i=1}^{k} t_i^2 - (\sum_{i=1}^{k} t_i)^2}{2k(k-1)}} \times \sqrt{\frac{k-1}{NAAQS\ Concentration * X^2_{0.1,k-1}}}$$

As a result of the positive comments received and the correction to the equation made in response to those comments, the EPA is finalizing the update to Equation 6 and retaining Equation 7 as proposed for the calculation of the *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$ and Pb* in section 4.2.1.

The EPA proposed to update the appendix B, section 4.2.5, Equation 8, calculation for the Performance Evaluation Program Bias Estimate for $PM_{2.5}$ (88 FR 5668–59, January 27, 2023). Because average ambient PM concentrations across the nation have steadily declined since the promulgation of the $PM_{2.5}$ standard, the EPA proposed to replace the current percent difference equation with a relative difference equation. The EPA received several comments in support of this change in general, but some commenters identified a potential error in the new calculation that resulted in an artificially high estimate, which they do not support. The EPA reviewed the technical memorandum and discovered that a multiplier of 100 was left in the new relative difference equation used in the bias equation. The technical memorandum, ''Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network'' has been amended to correct the error and is included in the docket. The proposed Equation 8 (88 FR 5669, January 27, 2023) was:

[187] Noah, G. (2023). Task 16 on PEP/NPAP Task Order: Bias and Precision DQOs for the $PM_{2.5}$ Ambient Air Monitoring Network. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

$$100 * \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}} \times 100$$

and the corrected Equation 8 is:

$$100 \times \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}}$$

As a result of the supportive comments received and the correction to the equation in response to some comments, the EPA is updating and finalizing Equation 8 as described for the calculation for the Performance Evaluation Program Bias Estimate for $PM_{2.5}$, in section 4.2.5.

d. References

The EPA proposed to update the references and hyperlinks in appendix B, section 6 (88 FR 5669, January 27, 2023) to provide accuracy in identifying and locating essential supporting documentation and delete references to historical documents that do not represent current practices. The EPA received only favorable comments, and as a result, the EPA is finalizing the updated the references and hyperlinks in appendix B, section 6, as proposed.

The EPA also proposed to add a footnote to Table B–1 of part 58, appendix B—Minimum Data Assessment Requirements for NAAQS Related Criteria Pollutant PSD Monitors (88 FR 5669, January 27, 2023). The proposed footnote clarifies the allowable time (*i.e.,* every two weeks, once a month, once a quarter, once every six months, or distributed over all four quarters depending on the check) between checks and encourages monitoring organizations to perform data assessments at regular intervals. The EPA received two comments regarding this proposal. One commenter indicated that this change is inconsistent with the QA Handbook. The EPA agrees with the commenter; because the QA Handbook is guidance, the EPA will revise it after this action is finalized to be consistent with the updated CFR provision. Another commenter does not support the addition of the footnote due to concerns about limiting flexibility. In response, the EPA reiterates that the proposed revision is intended to clarify intent and does not make any changes to the required frequencies or acceptance criteria for data assessment. A ''weight of evidence'' narrative is still found in 40 CFR part 58, appendix B, section 1.2.3. As a result of the comments received and the rationale discussed above, the EPA is adding the new footnote to Table B–1 of part 58, appendix B—Minimum Data Assessment Requirements for NAAQS Related Criteria Pollutant PSD Monitors as proposed.

3. Amendments to PM Ambient Air Quality Methodology

a. Revoking Approved Regional Methods (ARMs)

The EPA proposed to remove provisions for approval and use of Approved Regional Methods (ARMs) throughout parts 50 and 58 of the CFR (88 FR 5669, January 27, 2023). ARMs are continuous $PM_{2.5}$ methods that have been approved specifically within a State or local air agency monitoring network for purposes of comparison to the NAAQS and to meet other monitoring objectives. Currently, there are no approved ARMs. There are, however, more than a dozen approved Federal Equivalent Methods (FEMs) for $PM_{2.5}$. These approved FEMs are eligible for comparison to the NAAQS and to meet other monitoring objectives.

The EPA received comments from multiple State air programs in support of the proposal to remove provisions for approval and use of ARMs. One commenter cites that there are multiple FEMs available for monitoring agencies to work with and that the agency was never able to get a candidate ARM to meet the requirements for approval. With the availability of multiple FEMs that now work in the monitoring agency's network, the commenting agency does not anticipate the need to ever pursue an ARM in the future and, therefore, suggests that the ARM provision is no longer needed. Another commenter strongly supported the proposed changes to remove the ARM provisions. The EPA also received comments from a few agencies that supported retaining the ARM provisions instead. One commenter cited the need to consider the rapid advancement of various new technologies and that, in some cases, approved continuous FEMs may have shortcomings, meaning that losing the ability to propose an ARM in the future may limit useful alternative options to monitoring agencies. Another commenter suggested that the removal of the ARM would take away the ability and right to use locally derived correction factors.

After considering the comments for and against removing the provisions for ARMs, the EPA believes it is most appropriate to remove the ARM provisions. As described in the proposal, when the EPA first proposed the process for approving and using ARMs, there were no continuous FEMs approved. There are now over a dozen approved $PM_{2.5}$ continuous FEMs and no approved ARMs. Therefore, the EPA is finalizing the removal of ARMs throughout 40 CFR parts 50 and 58 as proposed.

b. Calibration of PM Federal Equivalent Methods (FEMs)

The EPA proposed to modify its specifications for PM FEMs in appendix C to Part 58 (88 FR 5670–73, January 27, 2023). Specifically, the EPA proposed that valid State, local, and Tribal (SLT) air monitoring data from Federal Reference Methods (FRMs) generated in routine networks and submitted to the EPA may be used to improve the PM concentration measurement performance of approved FEMs. This approach, initiated by instrument manufacturers, would be implemented as a national solution in factory calibrations of approved FEMs through a firmware update. This could apply to any PM FEM methods (*i.e.,* PM_{10}, $PM_{2.5}$, and $PM_{10-2.5}$).

The EPA proposed this modification because there are some approved PM FEMs that are not currently meeting bias measurement quality objectives (MQOs) when evaluating data nationally as described in the 2022 PA (U.S. EPA, 2022b, section 2.2.3.1), meaning that an update to factory calibrations may be appropriate; however, there is no clearly defined process to update the calibration of FEMs. While there are several types of data available to use as the reference for such updates (*e.g.,* routinely operated FRMs, audit program FRMs, and chemical speciation sampler

data), we proposed to use routinely operated SLT FRMs as the basis of comparison upon which to calibrate FEMs. The goal of updating factory calibrations would be to increase the number of routinely operating FEMs meeting bias MQOs across the networks in which they are operated. While there are other approaches that could improve data comparability between PM FEMs and collocated FRMs, the EPA believes that the proposed modification to calibrate PM FEMs represents the most reliable approach to update FEM factory calibrations, since the existing FRM network data that meet MQOs would be used to set updated factory calibrations.

While the Agency proposed to add this language to more expressly define a process to update factory calibrations of approved PM FEMs, the EPA believes that the existing rules for updating approved FRMs and FEMs found at 40 CFR 53.14 may also continue to be utilized for this purpose, as appropriate. 40 CFR 53.14 allows instrument manufactures to submit to the EPA a ''Modification of a reference or equivalent method.'' Submitting a modification request may be appropriate to ensure an approved FEM continues to meet 40 CFR 53.9, ''Conditions of designation.'' Specifically, 40 CFR 53.9(c) requires that, ''Any analyzer, PM_{10} sampler, $PM_{2.5}$ sampler, or $PM_{10–2.5}$ sampler offered for sale as part of an FRM or FEM shall function within the limits of the performance specifications referred to in § 53.20(a), § 53.30(a), § 53.35, § 53.50, or § 53.60, as applicable, for at least 1 year after delivery and acceptance when maintained and operated in accordance with the manual referred to in § 53.4(b)(3).'' Thus, instrument manufacturers are encouraged to seek improvements to their approved FEM methods as needed to continue to meet data quality needs as operated across the network.

There are several technical components to EPA's proposed modification, including: the reference data to be used in the calibrations; implementing as a national solution in factory calibrations of approved FEMs through firmware updates; application to any PM FEM methods (*i.e.,* PM_{10}, $PM_{2.5}$, and $PM_{10–2.5}$); the appropriate range of data to be used to develop and test new factory calibrations, from just the most representative concentrations up to all available concentrations; the representative set of geographic locations that can be used; whether outliers may be included or not included; that new factory calibrations should be developed using data from at least 2 years and tested on data from a separate year or years; that updates to factory calibrations can occur as often as needed; that calibrations should be evaluated by monitoring agencies as part of routine data assessments, *e.g.,* during certification of data and 5-year assessments; the EPA's recognition that only data from existing operating sites is available; and finally, that an updated factory calibration does not have to work with the original field study data submitted that led to the original FEM designation.

With the proposed modification, the EPA solicited input on these technical issues as well as the overall approach and any alternatives that could lead to more sites meeting the bias MQO with automated FEMs, especially for those sites that are near the level of the primary annual $PM_{2.5}$ NAAQS, as proposed to be revised in section II above. In response, the EPA received comments from about two dozen entities, most of which were SLT air programs or Multi-Jurisdictional Organizations (MJOs) comprised of these entities.

Overall, there was broad and strong support from a majority of commenters for the proposed requirement to use FRM data generated in routine networks and submitted to the EPA to update factory calibrations included as part of approved FEMs. There were a smaller number of critical comments on the proposed process as well as some commentors that supported the proposed requirement but also provided additional suggestions for the EPA's consideration. Below, we address each of the areas on which the EPA requested comment regarding the calibration of PM FEMs, as well as a few additional areas where multiple commenters offered input on other areas related to our proposal.

A majority of the commenters on the proposed PM FEM calibration process support the process to use valid State, local, and Tribal FRM data generated in routine networks and submitted to the EPA to improve the PM concentration measurement performance of approved FEMs. Some commenters suggested that this action is needed to ensure that data reported from FRMs and FEMs are comparable and correction methods applied to data from FEM monitors are defensible across the national PM monitoring network. Others stated that they agree with the EPA that this is a critical step in the right direction to account for the discrepancies between $PM_{2.5}$ FRM data and $PM_{2.5}$ FEM data. Some commented that applying corrections includes a recognition that, while different measurement principles may produce differences in the resulting data, having an approach that minimizes bias is extremely important. Finally, some stated their belief that a correction factor is necessary to preserve data integrity with the FRM.

The EPA also received comments suggesting ways that the PM FEM correction could be performed, including through detailed analysis of data; by having PM FEM instrument manufacturers evaluate nationally available valid FRM data to update factory calibrations; and, by having the instrument manufacturers implement calibration adjustments at the factory.

The EPA also received supportive comments on the PM FEMs calibration relating to comparability to the NAAQS. For example, a commenter stated that it is important to ensure bias MQOs are met for FEMs run at sites potentially affected by revised standards as well as the need to accurately designate areas as attaining or not attaining the NAAQS. There were comments supporting the correction of PM FEM data as helping the EPA and SLT monitoring programs continue to evolve toward more automated methods. For example, one commenter appreciates the EPA's support for the ongoing move from filter-based $PM_{2.5}$ FRMs to use of continuous FEMs, stating that they concur with the EPA's assessment that there is monitoring bias between FRMs and FEMs, and commending EPA for recognizing ongoing data quality issues for FEMs and for taking action to improve these issues in collaboration with instrument manufacturers and SLT agencies.

A small number of commenters were critical of the proposed FEM calibration approach. One commenter noted that EPA should further examine the handling of FEM $PM_{2.5}$ data when used for comparison to the NAAQS. In response, we note that monitoring agencies and the EPA will continue to examine the comparability and use of FEM data used in comparison to the NAAQS. Another commenter suggested that the calibration process for a designated PM monitor should not be altered following Class III designation approval. The EPA disagrees as we believe it is appropriate for FEMs to be calibrated with routinely operated FRMs, because doing so is an efficient way to work towards FEM data meeting the bias MQO across the networks in which the FEMs are currently being operated. Also, having continuous PM FEMs meeting bias MQOs allows the use of the data in a variety of other ways that manually operated FRMs samplers cannot support. Another commenter stated that, if a particular FEM designated make or model of

instruments fails to meet MQOs, then that make or model should be removed from the designations altogether. The EPA agrees and clarifies that the modification would not prevent removal of FEM designation from a make or model of instrument under the existing 40 CFR 53.11—Cancellation of reference or equivalent method designation. This may be appropriate if there are no other solutions to improve the method such that it achieves bias MQOs.

A few commenters provided specific recommendations for how the regulatory language could be improved. These included comments that the new regulatory language proposed for 40 CFR part 58, appendix C, section 2.2 must ensure consistency and transparency when requesting changes to the factory calibration; that the EPA should incorporate binding regulatory language in 40 CFR part 58, appendix C, section 2.2 (*i.e.,* it currently lacks ''shall'' or ''must'') to ensure the language is not open to inconsistency and does not provide unique deference to instrument manufacturers without a mechanism for transparent communication of the changes being made and the supporting technical analysis. A commenter also requested that the EPA define the core requirements needed to ensure all requests for updating factory calibrations are required to follow the same process, using data of the same known quality, and evaluating the effectiveness of the resulting correction factors consistently.

In response to these comments, while the EPA agrees that the proposed regulatory language for 40 CFR part 58, appendix C, section 2.2 must ensure consistency and transparency when entities request changes to factory calibrations, the EPA disagrees that the regulations cannot also provide some flexibility. For example, we believe that a degree of flexibility is appropriate regarding whether outliers in the data to be used for factory calibration should or should not be included, the range of data to be included, and in utilizing collocated FRM and FEM data for updated calibrations from a representative set of geographic areas in which it is produced. The EPA believes that the proposal defined the core requirements needed to ensure all requests for updating FEM factory calibrations will follow the same process, using data of the same known quality and evaluating the effectiveness of the resulting correction factors consistently.

In its proposal, the EPA identified that while there are several types of data available to use as the reference for FEM calibration updates, including data from routinely operated FRMs, audit program FRMs, and $PM_{2.5}$ chemical speciation samplers, the EPA proposed to use routinely operated State, local, and Tribal FRMs as the basis of comparison upon which to calibrate FEMs (88 FR 5670–71, January 27, 2023). Importantly, routine SLT agency FRM data form the largest portion of the monitored air quality data used in epidemiologic studies that are being used to inform proposed decisions regarding the adequacy of the public health protection afforded by the primary $PM_{2.5}$ NAAQS, as discussed in section II above.

Overall, there was broad and strong support for utilizing collocated FRM data from routine SLT networks to provide calibrations of the continuous FEMs. For example, several commenters agree that valid SLT air monitoring data generated in routine networks and submitted to the EPA will improve the PM concentration measurement performance of approved FEMs. Another commenter provided support for PM FEM instrument manufacturers to evaluate nationally available valid FRM data as well as other data sets such as the performance evaluation audit program to update factory calibrations. The EPA believes that the routinely operated PM FRMs represent the best and largest source of data to calibrate continuous PM FEMs, and that performance evaluation audit program data should be kept independent of the calibration process. This will mean that assessments of the routine monitoring operations, including both the FRM and any future updated PM FEMs, will appropriately remain independent in evaluating whether updated methods are meeting bias MQOs. The EPA is, therefore, finalizing its approach to use routinely operated SLT FRMs as the basis of comparison upon which to calibrate continuous PM FEMs as proposed.

Regarding the EPA's proposed requirement to utilize factory calibrations (88 FR 5670–71, January 27, 2023), several commenters agreed that factory calibrations provide the best option to improve PM FEMs. For example, one commenter stated that the correction factors are necessary to preserve data integrity with the FRM, and they support the proposal that the approach be initiated by instrument manufacturers and implemented as a national solution through firmware updates.

Regarding the proposed requirement that calibrations be initiated by instrument manufacturers (88 FR 5671, January 27, 2023), most commenters were supportive of the proposed approach that recalibration of FEM PM instruments be initiated by instrument manufacturers. For example, one commenter stated they support allowing instrument companies submit improvements to their existing FEMs, as vendors should be encouraged to improve their methods. Another commenter noted that having a methodology initiated by the manufacturer will have nationwide consistency. A few of commenters recommended that SLT air agencies should have the additional ability to petition the EPA Administrator to initiate factory calibrations of FEMs to better meet MQOs when data collected by their agencies indicate disparities, because the monitoring agencies are responsible for the quality of the data from the specific makes and models of instrumentation used in their networks. While the EPA believes that, in most cases, the instrument companies should be the ones to initiate the process for calibration of FEMs to routinely operated FRMs, we agree with the commenters who suggested that other options should be available, including allowing monitoring agencies or MJOs to work independently or together to pursue improvements to designated FEMs. However, the EPA believes that any such improvements initiated by monitoring agencies or MJOs should still be facilitated through the responsible instrument company. Also, any such effort to improve data quality should be employed across all the networks in which the methods are operated and not limited to the networks operated by the agency(s) pursuing such improvements.

Regarding how frequently factory calibrations should be updated, our proposal identified that it would be most appropriate to not define a specific time period for updates; rather, updates should be based on whether or not quality data is being produced across a given network (88 FR 5672, January 27, 2023). Regarding this issue, one commenter recommended that instrument manufacturers be required to evaluate and, if necessary, adjust PM FEMs factory calibrations on an ongoing basis at regular intervals. The EPA notes that while it does not have the authority to require instrument companies to evaluate the quality of data from operating FEMs under 40 CFR part 58, the EPA does routinely participate in conferences and workshops and makes assessments of data quality specific to instrument makes and models publicly available. The EPA also regularly summarizes relevant FRM and FEM data

quality in documents such as the 2022 PA (U.S. EPA, 2022b). Therefore, consistent with the proposal, we are not finalizing any specifics regarding how frequently factory calibrations should be updated but commit to continue to routinely provide information to SLT agencies regarding FEM data quality.

The EPA proposed that the calibration of FEMs could apply to any of the PM FEM method indicators (*i.e.,* PM_{10}, $PM_{2.5}$, and $PM_{10–2.5}$) (88 FR 5670, January 27, 2023). The EPA received only supportive comments. All comments that included a discussion of three PM metrics support their inclusion for calibration of PM FEMs. Therefore, the EPA is finalizing the inclusion of all three PM indicators (*i.e.,* PM_{10}, $PM_{2.5}$, and $PM_{10–2.5}$) as proposed.

The EPA proposed that either all data available or a range of data up to 125% of the 24-hour NAAQS for the PM indicator of interest may be used to establish new factory calibrations, (88 FR 5671–73, January 27, 2023). The EPA received many comments supportive of the proposal and one comment offering a different approach on the range of data to use. One commenter recommends that the EPA should consider using all ''validated'' data because how these instruments behave under normal operating ranges may be just as important as how they behave when monitoring conditions are low or elevated, and that the full range of data should be used when determining the appropriate level of the standard, just as the full range of data is used in determining if an area is attaining the standard. In response to this comment, the EPA believes that making allowances for some flexibilities will increase the likelihood of instrument companies pursuing such improvements. Also, even though there is flexibility, the EPA will still be able to evaluate the appropriateness of a range of concentration data included as part of each application submitted. Also, the EPA notes that in certain circumstances, States do petition the EPA to set aside data under the Exceptional Events Rule (§ 50.14, ''Treatment of air quality monitoring data influenced by exceptional events''). Where approved, exceptional event data are set aside from use in regulatory decisions. Thus, there is a process to set aside certain high concentration data for certain purposes. Therefore, the EPA is finalizing the provision that factory calibrations may be based on a range of valid data as proposed.

The EPA solicited comment on the representative set of geographic locations to use in the calibration of FEMs compared to collocated FEMs (88 FR 5671, January 27, 2023). Most commenters were supportive of the approach of using representative sites in SLT networks from across the country. For example, several commenters provided their support for PM FEM instrument manufacturers to evaluate nationally available valid FRM data to update factory calibrations. Commenters disagreeing with a national geographic approach preferred to allow local solutions to correct data. For example, one commenter suggested having a local or regional option because PM instruments are impacted by, and respond differently to, a variety of local factors, including relative humidity, temperature, concentration levels, and particle composition. The EPA agrees that there are challenges in the response of PM FEMs to a variety of local factors; however, this can be true of many methods and are not specific to PM FEMs and, therefore, does not provide a reason to reject this approach in this instance. Another commenter stated that the proposed national correction factor is a ''flawed concept,'' suggesting that it is ''widely understood throughout the monitoring community that monitors perform best with a local correction factor.'' This commentor offered no record or citation supporting this point. The EPA counters that while monitoring agencies may statistically correct data from a PM continuous monitor for AQI purposes (40 CFR part 58, appendix G), there are both examples of well performing statistically corrected PM continuous monitors being used for AQI purposes; however, without proper attention and updates, there are also examples of poorly performing ones. Finally, another commenter believes that a national correction factor cannot possibly incorporate data to represent all the scenarios across the nation that have an impact on monitor performance and data quality. Although the EPA agrees that there are a variety of local scenarios that could affect monitor performance, the overall benefits of having nationally consistent measurement of PM concentrations and national calibration of data outweigh the potential advantages of locally specific calibrations.

Several commenters also disagreed with using local and regional calibrations of data, including some monitoring agencies that asserted being unable to reinvest in the operation of FRMs that would be required to locally calibrate their own PM FEMs. Further, every approved PM FEM method designated today is effectively calibrated through demonstration of field testing in the areas in which it was required to be tested (40 CFR 53.35(b)(1)). Moreover, the EPA proposed to require instrument manufacturers to demonstrate that they can improve the number of sites meeting bias MQOs by initiating a recalibration of an FEM. Thus, the use of a national set of sites where the methods are operated is essentially a fine-tuning of the PM FEMs performance across all sites where it is used.

After considering all the comments received, the EPA believes it is appropriate to finalize as proposed with a representative set geographic locations at SLT sites to calibrate PM FEMs. Identification of such sites would be made by the applicant of the planned updated calibration, subject to EPA approval, and submitted to the EPA in accordance with the requirements and application instructions in 40 CFR part 58, appendix C, sections 2.2 and 2.7. The EPA encourages early communication between an applicant seeking a method update and the EPA to facilitate the most appropriate sites are included in any updated application of the methods calibration.

The EPA proposed that instrument companies may, but are not required to, check for and exclude any potential outliers that may exist in the validated State, local, and Tribal agency network data available from AQS that would be used to establish new factory calibrations. The EPA received two comments regarding potential outlier approaches. One commenter disagreed with the proposed approach and instead recommended the use of all ''validated'' data, because how these instruments behave under normal operating ranges may be just as important as how they behave when monitoring conditions are low or elevated. The EPA acknowledges this point; however, the proposal on outliers allows flexibility in using standard outlier tests if needed to include or exclude such data as part of the calibration process. Ultimately, the true test of success for an updated method calibration will be that a higher number of sites are meeting bias MQOs in the areas in which the method is used, which will include all routine valid data including any potential outliers. Another commenter asserted concerns with the ability of instrument manufacturers to analyze data within individual monitoring agencies. The EPA disagrees with the commenter because decisions whether to include or exclude outliers should be flexible and made on a case-by-case basis. Moreover, the expected substantially larger dataset from routinely operated collocated FRMs and FEMs compared to what was

used in the original FEM designation testing (§ 53.35 Test procedure for Class II and Class III methods for $PM_{2.5}$ and $PM_{10–2.5}$) will minimize the effect of any potential outliers.

In contrast to these two comments, the EPA received many comments supportive of the proposed outlier approach overall. Therefore, the EPA is finalizing this part of the proposal that instrument companies may, but are not required to, check for and exclude any potential outliers that may exist in the validated State, local, and Tribal agency network data available from AQS that would be used to establish new factory calibrations.

Several commenters offered input on statistical criteria and initial testing requirements for approval of candidate PM FEMs and the role of instrument manufacturers in this process. The EPA did not propose any changes related to these issues; however, these comments have been considered below.

One commenter suggested that data quality objectives, bias, and precision estimators for different monitoring methods should be based on averages at both national and regional levels for purposes of comparison. Another commenter asked to strengthen the criteria for Class 3 Equivalency standards for candidate PM instrumentation. On testing requirements, one commenter recommended that the EPA consider updating the 40 CFR part 53 process for approving FEMs so that the testing process more closely reflects the regulatory deployment and data handling that generates NAAQS-comparable data. Another commenter asked that the results from ''summer'' and ''winter'' field evaluations not be averaged together because it allows agencies to minimize the error of biased instruments by averaging poor results with data often biased in the other direction. The same commenter also recommended that candidate instruments data sets should not be averaged together as is done currently where data from triplicate instruments are averaged for each day. Another commenter asked that the EPA require FEM field comparability tests in the northwest (*e.g.,* in EPA Region 10) in areas where particulate derived from biomass predominates to ensure that certified instruments will perform reliably in regions influenced by these sources. Related to the different measurement principles and the instrument companies' role in PM FEMs, one commenter noted that FEMs may never align perfectly with the FRMs due to the use of different measurement principles. Another commenter asked that manufacturers of FEM instruments be held accountable for ensuring that they continue to meet FEM criteria, whether through calibration updates and/or follow-up evaluations. Another commenter suggested that instrument manufacturers should be required to further evaluate the FEM monitoring data at defined intervals including, but not limited to, the 2-year and 5-year approval anniversaries.

The EPA did not propose to make modifications to the statistical criteria or testing requirements; however, we did solicit comment on any alternatives that would lead to more sites meeting the bias MQO with automated FEMs, especially for those sites that are near the level of the primary annual $PM_{2.5}$ NAAQS as proposed (88 FR 5672–73, January 27, 2023). While the comments requesting that the statistical criteria be strengthened may have merit, doing so would not address the large inventory of already deployed PM FEMs used throughout the country. Also, without performing a detailed Data Quality Objective (DQO) design process, it is unclear how changing one or more statistical criteria would help improve the number of sites meeting the bias MQO now or in the future. Similarly, while the comments asking for changes to the locations of testing may also have merit, the EPA believes this could be a deterrent for instrument manufactures to seek additional improvements since more testing would be required, at least for candidate methods. Regarding the comment on the different measurement principles, the EPA concurs that different measurement principles may never align perfectly. Also, the EPA notes that the Agency has longstanding goals for acceptable measurement uncertainty of automated and manual $PM_{2.5}$ methods in 40 CFR part 58, appendix A, section 2.3.1.1. Therefore, while having different measurement principles align is useful, meeting the goal for acceptable measurement uncertainty is the objective.

Regarding the comments related to the instrument companies' role in PM FEMs, the EPA notes that FEMs are already required to meet 40 CFR 53.9, ''Conditions of designation.'' Specifically, 40 CFR 53.9(c) requires that, ''Any analyzer, PM_{10} sampler, $PM_{2.5}$ sampler, or $PM_{10–2.5}$ sampler offered for sale as part of an FRM or FEM shall function within the limits of the performance specifications referred to in § 53.20(a), § 53.30(a), § 53.35, § 53.50, or § 53.60, as applicable, for at least 1 year after delivery and acceptance when maintained and operated in accordance with the manual referred to in § 53.4(b)(3).'' The EPA does not have the authority to require instrument manufacturers to further evaluate the FEM monitoring data at defined intervals, including but not limited to the 2-year and 5-year approval anniversaries, as one commenter suggested.

In addition to these few recommendations, the EPA received many comments supportive of the proposal that valid State, local, and Tribal air monitoring data from FRMs generated in routine networks and submitted to the EPA may be used to improve the PM concentration measurement performance of approved FEMs; therefore, consistent with the proposal we are not finalizing any updates to the statistical criteria, testing requirements, or requirements on instrument manufactures as proposed.

The EPA proposed that any new factory calibration should be developed using data from at least 2 years and tested on a separate year(s) of data (88 FR 5672, January 27, 2023). Comments on this part of the proposal were generally supportive. One commenter requested that at least a 3-year dataset, rather than the proposed 2 years, be used for a representative design value comparison of the FEM and FRM datasets to be evaluated. Another commenter pointed out that as large a data set as possible should be used, but EPA should not limit it to only data collected by instruments that have operated for more than 2 years.

In response to these comments, the EPA notes the broad support for the proposal as written. Also, the EPA notes that the 2-year period for using data to develop a factory calibration is a minimum, and that more years may be used as appropriate. Therefore, the EPA is finalizing its approach that any new factory calibration should be developed using data from at least 2 years and tested on a separate year(s) of data as proposed.

The EPA proposed several aspects of the FEM calibration on which we did not receive specific comments, including a provision that FEM methods should be evaluated by monitoring agencies as part of routine data assessments, such as during certification of data and 5-year assessments; the fact that the EPA recognizes only data from existing operating sites are available for use in factory calibrations; and recognition that an updated factory calibration does not have to work with the original field study data submitted that led to the designation as an FEM. With the broad general support from commenters summarized above, the EPA is finalizing each of these

individual aspects of the FEM calibration as proposed.

In the proposal, the EPA identified that we should expect a lag between the date when an already designated method is approved with a new factory calibration as an updated method by the EPA and when it can be implemented in the field. The EPA solicited comment on how to approach the data produced during this lag. Commenters provided input not only on how to address data during the lag, but also regarding how to address data already collected prior to a method update that has the potential to be used in regulatory decision making, particularly where such collected data do not meet the bias MQO. In response to this solicitation of comment, there was a consistent recommendation that calibrations of data associated with method updates should be applied to all relevant PM data prior to the EPA using it for designations under a final NAAQS.

While the EPA appreciates these comments and recognizes their support for retroactive data correction, at this time and following this final rule, monitoring agencies should continue to report PM FEM data as measured. This component of this final rule is focused only on revising 40 CFR part 53, appendix C to implement an updated calibration for approved PM FEMs. The issue of how prior and future monitoring data will be used in the implementation of this NAAQS, such as for designations, and for air quality regulatory programs is outside the scope of this rulemaking and will therefore be addressed by the EPA in a subsequent relevant action or actions.

The EPA received comments on whether updates to PM FEM methods should be required to be implemented or there would flexibility in when and if a monitoring agency implemented them. The commenters asked that EPA be flexible in allowing the use of updated method correction factors intended to improve the data comparability between the FRMs and FEMs.

In most cases, the EPA expects that updating the FEMs will result in improved data quality and more sites meeting bias MQOs; however, the EPA is not finalizing an update requirement in this action. Monitoring agencies can assess their data and make decisions on an update based on whether they are meeting the bias MQOs. Such decisions on whether or not to update a method may efficiently be included in those agencies' annual monitoring network plans under 40 CFR 58.10, ''Annual monitoring network plan and periodic assessment,'' which are already subject to EPA Regional office approval. In some circumstances, it is possible the original PM FEM may be revised in a manner where only the updated method has an active approved designation. In these cases, monitoring agencies would need to address updating their PM FEM in a timely manner.

The EPA solicited input on any alternative approaches that could lead to more sites meeting the bias MQO with automated PM FEMs, especially for those sites that are near the level of the primary annual $PM_{2.5}$ NAAQS as proposed to be revised in section II above. A few commentors provided input on potential options for alternative approaches and several others offered input on how a local or regional calibration of an FEM could work. Among alternative approaches, one commenter suggested that manufacturers of FEMs could provide settings that would allow for adjustments to make FEM data more ''FRM-like.'' Another commenter suggested working with the manufacturers of FEM equipment to diagnose the cause of the bias and then to address it appropriately.

The EPA received several comments on how to implement a local or regional calibration of FEMs. One commenter suggested that EPA could allow for SLT agencies to adjust FEM data to be more ''FRM-like'' prior to submitting data to AQS. Another commenter suggested using a rolling 3-month linear regression based on a comparison of FEM data to $PM_{2.5}$ levels measured by a 1-in-6-day FRM. Another commenter recommended that the EPA allow the application of a correction factor that is from an area with a similar climate and other conditions. Another commenter suggested that, for metropolitan statistical areas (MSAs) where the re-calibrated FEMs still do not meet equivalency criteria, monitoring agencies should be able to use the rolling linear regression technique to further calibrate the FEMs within an MSA. Another commenter suggested that developing a simple linear regression could establish the relationship between FEM data and FRM data and be used to adjust the FEM data at each site where they are collocated. Another commenter suggested that averaging the results within a MSA and applying it on an MSA basis with the previous 2 years of data could provide an adjustment method for sites without a collocated FRM. Another commenter identified that a regional correction factor potentially could improve instrument accuracy to biomass sources, which are a large component of PM in many communities.

Among the alternative approaches suggested, having settings that would allow for adjustments to make FEM data more ''FRM-like'' has merit, but assuming this was within a PM FEM itself, it would need to be separately incorporated into each make and model of FEM. If EPA were to pursue this alternative approach, the suggestion could be incorporated into a future regulatory action as a potential condition of designation because, without having the opportunity to thoughtfully consider how every step of such an approach would need to work, including what such requirements would look like and how potential settings adjustments would be made, it is not appropriate for the EPA to require the availability of such settings now, nor would it address the inventory of currently available PM FEMs already operating.

Regarding the suggestion that the EPA and SLTs should work with the manufacturers of FEM equipment to diagnose the cause of any biases and then to address them appropriately, the EPA supports this recommendation, but does not believe a regulatory change is required to allow the monitoring community (EPA and SLTs) to work with instrument manufacturers in this way.

Regarding the several comments on how to implement a local or regional calibration of FEMs, the EPA acknowledges the desire for this flexibility but believes that any such provisions for local or regional calibration of FEMs would need to be thoroughly thought out and proposed for consideration across the monitoring community. While several commenters support such an approach, the EPA also received adverse comments on the potential for local and regional calibration of PM FEMs instead of national. Most of the criticism of local and regional calibration of PM FEMs centered on both the lack of existing operating PM FRMs in commenters' networks and monitoring agencies' inability to staff the higher number of operating FRMs that would have to be collocated with PM FEMs to calibrate. Thus, the commenters that oppose local and regional calibrations of data prefer to utilize the national calibration of FEM data as proposed. Acknowledging all of these viewpoints, the EPA believes that it would not be appropriate to institute such an approach at this time. As discussed throughout this section, this final rule, the EPA is embarking on a new national approach to calibration of FEMs where valid State, local, and

Tribal air monitoring data from FRMs generated in routine networks and submitted to the EPA may be used to improve the PM concentration measurement performance of approved FEMs. The EPA and the community of SLT monitoring agencies can further consider other solutions to improving PM FEM methods, including local and regional scale calibration of FEMs, in a future review of the PM NAAQS.

In summary, the EPA is finalizing its proposal to allow valid State, local, and Tribal air monitoring data from PM FRMs and FEMs generated in routine networks and submitted to the EPA to update factory calibrations included as part of approved FEMs (40 CFR part 58, appendix C, sections 2.2 and 2.7). This approach, which will typically be initiated by instrument manufacturers but can also be spurred by monitoring agencies, MJOs of monitoring agencies, and the EPA itself, is to be implemented as a national solution in factory calibrations of approved FEMs through a firmware update, subject to EPA approval. FEM calibrations can apply to any PM FEM methods (*i.e.,* PM_{10}, $PM_{2.5}$, and $PM_{10-2.5}$). As part of this process, the EPA is finalizing that a range of data based on the most representative concentrations up to all available concentrations may be used in developing and testing a new factory calibration; that a representative set of geographic locations can be used; that outliers may be included or not included; that a new factory calibration should be developed using data from at least 2 years and tested on a separate year(s) of data; that updates to factory calibrations can occur as often as needed and should be evaluated by monitoring agencies as part of routine data assessments such as during certification of data and 5-year assessments; that the EPA recognizes only data from existing operating sites is available; and that an updated factory calibration does not have to work with the original field study data submitted that led to the designation as an FEM. The EPA is finalizing this approach as proposed with the intention of having more sites meet the bias MQOs with automated PM FEMs.

4. Revisions to the $PM_{2.5}$ Monitoring Network Design Criteria To Address At-Risk Communities

To enhance protection of air quality in communities subject to disproportionate air pollution risk, particularly in light of the proposed range for a revised primary annual $PM_{2.5}$ standard, the EPA proposed to modify the $PM_{2.5}$ monitoring network design criteria to include an environmental justice (EJ) factor that accounts for proximity of at-risk populations (*i.e.,* those identified in the 2019 ISA and ISA Supplement as being at increased risk of adverse health effects from $PM_{2.5}$ exposures to sources of concern), consistent with the statutory requirement that the NAAQS protect the health of at-risk populations (88 FR 5673, January 27, 2023). Specifically, the EPA proposed to modify the existing requirement at 40 CFR part 58, appendix D, section 4.7.1(b)(3)): ''For areas with additional required SLAMS, a monitoring station is to be sited in an area of poor air quality,'' to additionally address at-risk communities with a focus on anticipated exposures from local sources of emissions. The scientific evidence evaluated in the 2019 ISA and ISA Supplement indicates that sub-populations at potentially greater risk from $PM_{2.5}$ exposures include children, lower socioeconomic status (SES) [188] populations, minority populations (particularly Black populations), and people with certain preexisting diseases (particularly cardiovascular disease and asthma). The EPA proposed that communities with relatively higher proportions of sub-populations at greater risk from $PM_{2.5}$ exposure within the jurisdiction of a State or local monitoring agency should be considered ''at-risk communities'' for these purposes.

The $PM_{2.5}$ network design criteria have led to a robust national network of $PM_{2.5}$ monitoring stations. These monitoring stations are largely in Core-Based Statistical Areas (CBSAs) [189] across the country that include many $PM_{2.5}$ monitoring sites in at-risk communities. Many of the epidemiologic studies evaluated in the 2019 ISA and ISA Supplement, including those that provide evidence of disparities in $PM_{2.5}$ exposure and health risk in minority populations and low-SES populations, often use data from these existing $PM_{2.5}$ monitoring sites. However, we anticipate that with the more protective annual NAAQS finalized in section II above, characterizing localized air quality issues around local emission sources may become even more important. The EPA believes that adding a network design requirement to locate monitors in at-risk communities will improve our characterization of exposures for at-risk communities where localized air quality issues may contribute to air pollution exposures. Requiring that $PM_{2.5}$ monitoring stations be sited in at-risk communities will allow other methods to be operated alongside $PM_{2.5}$ measurements to support multiple monitoring objectives per 40 CFR part 58, appendix D, section 1.1. The EPA believes that it is appropriate to formalize the monitoring network's characterization of $PM_{2.5}$ concentrations in communities at increased risk to provide such areas with the level of protection intended with the $PM_{2.5}$ NAAQS. The addition of this requirement will also lead to enhanced local data that will allow air quality regulators help communities reduce exposures and inform future implementation and reviews of the NAAQS.

The EPA received comments concerning the proposed requirement to modify the $PM_{2.5}$ monitoring network design criteria to include an EJ factor that accounts for the proximity of populations at increased risk of adverse health effects from $PM_{2.5}$ exposures to sources of concern. Commenters included State, local, and Tribal air agencies and multijurisdictional organizations (MJOs) comprised of those agencies; industry and industry groups; other Federal, State, and local government entities; public health, medical, and environmental nongovernmental organizations (NGOs); and private citizens. The EPA proposed to require that sites located in at-risk communities (particularly those whose air quality is potentially affected by local sources of concern) should nonetheless meet the requirements to be considered representative of ''areawide'' air quality as this is consistent with all other minimally required sites. There were several other technical components of the proposed requirement for which we asked for comment, including: how to identify at-risk communities; the PM sources of concern important to consider; the datasets that can be used to identify communities with high exposures; the most useful measurement methods to collocate with $PM_{2.5}$ in at-risk communities; and the timeline to implement any new or moved sites.

Overall, most commenters were very supportive of the EPA's proposed modification to the $PM_{2.5}$ monitoring

[188] SES is a composite measure that includes metrics such as income, occupation, and education, and can play a role in populations' access to healthy environments and healthcare.

[189] Metropolitan and Micropolitan Statistical Areas are collectively referred to as ''Core-Based Statistical Areas.'' Metropolitan statistical areas have at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. Micropolitan statistical areas are a set of statistical areas that have at least one urban cluster of at least 10,000 but less than 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties.

network design criteria to include an EJ factor that accounts for proximity of populations at increased risk of adverse health effects from $PM_{2.5}$ exposures to sources of concern. A few commenters offered detailed supporting comments. For example, one commenter recommended targeting investment in regulatory monitors in EJ communities, opining that there is presently a lack of equitable distribution of these monitors in low-income and minority communities. Another commenter supports the inclusion of an EJ factor in $PM_{2.5}$ monitoring network design criteria as a means to assess whether disparities in exposure are reduced in the future. The EPA appreciates the support for the proposed requirement and acknowledges the desirability of a goal to assess if disparities in exposure are reduced in the future as a result of these monitoring efforts.

Some commenters were generally supportive of the proposed requirement but suggested that the EPA should recast the approach in a more specific way or offered additional examples of sources of concern. For example, one commenter stated that $PM_{2.5}$ emissions from residential and commercial wood burning result in localized hotspots that are often not revealed by community air monitoring. Another commenter asked that the EPA adopt a strategy to monitor EJ communities near both larger well-known point sources of $PM_{2.5}$ and along traffic corridors as well as smaller sources that, when taken together, may create a large amount of emissions and health harms in the area. Another commenter stated that the national network of monitors operated by the EPA captures data used for generalized modeling, but overall monitoring is not as granular as one would expect, especially in urban areas. For instance, the commenter suggested that EPA could monitor suspected ''hot spots'' (*e.g.,* residential development adjacent to highways and active construction sites) to better manage and mitigate $PM_{2.5}$ pollution at their sites of origin, and that more extensive and granular monitoring data would also facilitate essential research and inform future evaluations and adjustments of the NAAQS. The EPA acknowledges these comments identifying other sources of concern, and we address these and other potential sources of concern below.

Among adverse comments, a few commenters stated that ''at-risk communities'' is not well defined. The EPA disagrees and directs those commenters to the numerous places where this definition is covered, including in Section II.B.2 of the proposal where we explained the term related to a variety of at-risk populations (88 FR 5591–92, January 27, 2023) as well as section 12.5 of the 2019 ISA (U.S. EPA, 2019a) and section 3.3.3 of the ISA Supplement (U.S. EPA, 2022a). Other commenters oppose the addition of the proposed monitoring because they feel it would reduce flexibility for agencies in deciding where they should site monitors, advocating that monitoring agencies should be afforded maximum flexibility to identify where to site monitors for at-risk areas. Because the EPA recognizes the challenges cited by these commenters related to establishing new ambient air monitoring stations, the EPA is finalizing the modified requirement on $PM_{2.5}$ monitoring network design criteria intended to address at-risk communities that allows flexibility regarding which EJ communities should be monitored. Finally, one commenter asked that the EPA clarify a specific metric to judge how to site monitors in at-risk communities. Instead, the EPA believes it is appropriate for agencies to recommend what they believe to be the most important things to consider for their sites to meet the $PM_{2.5}$ network design requirements and, thus, applying a new metric could take away from local priorities for at-risk communities.

A few commenters asked that the EPA require more monitoring than proposed. One commenter stated that it would be more beneficial to overburdened communities if air monitoring were required in all at-risk communities. A few commenters asked that EPA require additional monitoring for attainment of $PM_{2.5}$ NAAQS in EJ communities. In response to these comments, the EPA supports the SLT agencies' initiatives to conduct additional monitoring beyond the minimum monitoring requirements and network design criteria. In addition, the EPA supports agencies' use of alternative datasets such as sensors and sensors networks, satellites, and other non-regulatory monitoring where appropriate for non-regulatory data uses. The EPA notes that many monitoring agencies already operate more monitoring sites than are minimally required, and we expect this to continue as agencies consider siting monitors in at-risk communities.

However, the EPA also received substantial concerns from monitoring agencies about their resource constraints, including staffing to support any potential new monitoring. The EPA also notes that the existing and robust network of almost 1,000 $PM_{2.5}$ sites nationally is designed to continue to protect all populations at the level of the NAAQS discussed in section II of this final action by always having at least one site in the area of expected maximum concentration for each CBSA where monitoring is required. As a result of the revisions to the annual $PM_{2.5}$ NAAQS being finalized in this action, a small number of new monitoring sites will also be required under EPA's current minimum monitoring requirements. With the monitoring network design changes finalized in this rule, many of these existing and new sites will form an important sub-component of the $PM_{2.5}$ network by better characterizing air quality in at-risk communities, particularly with respect to sources of concern.

The EPA concludes that the requirements in this final rule for siting of monitoring in at-risk communities will meaningfully improve the $PM_{2.5}$ monitoring network and its characterization of air quality in at-risk communities, without placing substantial new resource burdens on States and their monitoring agencies that would be associated with requirements for additional monitoring sites. Therefore, the EPA is finalizing this part of the proposed action without requiring additional monitoring sites beyond what would be associated with the revised annual $PM_{2.5}$ NAAQS described in section II as they pertain to the minimum requirements associated with Table D–5 of Appendix D to Part 58—$PM_{2.5}$ Minimum Monitoring Requirements.

A few commenters asked that the EPA enhance monitoring in smaller cities and rural areas. One commenter asked for the EPA to extend the proposed monitoring network to Micropolitan Statistical Areas with populations of 10,000–50,000 and to rural areas. Another commenter pointed out that current air quality monitoring networks focus on urban and densely populated areas; therefore, rural areas are often not captured in this existing monitoring infrastructure, despite well-documented examples of high PM concentration in rural communities. The commenter believes this results in inadequate assessment of air pollution exposures for a substantial segment of the U.S. population. The EPA disagrees that there needs to be additional requirements for small CBSA's and rural areas. Regarding these comments, the EPA points out that we have a long-standing requirement for each State to monitor at background and transport sites (40 CFR part 58, appendix D, section 4.7.3—Requirement for $PM_{2.5}$ Background and Transport Sites). Also, if an agency deems it appropriate to do so, monitoring coverage of rural areas can be accomplished with other tools

such as sensors and sensors networks, satellites, and other non-regulatory monitoring. Although there may be short-term high exposures in rural areas, there is no evidence that long-term averages are higher in rural areas compared to urban areas with significantly higher density of populations and emissions. For smaller cities or rural areas that may have concentrations near the level of the $PM_{2.5}$ NAAQS finalized in section II above, monitoring agencies are encouraged to monitor and address emissions as appropriate.

Some commenters disagree that the proposed revision to the $PM_{2.5}$ monitoring network design criteria to address at-risk communities is needed. One commenter stated that including an EJ factor is not necessary because the current network is designed to protect all citizens. Another commenter stated that EJ factors could be cumbersome to implement. Another commenter asserted the proposal to add SLAMS in at-risk communities with higher $PM_{2.5}$ concentrations might create more granular data and provide for a greater margin of safety for those communities and monitors in such a way that data from those areas could misrepresent the larger area represented by the network. In response to the comment on the current network protecting all citizens, the EPA agrees that by measuring in the community with the highest concentration of $PM_{2.5}$ we protect other citizens; however, as stated in the proposal, the EPA believes that adding a requirement for sites with an EJ factor near sources of concern will enhance the overall network to the benefit of all citizens. Also, we anticipate that with the more protective annual NAAQS finalized in section II above, characterizing localized air quality issues will become even more important around local emission sources. As for EJ factors being cumbersome to implement, the EPA disagrees because there are many such locations already operating successfully in the current network. Regarding the comment that sites in at-risk communities may misrepresent the larger area represented by a particular network, the EPA notes that pursuant to 40 CFR part 58, minimally required sites in a given network are to represent area-wide air quality; therefore, sites in at-risk communities, by definition, would be representative of the communities within the network in which they are sited for the level of protection intended under the annual $PM_{2.5}$ NAAQS.

In the proposal, the EPA identified that, in light of the evidence of increased risk to at-risk communities, it would be appropriate to better characterize exposures for communities in proximity to local sources of concern (88 FR 5673–76, January 27, 2023). Thus, the EPA proposed that enhanced networks should include representation of at-risk communities living near emission sources of concern (*e.g.,* major ports, rail yards, airports, industrial areas, or major transportation corridors). The EPA requested comment on the types of sources of concern most important to consider. In addition to supporting the types of sources the EPA identified in the proposal, commenters also identified several additional localized sources such as railroads, stationary sources, transportation facilities, and communities with high numbers of wood stoves.

A few commenters suggested the inclusion of sources that are often considered line and/or area sources, *e.g.,* traffic corridors and emissions from federally regulated facilities, military installations, and national forests. Commenters also identified other sources usually associated with long-range transport such as smoke from wildfire and prescribed fires and long-distance transport of PM, for example from Saharan dust and other international transport. As explained in the proposal, the site with the highest expected $PM_{2.5}$ is already required to have a monitor by our long-standing requirement that monitors be placed ''. . . in the area of expected maximum concentration'' (§ 58.1 and appendix D, section 4.7.1(b)(1)). The EPA expects that both sites with the expected maximum concentration and sites specifically placed in at-risk communities would be impacted by any long-range transport in the area. Therefore, the EPA believes any emphasis on the sources of concern should prioritize localized sources, including point, area, and line sources of concern impacting the at-risk community of interest. Therefore, based upon the comments, the EPA is finalizing a broader example list of sources of concern to include localized sources such as point sources and transportation facilities, since these are the most commonly expected additional sources of concern. In response to the other sources of concern suggested by commenters, the EPA notes that while it has provided examples, the siting of monitors in EJ communities would not be limited to these examples. Thus, the revised set of examples would include ''a major industrial area, point source(s), port, rail yard, airport, or other transportation facility or corridor.'' In finalizing this modified list of examples, the EPA is not looking to prioritize one type of source category over another; rather, we intend to further illustrate the types of localized sources of pollution that might impact at-risk communities such that the siting of monitors nearby may be appropriate.

One commenter noted that the proposal may have unintentionally taken out the requirement related to specific design criteria for $PM_{2.5}$ in 40 CFR part 58, appendix D, 4.7.1(b)(3) that, for an area with a requirement for an additional SLAMS monitor, it should ''be sited in an area of poor air quality.'' Thus, the language as proposed neither requires that such monitors be sited in areas of poor air quality, nor does it require that the monitor be sited in an area that is anticipated to experience poor air quality from unspecified (and thus potentially relatively insignificant) sources in the area. The EPA agrees that this was not our intention; the EPA wants to protect populations in at-risk communities by ensuring they are protected by the NAAQS when there are sources of concern that may be impacting them (*i.e.,* not insignificant sources). Thus, the EPA is reinstating this requirement in the network design language and combining it with the examples of the types of localized sources of concern: ''For areas with additional required SLAMS, a monitoring station is to be sited in an at-risk community with poor air quality, particularly where there are anticipated effects from sources in the area (*e.g.,* a major industrial area, point source(s), port, rail yard, airport, or other transportation facility or corridor).''

To ensure minimally required monitoring sites appropriately represent exposures in at-risk communities, the EPA proposed that sites represent ''area-wide'' air quality near local sources of concern (88 FR 5674, January 27, 2023). Sites representing ''area-wide'' air quality are those monitors sited at neighborhood, urban, and regional scales, as well as those monitors sited at either micro- or middle-scale that are identified as being representative of many such locations in the same Metropolitan Statistical Area (MSA).[190] Most existing—as well as new or moved sites—are expected to be neighborhood-scale, which means that the monitoring stations would typically represent conditions throughout some reasonably homogeneous urban sub-region with dimensions of a few kilometers per part 58, appendix D, section 4.7.1(c)(3). Additionally, as described in § 58.30,

[190] MSA means a CBSA associated with at least one urbanized area of 50,000 population or greater. The central-county, plus adjacent counties with a high degree of integration, comprise the area.

sites representing ''area-wide'' air quality have a long-standing applicability to both the annual and 24-hour $PM_{2.5}$ NAAQS. Our proposed requirement for siting monitors in communities representing ''area-wide'' air quality is consistent with other network design objectives pursuant to which we seek to have monitors located where people live, work, and play.

The EPA received a few comments on its proposed requirement that minimally required sites represent ''area-wide'' air quality. One commenter stated that the inclusion of a provision for EJ would narrow the location of monitors to certain communities that may not best represent ''areawide'' air quality. Another commenter asked the EPA to consider removing requirements that sites be area-wide, since 24-hour and annual averaging times would miss short, elevated pollution events. A couple commenters had concerns with the difference in the scale of representation between EJ monitors using small scale and other NAAQS monitors using area-wide scale, in that area-wide scale would not protect those most at risk. However, another commenter agreed with the EPA that sites representing at-risk communities should represent area-wide air quality. In addition to these comments, the EPA received many comments with support for its proposed modifications to the network design criteria as whole.

Regarding whether narrowing the location to certain communities may not best represent ''area-wide'' air quality, the EPA notes that sites are either identified as being area-wide or not; the EPA did not suggest it was seeking a best ''area-wide'' location. In response to the comment that area-wide site may miss short, elevated pollution events, the EPA is aware that there can be local, short-term spikes in $PM_{2.5}$ concentrations. However, the network design criteria associated with minimally required sites is applicable to both the annual and 24-hour $PM_{2.5}$ NAAQS, and the EPA believes it is appropriate to continue to ensure all minimally required sites have the most utility and remain applicable to both forms of the $PM_{2.5}$ NAAQS. The identification of unique micro- and middle-scale sites was directed at discretionary efforts of any monitoring agency, with the recognition that such sites, (*i.e.,* relatively unique micro-scale, or localized hot spot, or unique middle-scale impact sites), are not applicable to the annual NAAQS as described in § 58.30—Special consideration for data comparison to the NAAQS.

After considering all the comments on this topic, the EPA is finalizing this part of the modification to the network design criteria to maintain, consistent with our long-standing network design criteria, that all minimally required sites are to represent area-wide air quality.

In addition to using data from the robust network of almost 1,000 $PM_{2.5}$ sites for NAAQS and AQI purposes, having a stable network of long-term sites is especially valuable to examine trends and to inform long-term health and epidemiology studies that support reviews of the PM NAAQS. Therefore, while we proposed to add a $PM_{2.5}$ network design criterion to address at-risk communities, many sites are likely already in valuable locations meeting one of the existing network design criteria (*i.e.,* being in an area-wide area of expected maximum concentration or collocated with near-road sites) and supporting multiple monitoring objectives. Also, in many communities, there may already be sites meeting the network design criterion we proposed for at-risk communities. Thus, acknowledging the value of having long-term data from a consistent set of network sites, the EPA believes that moving sites should be minimized, especially in MSAs with a small number of sites. However, because a small number of new sites are expected to be required due to the existing minimum monitoring requirements (40 CFR part 58, appendix D, Table D–5) [191] and the revised primary annual $PM_{2.5}$ NAAQS detailed in section II, and because sites occasionally have to be moved—due to, for example, loss of access to a site or a site no longer meeting siting criteria—the EPA believes it is appropriate to prioritize establishing sites in at-risk communities near sources of concern, whenever new sites are established, whether because it is a new site or a replacement for a prior site that must be moved. The EPA accordingly proposed that annual monitoring network plans (40 CFR 58.10(a)(1)) and 5-year assessments (40 CFR 58.10(d)) that include any of the few new sites that will be required include a commitment to examine the ability of existing and proposed sites to support air quality characterization for areas with at-risk populations in the community and the objective discussed herein.

In the proposal, the EPA identified that assessing and prioritizing at-risk communities for monitoring can be accomplished through several approaches (88 FR 5675). The most critical aspect of prioritizing which communities to monitor is their representation of the at-risk populations described earlier in this section. The other major consideration is whether the community is near a source or sources of concern. While many CBSAs have one or more sources of concern described above, some CBSAs will not have a quantity of emissions from sources of concern that result in an elevated level of measured $PM_{2.5}$ concentrations in surrounding communities. The siting criteria to be ''in the area of expected maximum concentration,'' § 58.1 & appendix D, section 4.7.1(b)(1) ensures there is a monitoring site in the community with the highest exposure in each CBSA with a monitoring requirement. Some CBSAs may also have a requirement to collocate a $PM_{2.5}$ monitor at a near-road NO_2 station. Therefore, the EPA believes that for cases where an additional $PM_{2.5}$ site is required, we should include a criterion that the site be in an at-risk community when there are no sources of concern identified in that CBSA, or such sources do exist but are not expected to lead to elevated levels of measured $PM_{2.5}$ concentrations.

In its proposal, the EPA highlighted that tools such as the EPA's EJSCREEN [192] are available to identify the at-risk communities intended for monitoring as part of the proposed revision to the $PM_{2.5}$ network design criteria (88 FR 5675–76, January 27, 2023). The EPA solicited comment on other tools and/or datasets that can be utilized to identify at-risk communities. In addition to support for using EJSCREEN, commenters identified several other options to identify at-risk communities intended for monitoring as part of the proposed revision to the $PM_{2.5}$ network design criteria. Among similar tools, one commentor suggesting using CalEnviroScreen.[193] Commenters also identified different options for models including InMAP,[194] satellite-derived models that can be employed to help identify EJ communities, and hybrid models. A few commenters also suggested using sensors and sensor networks such as the BlueSky [195] and PurpleAir [196] sensors.

The EPA supports the use of other State and local tools designed to help identify the at-risk communities that

[191] Gantt, B. (2022). Analyses of Minimally Required $PM_{2.5}$ Sites Under Alternative NAAQS. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

[192] See: *https://www.epa.gov/ejscreen.*

[193] See: *https://oehha.ca.gov/calenviroscreen.*

[194] See: *https://inmap.run/#home.*

[195] Mention of commercial names does not constitute EPA endorsement.

[196] Mention of commercial names does not constitute EPA endorsement.

should be monitored to meet the revised network design criteria. The EPA additionally agrees with commenters that the use of models as well as sensors and sensor networks may be appropriate and helpful in identifying the most appropriate at-risk communities in which to locate monitors.

For at-risk communities, monitoring agencies need data that can best inform where there may be elevated levels of exposures from sources of concern. While we use FRMs and FEMs to determine compliance with the NAAQS, data from these methods will only be available at existing sites. However, there are several additional datasets available that may be useful in evaluating the potential for elevated levels of exposure to communities near sources of concern. In the proposal, EPA identified potential non-regulatory monitoring datasets such as CSN, IMPROVE, and AQI non-regulatory $PM_{2.5}$ continuous monitors; modeling data that utilizes emission inventory and meteorological data; emerging sensor networks such as those that comprise EPA and the USFS's Fire and Smoke Map;[197] and satellites that measure radiance and, with computational algorithms, can be used to estimate $PM_{2.5}$ from aerosol optical depth (AOD) (88 FR 5675–76, January 27, 2023). The EPA solicited comment on datasets most useful to identify communities with high exposures for $PM_{2.5}$ NAAQS (*i.e.,* annual or 24-hour). In addition to providing information about datasets that can inform the NAAQS comparison, commenters additionally identified several types of datasets that may be useful to identify where there may be elevated levels of exposures from sources of concern. These datasets include satellite measurements, sensors, and sensor network data, which may all be useful to find hot spots in communities. Commenters also identified EJScreen and CalEnviroScreen, which are screening and mapping tools that utilize several datasets. Another commenter stated that to better understand exposure differences in disadvantaged communities, shorter measurement intervals should be measured and reported.

In considering the datasets identified in the proposal as well as the ones commenters provided, the EPA believes all the datasets have value to help inform where there may be elevated levels of exposures from sources of concern. However, each of them may also have limitations and, therefore, users should be careful not to rely solely on one dataset versus another for all purposes. Fortunately, many of the available datasets are becoming easier to work with and more accessible, which will allow interested parties and monitoring agencies the opportunity to efficiently review the datasets and determine best applicability. For all of these reasons, the EPA is not finalizing a requirement to use a specific dataset or tool to identify at risk communities; however, whatever datasets a monitoring agency elects to use, its plan to use such data for purposes of meeting the network design requirements will be subject to EPA approval as part of the 40 CFR 58.10 annual monitoring network plan. Regarding the comment recommending shorter measurement intervals in measuring and reporting data to better understand exposure differences in disadvantaged communities, the EPA agrees and generally supports use of continuous methods. While we generally support use of continuous methods, approved filter-based technologies and methods also provide valuable air quality information. Therefore, the EPA is not requiring the use of automated continuous methods beyond what is already required in 40 CFR part 58, appendix D, section 4.7.2—Requirement for Continuous $PM_{2.5}$ Monitoring.

The monitoring methods appropriate for use at required $PM_{2.5}$ sites in at-risk communities are FRMs and automated continuous FEMs (88 FR 5675–76, January 27, 2023). These are the methods eligible to compare to the $PM_{2.5}$ NAAQS, which is the primary objective for collecting this data. There are several other monitoring objectives that would benefit from the use of automated continuous FEMs. For example, having hourly data available from automated continuous FEMs would allow sites to provide data in near-real time to support forecasting and near real-time reporting of the AQI. Automated continuous methods are also useful to support evaluation of other methods such as low-cost sensors. When used in combination with on-site wind speed and wind direction measurements, automated FEMs can provide useful pollution roses, which help in identifying the origin of emissions that affect a community. Additionally, when collocated with continuous carbon methods such as an aethalometer, automated FEMs can help identify potential local carbon sources contributing to increased exposure in the community. While either FRMs or automated FEMs may be used at a site for comparison to the $PM_{2.5}$ NAAQS, the EPA supports use of automated continuous FEMs at sites in at-risk communities.

The EPA requested comment on the measurement methods most useful to collocate with $PM_{2.5}$ in at-risk communities (88 FR 5675–76, January 27, 2023), and a few commenters provided input. One commenter recommended that the EPA should employ supplemental technologies and systems to increase coverage of the regulatory monitoring network and obtain more complete data to further protect public health and address environmental injustice in air pollution exposure. Another commenter recommended that the EPA invest in community-led monitoring and mobile air quality monitoring with a goal of recording block-level variabilities in data. And another commenter cited the value of community-deployed $PM_{2.5}$ monitoring.

The EPA appreciates the comments provided on the measurement methods most useful to collocate with $PM_{2.5}$ monitoring sites in at-risk communities. Because the use of methods beyond the required $PM_{2.5}$ FRMs or FEMs or other criteria pollutant measurements meeting a NAAQS monitoring requirement is voluntary, the establishment of $PM_{2.5}$ NAAQS comparable sites in at-risk communities will allow for collaboration at multiple levels. The EPA strongly encourages such collaboration with impacted communities, and the measurement methods discussed here should be considered for use as appropriate.

In the proposal, the EPA identified that, to meet the revised network design criteria, there will be only a few new sites required,[198] plus any potentially moved sites in cases where an existing site lease is lost or otherwise requires relocation (88 FR 5675–76, January 27, 2023). To handle these new or relocated sites, the EPA proposed to build upon our existing regulatory process for selecting and approving these sites under 40 CFR 58.10 (88 FR 5676, January 27, 2023). In the proposal, we stated it would be appropriate to provide at least 12 months from the effective date of the final rule to allow monitoring agencies to initiate planning to implement these measures by seeking input from communities and other interested parties and considering whether to revise their $PM_{2.5}$ networks

[197] See: *https://fire.airnow.gov/.*

[198] Gantt, B. (2022). Analyses of Minimally Required $PM_{2.5}$ Sites Under Alternative NAAQS. Memorandum to the Rulemaking Docket for the Review of the National Ambient Air Quality Standards for Particulate Matter (EPA–HQ–OAR–2015–0072). Available at: *https://www.regulations.gov/docket/EPA-HQ-OAR-2015-0072.*

or explain how their existing networks meet the objectives of the proposed modification to the network design criteria. Thus, the EPA proposed that monitoring agencies should address their approach to the question of whether any new or moved sites are needed and identify the potential communities in which the agencies are considering adding monitoring, if applicable, as well as identifying how they intend to meet the revised criteria for $PM_{2.5}$ network design to address at-risk communities in the agencies' annual monitoring network plans due to each applicable EPA Regional office no later than July 1, 2024 (see 40 CFR 58.10). Specifics on the resulting new or moved sites for $PM_{2.5}$ network design to address at-risk communities were proposed to be detailed in the annual monitoring network plans due to each applicable EPA Regional office no later than July 1, 2025 (40 CFR 58.10). The EPA proposed that any new or moved sites would be required to be implemented and fully operational no later than 24 months from the date of approval of a plan or January 1, 2027, whichever comes first, but the EPA solicited comment on whether less time is needed (*e.g.,* 12 months from plan approval and/or January 1, 2026).

The EPA received a few comments on its proposed timeline for monitoring agencies to identify, propose, and ultimately bring any new or moved sites online. One commenter asked that the timeline give states more time to start or move sites. A few commenters asked that the EPA only require meeting a timeline for identifying whether any new or moved sites are needed after the EPA has provided the monitoring agencies with guidance on the priority of the potential at-risk communities. One of those commenters further requests that the EPA allow at least 24 months from the date of approval of a § 58.10 monitoring plan identifying any relocation of monitoring sites or establishment of new monitoring sites to implement any changes to the network, citing the need for more time to work with local officials, procure monitoring equipment, and contract for services, all of which can cause significant delays in establishing a monitoring site. Another commenter asked that the EPA remain attentive to the challenges that States, and air agencies face regarding recruiting and retaining the specialized staff needed to support their existing regulatory monitoring networks and the capital resources needed to implement and sustain new monitoring stations in areas that are clearly meeting the existing PM NAAQS or any revised PM NAAQS. Another commenter stated that the July 1, 2024, timeline for a network evaluation this complex is insufficient, noting that they submit their draft annual monitoring network plan for public review and comment in mid-April for 30 days. Because the final plan is due July 1 and must include all comments and responses and describe any changes based on those comments, the timeline does not take these requirements into consideration by allowing for the more extensive assessment of changes that may be needed to meet the proposed new monitoring requirements. The commenter stated that it would be appropriate to provide at least 12 months from the effective date of this final rule for monitoring agencies to initiate planning to implement these measures, seek input, consider revisions to their $PM_{2.5}$ networks, and explain how their existing networks meets the objectives of the final rule. The commenter notes that that SLT agencies should be provided a minimum of 18 months after the final recommendation is published to add this information to their § 58.10 annual monitoring network plans. Another commenter encourages the EPA to retain the proposed deadline for any newly required monitoring stations in at-risk communities to be operational (*i.e.,* 24 months after the July 2025 network plan approval or January 1, 2027, whichever is earlier). While the need for this data is urgent, the commenter stated that the process for procuring instrumentation, securing leases, and building permits, and other logistics in constructing new monitoring sites can take a significant amount of time, some of which are outside of agencies' control.

As stated earlier, the EPA received strong support for our proposal to modify the $PM_{2.5}$ monitoring network design criteria to include an EJ factor that accounts for proximity of populations at increased risk of adverse health effects from $PM_{2.5}$ exposures to sources of concern from a wide range of commenters. A few commenters support the timeline proposed, a few others support starting any new or moved sites sooner than proposed, while other commenters asked for more time or offered conditions regarding how to establish an appropriate timeline.

The EPA disagrees with the commenter that suggested the EPA should only require agencies to meet a timeline to identify whether any new or moved sites are needed after the EPA has provided the monitoring agencies with guidance on the priority of the potential at-risk communities, because the regulatory text provides all the guidance required for agencies to begin this process. As we explained above, the EPA does not anticipate that many new or moved sites will be required based on the final rule because we think most sites are already in suitable locations and long-term sites are highly valued. Also, monitoring agencies have discretion to provide to the EPA their recommendations regarding how they intend to meet the modifications to the $PM_{2.5}$ monitoring network design criteria to include an EJ factor that accounts for proximity of populations at increased risk of adverse health effects from $PM_{2.5}$ exposures to sources of concern. Overall, the EPA believes that having sites in the areas of expected maximum concentrations will best ensure that all communities are protected. Since there may be multiple choices for sites in EJ areas near sources of concern, the EPA acknowledges that there may be many locations that can meet the revised $PM_{2.5}$ network design criteria. While, as we explained earlier, we want such sites to also be in areas of poor air quality, the sites in the area of maximum concentration will ensure that all communities are protected, there can be more flexibility afforded in the selection amongst at-risk communities to meet the revised requirements, since any alternative at-risk communities would already be protected.

The EPA considered both the concerns and support for the timeline proposed and clarifies that the component of the proposed requirement regarding the need to identify potential new sites or an intention to move sites to be included in the annual monitoring network plan due to EPA on July 1, 2024, would be satisfied with a statement of intent to pursue a new site per the revised network design criteria and in consideration of the minimum monitoring requirements. While monitoring agencies may provide as much detail as they deem appropriate regarding the revised $PM_{2.5}$ network design criteria in their annual monitoring network plans due on July 1, 2024, there is no expectation that any details on site-specific information would be included at that stage. We encourage agencies to provide their initial thinking on the communities they are most interested in monitoring pursuant to the revised network design criteria. Therefore, the EPA is finalizing the timeline as proposed, including the provision that monitoring agencies report their intention to add or move sites, where required, in their annual monitoring network plans due to each applicable EPA Regional office no later than July 1, 2024 (40 CFR 58.10). The

monitoring agencies will then provide specifics on any new or moved sites for $PM_{2.5}$ network design to address at-risk communities in the annual monitoring network plans due to each applicable EPA Regional office no later than July 1, 2025 (40 CFR 58.10). And any new or moved sites shall be implemented and fully operational no later than 24 months from the date of approval of a § 58.10 plan, or January 1, 2027, whichever comes first.

In summary, the EPA is finalizing modifications to the $PM_{2.5}$ network design criteria to include an EJ factor to address at-risk communities with a focus on exposures from sources of concern in areas of poor air quality. While this modification to the $PM_{2.5}$ network design requires sites to be located in at-risk communities, particularly those whose air quality is potentially affected by local sources of concern, such sites must still meet the requirement for being considered ''area-wide'' air quality. In finalizing this modification to the $PM_{2.5}$ network design requirement, the EPA is making two changes in the final rule response to the comments received. First, the EPA is broadening our examples of ''sources of concern'' to include localized sources such as point sources and major transportation facilities or corridors. Second, the EPA is reinstating ''poor air quality'' in our requirement for the modified network design criteria, meaning the revised $PM_{2.5}$ network design requirement now states: ''For areas with additional required SLAMS, a monitoring station is to be sited in an at-risk community with poor air quality, particularly where there are anticipated effects from sources in the area (*e.g.,* a major industrial area, point source(s), port, rail yard, airport, or other transportation facility or corridor).'' All other aspects of the $PM_{2.5}$ network design requirements are being finalized as proposed.

5. Revisions to Probe and Monitoring Path Siting Criteria

The EPA proposed changes to monitoring requirements in the Appendix E—Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring (88 FR 5676–78, January 27, 2023). Since 2006, the EPA finalized multiple rule revisions to establish siting requirements for $PM_{10–2.5}$ and O_3 monitoring sites (71 FR 2748, January 17, 2006), Near-Road NO_2 monitoring sites (75 FR 6535, February 9, 2010), Near-Road CO monitoring sites (76 FR 54342, August 31, 2011), and Near-Road $PM_{2.5}$ monitoring sites (78 FR 3285, January 15, 2013). Through these previous revisions to the regulatory text, some requirements were inadvertently omitted, and, over time, the clarity of this appendix was reduced through those omissions that, in a few instances, led to unintended and conflicting regulatory requirements. The EPA proposed to reinstate portions of previous Probe and Monitoring Path Siting Criteria Requirements from previous rulemakings, where appropriate, to restore the original intent.

The EPA only received a few comments on the proposed rulemaking pertaining to the proposed changes regarding probe and monitoring path siting criteria for ambient air quality monitoring, most of which were supportive of the proposed revisions. One commenter noted that the image for Figure E–1 in Appendix E to part 58 was distorted and of extremely poor quality, rendering the text in places almost unreadable (88 FR 5712, January 27, 2023). The EPA makes several references to Figure E–1, which provides detailed information needed for assessing a range of acceptable probe distances from roadways based on a monitor's spatial scale. The commenter also stated that a higher quality image is needed for the figure so that agencies can fully interpret the figure to the extent that EPA requires. The EPA agrees with the commenter that a higher quality image for Figure E–1 is important and needed. Based on this comment, the EPA is finalizing the revision to Figure E–1 to clearly communicate the requirements of appendix E.

The EPA is revising appendix E in its entirety as proposed (88 FR 5709–5717, January 27, 2023) for clarity and as described in detail below.

a. Separate Section for Open Path Monitoring Requirements

The EPA proposed to relocate all open path monitor siting criteria requirements to a separate section in appendix E from those requirements for siting samplers and monitors that utilize probe inlets (88 FR 5676, January 27, 2023). Separate sections for these distinct monitoring method types allows the EPA to more clearly articulate minimum technical siting requirements for each.

The EPA received one supportive comment to adopt this change and received no adverse comments. Another commenter stated the regulatory text of the proposal improves the clarity of the appendix but encouraged the EPA to break the summary tables down further into more manageable components (perhaps by pollutant). The commenter stated that summary tables for the proposed appendix continue to be a ''jumbled mess of regulatory requirements.'' The EPA agrees that the summary tables E–3 and E–6 in the proposal could be improved further. Also, the EPA found that footnote 3 of Table E–6 in the proposed rule was incomplete and corrected this editorial error.

Therefore, the EPA is making editorial changes to both summary tables E–3 and E–6 and finalizing the remainder of the language as proposed with the open path monitor siting criteria requirements placed into a separate section of the appendix.

b. Distance Precision for Spacing Offsets

The EPA proposed to require that when rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures (88 FR 5676, January 27, 2023). The EPA proposed to communicate this rounding requirement in the regulatory text using footnotes in the tables of this appendix.

The EPA received two supportive comments and no adverse comments regarding this proposed change. While supportive of the proposal, one of the two supporting comments suggested it would be clearer if EPA explicitly defined a decimal in the distance values and round to the nearest tenths place for these assessments. The EPA disagrees with this recommendation because in some cases it would be more restrictive and burdensome than the proposed requirement that was intended to provide both clarity and flexibility. Therefore, the EPA is finalizing the language as proposed.

c. Summary Table of Probe Siting Criteria

The EPA proposed to provide additional specificity and flexibility to the summary table for probe siting criteria by changing the ''>'' (greater than) symbols to ''≥'' (greater than or equal to) symbols in the summary table E–4 (88 FR 5676, January 27, 2023). Because one commenter pointed out to the EPA that in the prior version of the rule there was no table E–4, as a clerical matter, we have renumbered this summary table to table E–3 in the final rule. This proposed minor revision to the summary table more clearly expresses the EPA's intent that the distance offsets provided in the summary tables in appendix E are acceptable for NAAQS compliance monitoring.

The EPA received one comment supporting the proposal. The EPA received no adverse comments. Because

one commenter pointed out to the EPA that in the prior version of the rule there was no table E–4, as a clerical matter, we have renumbered this summary table to table E–3 in the final rule. Therefore, the EPA is updating the table numbering and otherwise finalizing the tables as proposed.

d. Spacing From Minor Sources

The EPA proposed to clarify and provide flexibility regarding siting monitors near minor sources by changing a requirement to a goal (88 FR 5676–77, January 27, 2023). To accomplish this, the EPA proposed to replace the ''must'' in the regulation with a ''should.'' While the EPA proposed to change this requirement to a goal, the EPA reiterated in the proposal that it recommends that sites with minor sources be avoided whenever practicable and probe inlets should be spaced as far from minor sources as possible when alternative monitoring stations are not suitable.

The EPA received one comment supporting the proposed revision and received no adverse comments. Therefore, the EPA is finalizing the language as proposed.

e. Spacing From Obstructions and Trees

The EPA proposed to clarify and redefine that the minimum arc required to be free of obstructions for a probe inlet or monitoring path is 270-degrees and that probe inlets must be no closer than 10-meters to the driplines of any trees (88 FR 5677, January 27, 2023). These changes were proposed because of inconsistencies introduced into the rule with the 2006 rulemaking. Both are discussed in more detail in the following sections.

The majority of comments received were supportive of these proposed siting amendments and clarifications. Two commenters were not supportive of this proposal. One adverse comment focused on the potential that site modifications would be required if the minimum arc required to be free of obstructions for a probe inlet is 270-degrees. The second adverse comment pertained to the proposal to clarify distance requirements from tree driplines. The commenter stated they would expect significant challenges in meeting the proposed 20-meter tree dripline distance. This comment is not a substantive negative comment because the 20-meter distance provided in the proposal is a goal and not a requirement. As such, monitoring organizations should not expect additional challenges in meeting the probe siting requirements. One supportive commenter on the 270-degree minimum arc proposal also requested that the EPA acknowledge that some cases exist where monitoring is desired or necessary to protect the public health, but siting criteria cannot be met.

Based on the only two negative comments received from monitoring agencies or organizations, one of which was not substantive, the EPA believes most sites already meet these proposed requirements related to the arc and distance from dripline. However, the EPA also acknowledges that there may be limited cases where this proposed revision may require site modifications, and some sites may not be able to be achieve the proposed siting requirements, even with modifications to the site. For cases where long-term trend sites or monitors that determine the design value for their area cannot reasonably meet these regulatory siting requirements, the EPA encourages monitoring organizations to work with their respective EPA Regional offices to determine if a waiver from this siting criteria would be appropriate under appendix E, section 10.

These siting requirements are discussed in more detail below in sections VII.B.5.f and VII.B.5.h.

f. Reinstating Minimum 270-Degree Arc and Clarified 180-Degree Arc

The EPA proposed to correct identified inconsistencies in the 270-degree requirement for unrestricted airflow to the probe inlet by reinstating the requirement stated in appendix E, paragraph 4(b), and to clarify that the continuous 180-degree minimum arc of unrestricted airflow provision is reserved for monitors sited on the side of a building or wall to comply with network design criteria requirements specified in appendix D of part 58 (88 FR 5677, January 27, 2023).

The EPA received two comments regarding this proposal, with one being supportive and one being negative. The adverse comment focused on the potential that site modifications would be required if this revision was made. The commenter supporting the proposal also requested that the EPA acknowledge that some cases exist where monitoring is desired or necessary to protect the public health, but siting criteria cannot be met. The EPA agrees with both commenters and acknowledges that there does exist limited cases where this proposal would require site modifications and some sites may not be able to be achieve the proposed siting requirement even with modifications to the site. For these cases, and especially when long-term trend sites or monitors that determine the design value for their area cannot reasonably meet these regulatory siting requirements, the EPA encourages monitoring organizations to work with their respective EPA Regional Offices to determine if a waiver from this siting criteria is appropriate through the provisions found in Section 10 of this appendix.

Based on the EPA only receiving a single negative comment regard the 270-degree and 180-degree provisions the EPA thinks most sites already meet these proposed requirements. Additionally, as stated above, the EPA is also retaining waiver provisions from these siting requirements for the remaining cases that can be exercised when appropriate. Therefore, the EPA is finalizing the language as proposed.

g. Obstacles That Act as Obstructions

The EPA proposed to clarify the definitions of ''obstructions'' and ''obstacles'' in the regulatory text (88 FR 5677, January 27, 2023). Stating that, ''[o]bstructions to the air flow of the probe inlet are those obstacles that are horizontally closer than twice the vertical distance the obstacle protrudes above the probe inlet and can be reasonably thought to scavenge reactive gases or to restrict the airflow for any pollutant,'' the EPA proposed to reiterate that the EPA does not generally consider objects or obstacles such as flag poles or site towers used for NO_y convertors and meteorological sensors, etc., to be deemed obstructions.

The EPA received one comment supporting the proposal and received no adverse comments. Therefore, the EPA is finalizing the definitions as proposed.

h. 10-Meter Tree Dripline Requirement

The EPA proposed to reconcile the conflicting requirements in 5(a) and the prior table E–4 footnote 3 by clarifying that the probe inlet must always be no closer than 10 meters to the tree dripline (88 FR 5677, January 27, 2023). The EPA also proposed to reinstate the goal ''that monitor probe inlets should be at least 20-meters from the driplines of trees,'' a goal that was inadvertently omitted during previous rule revisions. In addition, the EPA proposed to clarify that if a tree or group of trees is considered an ''obstruction,'' section 4(a) will apply.

As described above, the majority of comments received were supportive of the EPA proposed amendments and clarification, with two commenters focused on the possibility that monitoring agencies may not be able to meet the revised siting requirements. Specific to the proposed dripline requirement, the EPA reiterates that the

20-meter tree dripline offset is not a requirement, but rather a goal. Monitoring programs should as much as practicable attempt to meet this 20-meter tree dripline offset goal but are only required to be at least 10 meters removed from tree driplines. If these requirements cannot be met, the EPA encourages monitoring organizations to contact their respective EPA Regional offices to determine if a waiver from this siting criteria would be appropriate under appendix E, section 10.

Another commenter recommended that the proposal should also include an elevation specification. For instance, if a monitor is on the roof of a shelter, a tree below that roof should not be considered an obstruction no matter the distance to the dripline. The EPA considers this scenario to occur in practice only rarely. The EPA agrees that when the overall tree height is less than the height of the probe inlet, the tree is not obstructing the airflow to the probe inlet. However, a tree in such proximity to the probe inlet in many cases is not likely to remain at a height lower than the probe inlet. The EPA considers a scenario such as this to be best addressed in the waiver provisions of this appendix due both to the rarity of this occurring as well as the need for the EPA to periodically reassess whether tree growth has adversely impacted the site conditions.

For these reasons, the EPA is finalizing the language as proposed.

i. Spacing Requirement for Microscale Monitoring

The EPA proposed to require that microscale sites for any pollutant shall have no trees or shrubs blocking the line-of-sight fetch between the monitor's probe inlet and the source under investigation (88 FR 5677, January 27, 2023). This proposed revision would bring consistency between near-road monitoring stations and other microscale monitoring.

The EPA received one comment on this proposed requirement expressing concerns regarding its practicality and legality. The commenter stated agencies may at times want to site a monitor close to a source, but the closest location will have trees in the line of sight on private property. Additionally, in some cases, the trees may have been planted for the purpose of reducing off-property emissions from a source such as a Concentrated Animal Feeding Operation (CAFO). The commenter further stated that the proposal mandates that State agencies order the removal of trees from private property to collect valid data.

The EPA disagrees that the proposed requirement is impractical or unlawful. The proposed requirement would not require, mandate, or otherwise empower monitoring agencies to force the removal of trees on private property. The EPA agrees with the commenter that trees may at times be planted as part of control strategies to reduce offsite emissions and thus protect the public, but the EPA disagrees with the commenter that the trees must be removed to perform ambient air monitoring in these locations. Rather, if trees or shrubs block the line-of-sight fetch between the monitor's probe inlet and the source under investigation, it is the EPA's position that, for most cases, a microscale designation does not accurately reflect the monitoring scale for this location, and instead the EPA would recommend that the monitoring scale be designated to a more representative monitoring scale such as middle scale or neighborhood scale.

Moreover, for cases where long-term trend sites or monitors that determine the design value for an area cannot reasonably meet this regulatory siting requirement, the EPA encourages monitoring organizations to work with their respective EPA Regional offices to determine if a waiver from this siting criteria may be appropriate under appendix E, section 10.

For these reasons, the EPA is finalizing the language as proposed.

j. Waiver Provisions

The EPA proposed to maintain the appendix E, section 10 waiver provisions in the current regulation for siting criteria, but to modify section 10.3 to require that waivers from the probe-siting criteria must be reevaluated and renewed minimally every 5 years (88 FR 5677–78, January 27, 2023).

The EPA received one comment supporting the proposal and no adverse comments. Therefore, the EPA is finalizing the language as proposed.

k. Acceptable Probe Materials

The EPA proposed to expand the list of acceptable probe materials for sampling reactive gases in appendix E, section 9, from just borosilicate glass and fluorinated ethylene propylene (FEP) Teflon®, or their equivalents. The EPA proposed to add polyvinylidene fluoride (PVDF), also known as Kynar®, polytetrafluoroethylene (PTFE), and perfluoroalkoxy (PFA) to the list of approved materials for efficiently transporting gaseous criteria pollutants, and the use of Nafion™ upstream of ozone analyzers (88 FR 5678, January 27, 2023). Mention of trade names or commercial products does not constitute endorsement.

The EPA received two comments supporting the proposal and received no adverse comments. Therefore, the EPA is finalizing the language as proposed.

D. Incorporating Data From Next Generation Technologies

In the proposal, the EPA requested comment on how to incorporate data from next generation technologies into Agency efforts (88 FR 5678–80, January 27, 2023). The near real-time integration of data from $PM_{2.5}$ continuous monitors, sensors, and satellites has allowed the EPA to use data in certain informational applications such as EPA and USFS's Fire and Smoke Map.[199] This mapping product uses Application Program Interfaces (APIs) where data sets are automatically shared on prespecified computer servers. Given the success of the Fire and Smoke Map, the EPA indicated interest in exploring the use of next-generation technologies to develop additional approaches, products, and applications to help address important non-regulatory air quality data needs. Therefore, the EPA solicited comment on the most important data uses and data sets to consider in such future initiatives. Such approaches and/or products could utilize historical or near real-time data. The EPA sought this input and prioritization on use of next generation technologies to help improve the utility of data to better support air quality management to improve public health and the environment.

The EPA received comments from about two dozen entities on its request for comments on how to incorporate data from next generation technologies. The entities that provided comment included federal agencies; representatives of industry and industry groups; public health, medical, and environmental organizations; State, local and related multi-state organizations involved in air program management; Tribes and Tribal organizations involved in air program management; and other State and local governments.

While there were some differences across commenters, a majority of the commenters support use of next generation data for non-regulatory purposes, but not for regulatory decision making due to their inherent uncertainties and limitations. The EPA also received comments from some environmental organizations support using alternative data for regulatory decision making.

[199] Available at *https://fire.airnow.gov/*.

Many commenters pointed out that they are already successfully using sensor data and networks in supplemental and informational applications and support further expansion of these capabilities. Across many commenters, there was support for using next generation data as ''fit for purpose,'' filling in gaps, finding hot spots, identifying and addressing EJ concerns, and evaluating and informing network siting. The EPA acknowledges the successful examples of sensor data and networks for non-regulatory purposes. A few commenters support expanding the use of sensor data to provide real-time AQI; the EPA is interested in this use of next generation data as well. A few commenters pointed the need for the EPA to work closely with them and their communities to understand and use next generation data, while others expressed a desire for help developing best practices around collecting and using next generation data, developing products with data analysis/visualization, and developing appropriate QA/QC for sensor data. The EPA acknowledges each of these requests and expects to continue to work closely with SLTs and other stakeholders to understand and develop information on the collection and use of next generation data.

A few commenters offered more detailed comments. Some recommended that the EPA repropose implementation provisions related to next generation technologies with greater clarity to provide for meaningful comment. For example, the use of low-cost sensor and satellite data could be used in drawing nonattainment area boundaries or identifying sources for emissions control, but doing so would be such a significant change from prior EPA policy that it warrants a more specific proposal, beyond the scope of this request for comment. In response to this comment, the EPA notes it did not propose or change the use of non-regulatory measurement data as part of this proposal, but instead opened an opportunity to comment about the use of next generation technologies.

Another commenter stated that while low-cost sensor data can be invaluable for some purposes, the potentially overwhelming amount of data produced by sensors may present additional challenges to communities without the resources or expertise to analyze it. Cost is another concern associated with some next generation technologies of which some communities may not be aware, as the initial cost of the sensor alone is not indicative of the total cost of operation, which can include costs of internet access and servers. The EPA appreciates the need to consider all the costs of implementing and maintaining sensor data.

Another commenter stated that having a dense sensor network collocated with FRMs and FEMs could help ensure timely maintenance of the regulatory measurements in the event there appears to be a divergence of data. The EPA appreciates the comment that emphasizes how sensors could be used to complement the FRM and FEM data with regard to ensuring timely maintenance.

Another commentor strongly opposes incorporating sensor data into any EPA systems unless robust quality assurance (QA) practices are widely established and managed by qualified personnel. The EPA agrees that QA is necessary, and notes that the ''fit for purpose'' aspect of using sensor data will inform the appropriate QA associated with the intended use of such data.

In summary, the EPA invited comment on how we should consider incorporating data from next generation technologies into our air monitoring efforts. In seeking comment on this topic, the EPA did not propose to add, edit, or delete any regulatory language associated with the PM NAAQS. The EPA received comments from a variety of entities that largely support using next generation data for a variety of purposes that supplement, but cannot replace, the measurement data from monitoring methods required (*i.e.,* FRMs and FEMs) for regulatory decision making. Across many commenters, there was support for using next generation technologies and data as ''fit for purpose,'' filling in gaps, finding hot spots, identifying, and addressing EJ concerns, and evaluating and informing network siting. Quality assurance of the data will be an important component in the use of next generation technology data. The EPA will consider these comments as it continues its work with the co-regulated community comprised of SLT agencies and other stakeholders to understand and use next generation data and joint efforts to manage the nation's ambient air.

VIII. Clean Air Act Implementation Requirements for the Revised Primary Annual $PM_{2.5}$ NAAQS

The EPA's revision to the primary annual $PM_{2.5}$ NAAQS discussed in section II above triggers a number of implementation related activities that were described in the NPRM. The two most immediate implementation impacts following a final new or revised NAAQS are related to stationary source permitting and the initial area designations process. Permitting implications are discussed below in section VIII.E. With regard to initial area designations, the EPA is separately issuing a memorandum regarding the Initial Area Designations for the Revised Primary Annual Fine Particle National Ambient Air Quality Standard Memorandum (the ''Annual $PM_{2.5}$ NAAQS Designations Memorandum'') that will provide information about the statutory schedule for the designations process. For other implementation related implications, please refer back to the NPRM section VIII.

The NPRM also referred to the $PM_{2.5}$ State Implementation Plan (SIP) Requirements Rule (81 FR 58010, August 24, 2016), which specifies planning requirements for areas designated as nonattainment for purposes of the $PM_{2.5}$ NAAQS and includes a number of key recommendations for areas to consider implications of environmental justice through the attainment planning process, consistent with the identification of at-risk groups in the 2019 ISA and ISA Supplement and the statutory requirement to protect the health of at-risk groups. As stated in the NPRM, State and local air agencies are encouraged to consider how they might develop implementation plans that encourage early emission reductions.

A. Designation of Areas

As discussed in section II, with respect to the $PM_{2.5}$ NAAQS, the EPA is finalizing: (1) Revisions to the level of the primary annual $PM_{2.5}$ NAAQS and retaining the current primary 24-hour $PM_{2.5}$ NAAQS (section II.B.4); and (2) no change to the current secondary annual and 24-hour $PM_{2.5}$ NAAQS at this time (section V.B.4). Upon promulgation of a new or revised NAAQS, States and the EPA must initiate the process for initial designations.

The timeline for initial area designations begins with promulgation of the revised primary annual $PM_{2.5}$ NAAQS, as stated in the CAA section 107(d)(1)(B)(i). Through this process, which provides for input from States and others at various stages, the EPA identifies areas of the country that either meet or do not meet the revised primary annual $PM_{2.5}$ NAAQS, along with the nearby areas contributing to NAAQS violations. The following includes additional information regarding the designations process described in the CAA.

Section 107(d)(1) of the CAA states that, ''By such date as the Administrator may reasonably require, but not later than 1 year after promulgation of a new or revised national ambient air quality standard for any pollutant under section

109, the Governor of each State shall . . . submit to the Administrator a list of all areas (or portions thereof) in the State'' and make recommendations for whether the EPA should designate those areas as nonattainment, attainment, or unclassifiable.[200] The CAA provides the EPA with discretion to require States to submit their designations recommendations within a reasonable amount of time not exceeding one additional year.[201] Section 107(d)(1)(A) of the CAA also states that ''the Administrator may not require the Governor to submit the required list sooner than 120 days after promulgating a new or revised national ambient air quality standard.'' Section 107(d)(1)(B)(i) further provides, ''Upon promulgation or revision of a NAAQS, the Administrator shall promulgate the designations of all areas (or portions thereof) . . . as expeditiously as practicable, but in no case later than 2 years from the date of promulgation. Such period may be extended for up to one year in the event the Administrator has insufficient information to promulgate the designations.'' With respect to the NAAQS setting process, courts have interpreted the term ''promulgation'' to be signature and widespread dissemination of a final rule.[202]

If the EPA agrees with the designations recommendation of the State, then it may proceed to promulgate the designations for such areas. If, however, the EPA disagrees with the State's recommendation, then the EPA may elect to make modifications to the recommended designations. By no later than 120 days prior to promulgating the final designations, the EPA is required to notify States of any intended modifications to the State designation recommendations for any areas or portions thereof, including the boundaries of areas, as the EPA may deem necessary. States then have an opportunity to comment on the EPA's intended modification and tentative designation decision. If a State elects not to provide designation recommendations for any area, then the EPA must itself promulgate the designation that it deems appropriate.

While section 107(d) of the CAA specifically addresses the designations process for States, the EPA intends to follow the same process for Tribes to the extent practicable, pursuant to section 301(d) of the CAA regarding Tribal authority, and the Tribal Authority Rule (63 FR 7254, February 12, 1998). To provide clarity and consistency in doing so, the EPA issued a guidance memorandum to our Regional Offices on working with Tribes during the designations process.[203]

Consistent with the process used in previous area designations efforts, the EPA will evaluate each area on a case-by-case basis considering the specific facts and circumstances unique to the area to support area boundary decisions for the revised standard. The EPA intends to issue a designations memorandum which will provide information regarding the designations process. In broad overview, the EPA has historically used area-specific analyses to support nonattainment area boundary recommendations and final boundary determinations by evaluating factors such as air quality data, emissions and emissions-related data (*e.g.,* population density and degree of urbanization, traffic and commuting patterns), meteorology, geography/topography, and jurisdictional boundaries. We expect to follow a similar process when establishing area designations for this revised $PM_{2.5}$ NAAQS. CAA section 107(d) explicitly requires that the EPA designate as nonattainment not only the area that is violating the pertinent standard, but also those nearby areas that contribute to the violation in the violating area. In the $PM_{2.5}$ NAAQS Designations Memorandum, the EPA intends to include information regarding consideration of federal land boundaries that may be fully or partially included within the bounds of a county otherwise identified as nonattainment.

As with past revisions of the $PM_{2.5}$ NAAQS, the EPA intends to make the designations decisions for the revised primary annual $PM_{2.5}$ NAAQS based on the most recent three years of quality-assured, certified air quality data in the EPA's Air Quality System (AQS). Accordingly, the EPA recommends that States base their initial area designation recommendations on the most current available three years of complete and certified air quality data at the time of the recommendations. The EPA will then base the final designations on the most recent three consecutive years of complete, certified air quality monitoring data available at the time of final designations.[204]

Monitoring data are currently available from numerous existing $PM_{2.5}$ Federal Equivalent Methods (FEM) and Federal Reference Methods (FRM) sites to determine violations of the revised primary annual $PM_{2.5}$ NAAQS. As described in section VII.C.3.b, the EPA took comment on how to deal with cases where an FEM is approved by the EPA with an update and when it can be implemented in the field. The EPA took comment on how to approach the data produced during this lag and received input from over a dozen commenters. The commenters asked that the EPA be flexible in allowing the use of updated method correction factors intended to improve the data comparability between the FRMs and FEMs. The EPA will address any data correction issues between the FRMs and FEMs through a future Notice of Data Availability (NOA).

Consistent with past practice and as noted in the NPRM, the EPA intends to provide additional information concerning the designations process, including information about the schedule and recommendations for determining area boundaries in the forthcoming Annual $PM_{2.5}$ NAAQS Designations Memorandum. Other topics addressed in this memorandum include the schedule for preparing and submitting exceptional events initial notification and exceptional events demonstrations relevant to the designations process, and information related to wildfire and prescribed fire on wildlands as it pertains to initial area designations, as well as addressing back-correction of PM FEM data when a method has an approved factory calibration as part of a method update. The Annual $PM_{2.5}$ NAAQS Designations Memorandum is intended to assist States and Tribes in formulating their area recommendations.[205]

As discussed in the proposal, the ''Treatment of Data Influenced by Exceptional Events; Final Rule,'' (81 FR 68216, October 3, 2016) and codified at 40 CFR 50.1, 40 CFR 50.14, and 40 CFR 51.930, contains instructions and requirements for air agencies that may

[200] While the CAA says ''designating'' with respect to the Governor's letter, in the full context of the CAA section it is clear that the Governor actually makes a recommendation to which the EPA must respond via a specified process if the EPA does not accept it.

[201] In certain circumstances in which the Administrator has insufficient information to promulgate area designations within two years from the promulgation of the NAAQS, CAA section 107(d)(1)(B)(i) provides that the EPA may extend the designations schedule by up to one year.

[202] *API* v. *Costle,* 609 F.2d 20 (D.C. Cir. 1979).

[203] ''Guidance to Regions for Working with Tribes during the National Ambient Air Quality Standards (NAAQS) Designations Process,'' December 20, 2011, Memorandum from Stephen D. Page to Regional Air Directors, Regions 1–X available at *https://www.epa.gov/sites/default/files/2017-02/documents/12-20-11_guidance_to_regions_for_working_with_tribes_naaqs_designations.pdf.*

[204] In certain circumstances in which the Administrator has insufficient information to promulgate area designations within two years from the promulgation of a new or revised NAAQS, CAA section 107(d)(1)(B)(i) provides the EPA may extend the designations schedule by up to one year.

[205] See: *https://www.epa.gov/particle-pollution-designations.*

flag air quality data for certain days in the Air Quality System due to potential impacts from exceptional events (*i.e.,* such as prescribed fires on wildland, wildfires, or high wind dust storms). Accordingly, for purposes of initial area designations for a new or revised NAAQS, an air agency may submit to the EPA an exceptional events demonstration with supporting information and analyses for each monitoring site and day the air agency claims the EPA should exclude from design value calculations for designations purposes.

The EPA has provided tools to assist air agencies in preparing adequate exceptional events demonstrations.[206] Further, the EPA will continue to work with air agencies as they identify exceptional events that may influence decisions related to the initial area designations process, and to prepare and submit exceptional events demonstrations if appropriate. Importantly, air quality monitoring data may be influenced by emissions from prescribed fires on wildland and wildfires. The EPA's Exceptional Events Rule provides for both of these types of events to be considered as exceptional events, provided the affected air agencies submit exceptional events demonstrations that meet the procedural and technical requirements of the EPA's Exceptional Events Rule. To that end, the EPA has issued guidance addressing development of exceptional events demonstrations for both wildfire and prescribed fires on wildland.[207] In light of the growing frequency and severity of wildfire events, and expected increases in the application of prescribed fire as a means to achieve long-term reductions in high severity wildfire risk and associated smoke impacts, the EPA seeks to ensure that the Agency's exceptional events process provides an efficient and clear pathway for excluding data that may be affected by such events in a manner that is consistent with the Clean Air Act and the public health objectives of the NAAQS. Accordingly, the EPA is continuing to explore opportunities to develop additional tools that could assist air agencies in preparing exceptional events demonstrations for wildfires and prescribed fires on wildland. In addition, EPA intends to continue engaging with the U.S. Department of Agriculture, U.S. Department of the Interior, air agencies, and other stakeholders on these issues. For more information regarding the exceptional events demonstration submission deadlines for the area designations process, please see Table 2 to 40 CFR 50.14(c)(2)(vi)—''Schedule for Initial Notification and Demonstration Submission for Data Influenced by Exceptional Events for Use in Initial Area Designations.''

B. Section 110(a)(1) and (2) Infrastructure SIP Requirements

As discussed in the NPRM, the CAA directs States to address basic SIP requirements to implement, maintain, and enforce the NAAQS. Under CAA sections 110(a)(1) and (2), states are required to have State implementation plans that provide the necessary air quality management infrastructure that provides for the implementation, maintenance, and enforcement of the NAAQS. After the EPA promulgates a new or revised NAAQS, States are required to make a new SIP submission to establish that they meet the necessary structural requirements for such new or revised NAAQS or make changes to do so. The EPA refers to this type of SIP submission as an ''infrastructure SIP submission.'' Under CAA section 110(a)(1), all States are required to make these infrastructure SIP submissions within three years after the effective date of a new or revised primary standard. While the CAA authorizes the EPA to set a shorter time for States to make these SIP submissions, the EPA is requiring submission of infrastructure SIPs within three years of the effective date of this revised primary annual $PM_{2.5}$ NAAQS.

The EPA has provided general guidance to States concerning its interpretation of these requirements of CAA section 110(a)(1) and (2) in the context of infrastructure SIP submissions for a new or revised NAAQS.[208] The EPA encourages States to use this guidance when developing their infrastructure SIPs for this revised primary annual $PM_{2.5}$ NAAQS.

As a reminder, the EPA notes that States are not required to address nonattainment plan requirements for purposes of the revised primary annual $PM_{2.5}$ NAAQS on the same schedule as infrastructure SIP requirements. The EPA interprets the CAA such that two elements identified in section 110(a)(2) are not subject to the 3-year submission deadline of section 110(a)(1) and thus States are not required to address them in the context of an infrastructure SIP submission. The elements pertain to part D, in title I of the CAA, which addresses additional SIP requirements for nonattainment areas. Therefore, for the reasons explained below, the following section 110(a)(2) elements are considered by the EPA to be outside the scope of infrastructure SIP actions: (1) The portion of section 110(a)(2)(C), programs for enforcement of control measures and for construction or modification of stationary sources that applies to permit programs applicable in designated nonattainment areas (known as ''nonattainment new source review'') under part D; and (2) section 110(a)(2)(I), which requires a SIP submission pursuant to part D, in its entirety.

Accordingly, the EPA does not expect States to address the requirement for a new or revised NAAQS in the infrastructure SIP submissions to include regulations or emissions limits developed specifically for attaining the relevant standard in areas designated nonattainment for the revised primary annual $PM_{2.5}$ NAAQS. States are required to submit infrastructure SIP submissions for the revised primary annual $PM_{2.5}$ NAAQS before they will be required to submit nonattainment plan SIP submissions to demonstrate attainment with the same NAAQS. States are required to submit nonattainment plan SIP submissions to provide for attainment and maintenance of a revised primary annual $PM_{2.5}$ NAAQS within 18 months from the effective date of nonattainment area designations as required under CAA section 189(a)(2)(B). The EPA reviews and acts upon these later SIP submissions through a separate process. For this reason, the EPA does not expect States to address new nonattainment area emissions controls per section 110(a)(2)(I) in their infrastructure SIP submissions.

One of the required infrastructure SIP elements is that each State SIP must contain adequate provisions to prohibit, consistent with the provisions of title I of the CAA, emissions from within the State that will significantly contribute to nonattainment in, or interfere with maintenance by, any other State of the primary or secondary NAAQS.[209] This

[206] See the EPA's Exceptional Events homepage at *https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional.*

[207] See EPA's ''Final Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations and EPA's Exceptional Events Guidance: Prescribed Fire on Wildland that May Influence Ozone and Particulate Matter Concentrations,'' found on EPA's Exceptional Events homepage at *https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional.*

[208] *See* ''Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2)'' September 2013, Memorandum from Stephen D. Page to Regional Air Directors, Regions 1–10.

[209] CAA section 110(a)(2)(D)(i)(I).

element is often referred to as the ''good neighbor'' or ''interstate transport'' provision.[210] The provision has two prongs: significant contribution to nonattainment (prong 1), and interference with maintenance (prong 2). The EPA and States must give independent significance to prong 1 and prong 2 when evaluating downwind air quality problems under CAA section 110(a)(2)(D)(i)(I).[211] Further, case law has established that the EPA and States must implement requirements to meet interstate transport obligations in alignment with the applicable statutory attainment schedule of the downwind areas impacted by upwind-state emissions.[212] Thus, the EPA anticipates that States will need to address interstate transport obligations associated with this revised PM NAAQS, in alignment with the provisions of subpart 4 of part D of the CAA, as discussed in more detail in section VIII.C below. Specifically, States must implement any measures required to address interstate transport obligations as expeditiously as practicable and no later than the next statutory attainment date, *i.e.,* for this NAAQS revision as expeditiously as practicable, but no later than the end of the sixth calendar year following nonattainment area designations. *See* CAA section 188(c). States may find it efficient to make SIP submissions to address the interstate transport provisions separately from other infrastructure SIP elements.

Each State has the authority and responsibility to review its air quality management program's existing SIP provisions in light of a new or revised NAAQS to determine if any revisions are necessary to implement the new or revised NAAQS. Most States have revised and updated their SIPs in recent years to address requirements associated with other revised NAAQS. For certain infrastructure elements, some States may believe they already have adequate State regulations adopted and approved into the SIP to address a particular requirement with respect to the revised primary annual $PM_{2.5}$ NAAQS.

If a State determines that existing SIP-approved provisions are adequate in light of this revised primary annual $PM_{2.5}$ NAAQS with respect to a given infrastructure SIP element (or sub-element), then the State may make an infrastructure SIP submission ''certifying'' that the existing State's existing EPA approved SIP already contains provisions that address one or more specific section 110(a)(2) infrastructure elements.[213] In the case of such a submission, the State does not have to include a copy of the relevant provision (*e.g.,* rule or statute) itself. Rather, this certification submission should provide citations to the SIP-approved State statutes, regulations, or non-regulatory measures, as appropriate, in or referenced by the already EPA-approved SIP that meet particular infrastructure SIP element requirements. The State's infrastructure SIP submission should also include an explanation as to how the State has determined that those existing provisions meet the relevant requirements.

Like any other SIP submission, that State can make such an infrastructure SIP submission certifying that it has already met some or all of the applicable requirements only after it has provided reasonable notice and opportunity for public hearing. This ''reasonable notice and opportunity for public hearing'' requirement for infrastructure SIP submissions is to meet the requirements of CAA sections 110(a) and 110(l). Under the EPA's regulations at 40 CFR part 51, if a public hearing is held, an infrastructure SIP submission must include a certification by the State that the public hearing was held in accordance with the EPA's procedural requirements for public hearings. See 40 CFR part 51, appendix V, section 2.1(g), and see 40 CFR 51.102.

In consultation with the EPA's Regional office, a State should follow all applicable EPA regulations governing infrastructure SIP submissions in 40 CFR part 51—*e.g.,* subpart I (Review of New Sources and Modifications), subpart J (Ambient Air Quality Surveillance), subpart K (Source Surveillance), subpart L (Legal Authority), subpart M (Intergovernmental Consultation), subpart O (Miscellaneous Plan Content Requirements), subpart P (Protection of Visibility), and subpart Q (Reports). For the EPA's general criteria for infrastructure SIP submissions, refer to 40 CFR part 51, appendix V, Criteria for Determining the Completeness of Plan Submissions. For additional information on infrastructure SIP submission requirements, refer to the EPA's 2013 guidance entitled ''Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2).'' The EPA recommends that States electronically submit their infrastructure SIPs to the EPA through the State Plan Electronic Collaboration System (SPeCS),[214] an online system available through the EPA's Central Data Exchange.

C. Implementing Revised Primary Annual $PM_{2.5}$ NAAQS in Nonattainment Areas

As discussed in the NPRM, the EPA issued a SIP Requirements Rule for implementing the $PM_{2.5}$ NAAQS (81 FR 58010, August 24, 2016) ($PM_{2.5}$ SIP Requirements Rule). It provides guidance and establishes additional regulatory requirements for States regarding development of attainment plans for nonattainment areas for the 1997, 2006, and 2012 revisions of the $PM_{2.5}$ NAAQS. The guidance and regulations in the SIP Requirements Rule also apply to any States for which the EPA promulgates nonattainment area designations for the new revised primary annual $PM_{2.5}$ NAAQS.

The $PM_{2.5}$ SIP Requirements Rule provides comprehensive information regarding nonattainment plan requirements including, among other things: nonattainment area emissions inventories; policies regarding $PM_{2.5}$ precursor pollutants (*i.e.,* SO_2, NO_X, VOC, and ammonia); control strategies (such as reasonably available control measures and reasonably available control technology for direct $PM_{2.5}$ and relevant precursors); air quality modeling; attainment demonstrations; reasonable further progress requirements; quantitative milestones; and contingency measures. Information provided in the $PM_{2.5}$ SIP Requirements Rule is supplemented by other EPA documents, including guidance on emissions inventory development (80 FR 8787, February 19, 2015; U.S. EPA, 2017), optional $PM_{2.5}$ precursor demonstrations (U.S. EPA, 2019b),[215] and guidance on air quality modeling for meeting air quality goals for the ozone and $PM_{2.5}$ NAAQS and regional haze program (U.S. EPA, 2018b).

As stated in the NPRM, the $PM_{2.5}$ SIP Requirements Rule provides recommendations to States regarding consideration of environmental justice in the context of $PM_{2.5}$ attainment

[210] CAA section 110(a)(2)(D)(i)(II) also addresses certain interstate effects that states must address and thus is also sometimes referred to as relating to ''interstate transport.''

[211] *See North Carolina* v. *EPA,* 531 F.3d 896, 909–11 (D.C. Cir. 2008).

[212] *See id.* 911–13. *See also Wisconsin* v. *EPA,* 938 F.3d 303, 313–20 (D.C. Cir. 2019); *Maryland* v. *EPA,* 958 F.3d 1185, 1203–04 (D.C. Cir. 2020).

[213] A ''certification'' approach would not be appropriate for the interstate pollution control requirements of CAA section 110(a)(2)(D)(i).

[214] *https://cdx.epa.gov/.*

[215] Provides guidance on developing demonstrations under section 189(e) intended to show that a certain $PM_{2.5}$ precursor in a particular nonattainment area does not significantly contribute to $PM_{2.5}$ concentrations that exceed the standard.

planning. Some of the considerations for States include: (1) Identifying areas with overburdened communities where more ambient monitoring may be warranted; (2) targeting emissions reductions that may be needed to attain the $PM_{2.5}$ NAAQS; and (3) increasing opportunities for meaningful involvement for overburdened populations (*see* 88 FR 5558, 5684, January 27, 2023; 80 FR 58010, 58136, August 25, 2016). In light of the identification of at-risk populations for this reconsideration, the EPA encourages States to consider these and other factors as part of their attainment plan SIP development process.

The $PM_{2.5}$ SIP Requirements Rule outlines some examples of how States can elect to implement these recommendations.[216] For instance, States can use modeling and screening tools to better understand where sources of $PM_{2.5}$ or $PM_{2.5}$ precursor emissions are located and identify areas that may be candidates for additional ambient monitoring. Furthermore, once these target areas are identified, States can prioritize direct $PM_{2.5}$ or $PM_{2.5}$ precursor control measures and enforcement strategies in these areas to reduce ambient $PM_{2.5}$ and achieve the NAAQS. As articulated in the NPRM and the $PM_{2.5}$ SIP Requirements Rule, the EPA recognizes that States have flexibility under the CAA to concentrate State resources on controlling sources of $PM_{2.5}$ emissions in light of environmental justice considerations (*see* 88 FR 5558, 5684, January 27, 2023; 81 FR 58010, 58137, August 24, 2016). Moreover, States can establish opportunities to bolster meaningful involvement in a number of ways, such as communicating in appropriate languages, ensuring access to draft SIPs and other information, and developing enhanced notice-and-comment opportunities, as appropriate (*see* 88 FR 5558, 5684, January 27, 2023; 80 FR 58010, 58136, August 25, 2016).

As previously mentioned, the $PM_{2.5}$ SIP Requirements Rule provides guidance and regulatory requirements for remaining nonattainment areas for the 1997, 2006, and 2012 revisions of the $PM_{2.5}$ NAAQS, as well as for nonattainment areas designated pursuant to any future revisions of the $PM_{2.5}$ NAAQS, including the revised annual $PM_{2.5}$ NAAQS being finalized in this action. The EPA is not making any changes to the current $PM_{2.5}$ SIP Requirements Rule.

[216] For more information on the EPA's recommendations and examples, *see* 81 FR 58010, 58137, August 24, 2016.

D. Implementing the Primary and Secondary PM_{10} NAAQS

As summarized in sections III.B.4 and V.B.4 above, the EPA is retaining the current primary and secondary 24-hour PM_{10} NAAQS to protect against the health effects associated with short-term exposures to thoracic coarse particles and against the welfare effects considered in this reconsideration (*i.e.,* visibility, climate, and materials effects). The EPA is retaining the existing implementation strategy for meeting the CAA requirements for the PM_{10} NAAQS. States and emissions sources should continue to follow the existing regulations and guidance for implementing the current standards.[217]

E. Prevention of Significant Deterioration and Nonattainment New Source Review Programs for the Revised Primary Annual $PM_{2.5}$ NAAQS

The CAA, at parts C and D of title I, contains preconstruction review and permitting programs applicable to new major stationary sources and major modifications of existing major sources. The preconstruction review of each new major stationary source and major modification applies on a pollutant-specific basis, and the requirements that apply for each pollutant depend on whether the area in which the source is situated is designated as attainment (or unclassifiable) or nonattainment for that pollutant. In areas designated attainment or unclassifiable for a pollutant, the Prevention of Significant Deterioration (PSD) requirements under part C apply to construction at major sources. In areas designated nonattainment for a pollutant, the Nonattainment New Source Review (NNSR) requirements under part D apply to construction at major sources. Collectively, those two sets of permit requirements are commonly referred to as the ''major New Source Review'' or ''major NSR'' programs.

Until the EPA designates an area with respect to the revised primary annual $PM_{2.5}$ NAAQS, the NSR provisions applicable under an area's current designation for the 1997, 2006, and 2012 $PM_{2.5}$ NAAQS would continue to apply. *See* 40 CFR 51.166(i)(2) and 52.21(i)(2). That is, for areas designated as attainment/unclassifiable for the 1997, 2006, and 2012 $PM_{2.5}$ NAAQS, PSD will apply to new major stationary sources and major modifications that trigger major source permitting requirements for $PM_{2.5.}$ For areas designated nonattainment for the 1997, 2006, or 2012 $PM_{2.5}$ NAAQS, NNSR requirements will apply for new major stationary sources and major modifications that trigger major source permitting requirements for $PM_{2.5}$. When the initial area designations for this revised primary annual $PM_{2.5}$ NAAQS become effective, those designations will further determine whether PSD or NNSR applies to $PM_{2.5}$ in a particular area, depending on the designation status. New major sources and major modifications will be subject to the PSD program requirements for $PM_{2.5}$ if they are located in an area that does not have a current nonattainment designation under CAA section 107 for $PM_{2.5}$.[218]

Under the PSD program, the permit applicant must demonstrate that the new or modified source emissions increase does not cause or contribute to a NAAQS violation. In 2017, the EPA revised the *Guideline on Air Quality Models* (published as appendix W to 40 CFR part 51) to address primary and secondary $PM_{2.5}$ impacts in making this demonstration. The EPA has since provided associated technical guidance, models and tools, such as the recent ''Final Guidance for Ozone and Fine Particulate Matter Permit Modeling'' (July 29, 2022).[219] Additionally, in light of this NAAQS revision, the EPA is updating its guidance that provides recommended significant impact levels (SILs) for $PM_{2.5}$ and expects that an updated SIL for the revised primary annual $PM_{2.5}$ NAAQS will be available

[217] CAA Sections 110(a) and 172 contain general nonattainment planning provisions, regarding the public review, adoption, submittal, and content of implementation plans. CAA Section 189 specifies additional plan provisions for particulate matter nonattainment areas. General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990 provides a detailed discussion of the EPA's interpretation of the Title I requirements (57 FR 13498, April 16, 1992; 59 FR 41998, August 16, 1994).

[218] 40 CFR 51.166(i)(2) and 52.21(i)(2).

[219] On July 29, 2022, the EPA issued ''Final Guidance for Ozone and Fine Particulate Matter Permit Modeling,'' available at *https://www.epa.gov/system/files/documents/2022-07/Guidance_for_O3_PM25_Permit_Modeling.pdf.* This guidance provides the EPA's recommendations for how a stationary source seeking a PSD permit may demonstrate that it will not cause or contribute to a violation of the National Ambient Air Quality Standards for Ozone and $PM_{2.5}$ and PSD increments for $PM_{2.5}$, as required under section 165(a)(3) of the Clean Air Act and 40 CFR 51.166(k) and 52.21(k). The EPA has also previously issued two technical guidance documents for use in conducting these demonstrations: ''Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program,'' available at *https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-19-003.pdf,* and ''Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$,'' available at *https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-16-005.pdf.*

on or before the effective date of the final NAAQS.

The statutory requirements for a PSD permit program set forth under part C of title I of the CAA (sections 160 through 169) are addressed by the EPA's PSD regulations found at 40 CFR 51.166 (minimum requirements for an approvable PSD SIP) and 40 CFR 52.21 (PSD permitting program for permits issued under the EPA's Federal permitting authority). These regulations already apply to $PM_{2.5}$ in areas that are designated attainment or unclassifiable for $PM_{2.5}$ whenever a proposed new major source or major modification triggers PSD requirements for $PM_{2.5}$.

For PSD, a ''major stationary source'' is one with the potential to emit 250 tons per year (tpy) or more of any regulated NSR pollutant, unless the new or modified source is classified under a list of 28 source categories contained in the statutory definition of ''major emitting facility'' in section 169(1) of the CAA. For those 28 source categories, a ''major stationary source'' is one with the potential to emit 100 tpy or more of any regulated NSR pollutant. A ''major modification'' is a physical change or a change in the method of operation of an existing major stationary source that results, first, in a significant emissions increase of a regulated NSR pollutant and, second, in a significant net emissions increase of that pollutant. See 40 CFR 51.166(b)(2)(i), 40 CFR 52.21(b)(2)(i). The EPA PSD regulations define the term ''regulated NSR pollutant'' to include any pollutant for which a NAAQS has been promulgated and any pollutant identified by the EPA as a constituent or precursor to such pollutant. See 40 CFR 51.166(b)(49), 40 CFR 52.21(b)(50). These regulations identify SO_2 and NO_X as precursors to $PM_{2.5}$ in attainment and unclassifiable areas. See 40 CFR 51.166(b)(49)(i)(b), 40 CFR 52.21(b)(50)(i)(b).[220] Thus, for $PM_{2.5}$, the PSD program currently requires the review and control of emissions of direct $PM_{2.5}$ emissions and SO_2 and NO_X (as precursors to $PM_{2.5}$), absent a demonstration otherwise for NO_X. Among other things, for each regulated NSR pollutant emitted or increased in a significant amount, the PSD program requires a new major stationary source or a major modification to apply the ''best available control technology'' (BACT) to limit emissions and to conduct an air quality impact analysis to demonstrate that the proposed major stationary source or major modification will not cause or contribute to a violation of any NAAQS or PSD increment.[221] See CAA section 165(a)(3) and (4), 40 CFR 51.166(j) and (k), 40 CFR 52.21(j) and (k). The PSD requirements may also include, in appropriate cases, an analysis of potential adverse impacts on Class I areas. See CAA sections 162(a) and 165(d), 40 CFR 51.166(p); 40 CFR 52.21(p)).[222] The EPA developed the Guideline on Air Quality Models and other documents to, among other things, provide methods and guidance for demonstrating that increased emissions from construction will not cause or contribute to exceedances of the $PM_{2.5}$ NAAQS and PSD increments for $PM_{2.5}$.[223]

Upon the effective date of the revised primary annual $PM_{2.5}$ NAAQS, the demonstration required under CAA Section 165(a)(3), and the associated regulations, must include the revised primary annual $PM_{2.5}$ NAAQS. In past NAAQS revision rules, including the 2012 $PM_{2.5}$ NAAQS (78 FR 3086, January 15, 2013) and 2015 Ozone NAAQS (80 FR 65292, October 26, 2015), the EPA included limited provision that exempted certain sources with pending PSD permit applications (those that had reached a particular stage in the permitting process at the time the revised NAAQS was promulgated or became effective) from the requirement to demonstrate that the proposed emissions increases would not cause or contribute to a violation of the revised NAAQS.[224] In August 2019, the U.S. Court of Appeals for the D.C. Circuit vacated the exemption provision in the PSD rules for the 2015 Ozone NAAQS, finding that the provision contradicted ''Congress's 'express policy choice' not to allow construction which will 'cause or contribute to' nonattainment of 'any' effective NAAQS, regardless of when they are adopted or when a permit was completed.'' *Murray Energy Corp.* v. *EPA,* 936 F.3d 597, 627 (D.C. Cir. 2019).[225] Based on that court decision, the EPA is not establishing any PSD permitting exemption provision in this action. Some commenters requested that the EPA provide the same kind of relief for pending PSD permit applications by extending the effective date of this new revised NAAQS beyond the 60 days that the EPA has traditionally used for such rules. Such comments are addressed in the Response to Comments portion of this action. The EPA is making this revised primary annual $PM_{2.5}$ NAAQS effective in 60 days.

The EPA anticipates that the existing $PM_{2.5}$ air quality in some areas will not be in attainment with the revised primary annual $PM_{2.5}$ NAAQS, and the EPA will designate these areas as nonattainment at a later date, consistent with the designation process described in the preceding sections. However, until such nonattainment designation occurs, proposed new major sources and major modifications located in any area currently designated attainment or unclassifiable for all preexisting $PM_{2.5}$ NAAQS will continue to be subject to the PSD program requirements for $PM_{2.5}$. Any proposed major stationary source or major modification triggering PSD requirements for $PM_{2.5}$ that does not receive its PSD permit by the effective date of a new nonattainment designation for the area where the source would locate would then be required to satisfy applicable NNSR preconstruction permit requirements for $PM_{2.5}$.

In areas where air pollution exceeds the level of the revised primary annual $PM_{2.5}$ NAAQS, a PSD permit applicant must demonstrate that the source or modification will not cause or

[220] Sulfur dioxide is a precursor to $PM_{2.5}$ in all attainment and unclassifiable areas. NO_X is presumed to be a precursor to $PM_{2.5}$ in all attainment and unclassifiable areas, unless a state or the EPA demonstrates that emissions of NO_X from sources in a specific area are not a significant contributor to that area's ambient $PM_{2.5}$ concentrations. VOC is presumed not to be a precursor to $PM_{2.5}$ in any attainment or unclassifiable area, unless a state or the EPA demonstrates that emissions of VOC from sources in a specific area are a significant contributor to that area's ambient $PM_{2.5}$ concentrations.

[221] By establishing the maximum allowable level of ambient pollutant concentration increase in a particular area, an increment defines ''significant deterioration'' of air quality in that area. Increments are defined by the CAA as maximum allowable increases in ambient air concentrations above a baseline concentration and are specified in the PSD regulations by pollutant and area classification (Class I, II and III). 40 CFR 51.166(c), 40 CFR 52.21(c); 75 FR 64864 (October 20, 2010).

[222] Congress established certain Class I areas in section 162(a) of the CAA, including international parks, national wilderness areas, and national parks that meet certain criteria. Such Class I areas, known as mandatory Federal Class I areas, are afforded special protection under the CAA. In addition, States and Tribal governments may establish Class I areas within their own political jurisdictions to provide similar special air quality protection.

[223] *See* 40 CFR part 51, appendix W; 82 FR 5182 (January 17, 2017); *See also* U.S. EPA, 2021d. The EPA provided an initial version of the 2021 guidance for public comment on February 10, 2020. Upon consideration of the comments received, and consistent with Executive Order 13990, the EPA revised the initial draft guidance and posted the revised version for additional public comment.

[224] This exemption was referred to as ''grandfathering'' in the 2015 Ozone NAAQS and the D.C. Circuit's *Murray Energy Corp.* decision on that exemption. *See* 80 FR 65292, 65431 (October 26, 2015); *Murray Energy Corp.* v. *EPA,* 936 F.3d 597, 627 (D.C. Cir. 2019). The EPA refers to this ''grandfathering'' provision in this action as an exemption provision.

[225] While the specifics of this case involved the 2015 ozone NAAQS, the case was based upon an interpretation of CAA section 165(a) and therefore applies equally to any PSD permitting exemption provision for a new or revised NAAQS.

contribute to a violation of the NAAQS. Section 165(a)(3)(B) of the CAA states that a proposed source may not construct unless it demonstrates that it will not cause or contribute to a violation of any NAAQS. This statutory requirement is implemented through a provision contained in the PSD regulations at 40 CFR 51.166(k) and 52.21(k).[226] If a source cannot make this demonstration, or if its initial air quality impact analysis shows that the source's impact would cause or contribute to a violation, the reviewing authority may not issue a PSD permit to that source. However, a PSD permit applicant may be able to make this demonstration if it compensates for the adverse impact that would otherwise cause or contribute to a violation of the NAAQS. In contrast to the NSR requirements for nonattainment areas, the PSD regulations do not explicitly specify remedial actions that a prospective source must take to address such a situation, but the EPA has historically recognized that sources applying for PSD permits may utilize offsetting reductions in emissions as part of the required PSD demonstration under CAA section 165(a)(3)(B).[227]

Part D of title I of the CAA includes preconstruction review and permitting requirements applicable to new major stationary sources and major modifications located in areas designated nonattainment for a pollutant for which the EPA has established a NAAQS (*i.e.,* a criteria pollutant). The relevant part D requirements are typically referred to as the nonattainment NSR (NNSR) program. The EPA's regulations for the NNSR program are contained in 40 CFR 51.165 and 52.24 and part 51, appendix S. Specifically, the EPA has developed minimum program requirements for a NNSR program that is approvable in a SIP, and those requirements, which include requirements for $PM_{2.5}$, are contained in 40 CFR 51.165. In addition, 40 CFR part 51, appendix S, contains requirements constituting an interim NNSR program. This interim program enables NNSR permitting in nonattainment areas by States that lack a SIP-approved NNSR permitting program during the time between the date of the relevant designation and the date that the EPA approves into the SIP a NNSR program. *See* 40 CFR part 51, appendix S, section I; 40 CFR 52.24(k).

For NNSR, ''major stationary source'' is generally defined as a source with the potential to emit at least 100 tpy of the regulated NSR pollutant for which the area is designated nonattainment. In some cases, however, the CAA and the NNSR regulations define ''major stationary source'' for NNSR in terms of a lower rate dependent on the pollutant and degree of nonattainment in the area. For purposes of the $PM_{2.5}$NAAQS, in addition to the general threshold level of 100 tpy in Moderate $PM_{2.5}$ nonattainment areas, a lower major source threshold of 70 tpy applies in Serious $PM_{2.5}$ nonattainment areas pursuant to subpart 4 of part D, title I of the CAA. *See* 40 CFR 51.165(a)(1)(iv)(A)(*1*)(*vii*) and (*viii*); 40 CFR part 51, appendix S, II.A.4(i)(a)(7) and (8).

Under the NNSR program, direct $PM_{2.5}$ emissions and emissions of each $PM_{2.5}$ precursor are considered separately in accordance with the applicable major source threshold. For example, the threshold for Serious $PM_{2.5}$ nonattainment areas is 70 tpy of direct $PM_{2.5}$, as well as for the $PM_{2.5}$ precursors SO_2, NO_X, VOC, and ammonia.[228] See 40 CFR 51.165(a)(1)(iv)(A)(*1*)(*vii*) and (*viii*); 40 CFR part 51, appendix S, II.A.4.(i)(a)(7) and (8). A source qualifies as major for nonattainment NSR in a $PM_{2.5}$ nonattainment area if it emits or has the potential to emit direct $PM_{2.5}$ or any $PM_{2.5}$ precursor in an amount equal to or greater than the applicable threshold.

For modifications, NNSR applies to proposed physical changes or changes in the method of operation of an existing stationary source where (1) the source is major for the nonattainment pollutant (or a precursor for that pollutant) and (2) the physical change or change in the method of operation of a major stationary source results, first, in a significant emissions increase of a regulated NSR pollutant and, second, in a significant net emissions increase of that same nonattainment pollutant (or same precursor for that pollutant). *See* 40 CFR 51.165(a)(1)(v)(A); 40 CFR part 51, appendix S, II.A.5.(i). For example, to qualify as a major modification for SO_2 (as a $PM_{2.5}$ precursor) in a Moderate $PM_{2.5}$ nonattainment area, the existing source would have to have the potential to emit 100 tpy or more of SO_2, and the project would have to result in an increase in SO_2 emissions of 40 tpy or more. See 40 CFR 51.165(a)(1)(x)(A).

New major stationary sources and major modifications for $PM_{2.5}$ subject to NNSR must comply with the ''lowest achievable emission rate'' (LAER), as defined in the CAA and NNSR rules. Such sources must also perform other analyses and obtain emission offsets, as required under section 173 of the CAA and applicable regulations.

Following the promulgation of this revised primary annual $PM_{2.5}$ NAAQS, some new areas may be designated nonattainment for $PM_{2.5}$. Where a State does not have an existing NNSR program or where the current NNSR program does not apply to $PM_{2.5}$, that State will be required to submit the necessary SIP revisions to ensure that new major stationary sources and major modifications for $PM_{2.5}$ or a $PM_{2.5}$ precursor undergo preconstruction review pursuant to the NNSR program. States with designated nonattainment areas for the revised primary annual $PM_{2.5}$ NAAQS are required to make SIP submissions to meet nonattainment plan requirements within 18 months from the effective date of designations, as required under CAA section 189(a)(2)(B). States that have existing NNSR program requirements that cannot be interpreted to apply at the time of designation to the revised primary annual $PM_{2.5}$ NAAQS may, in the interim, issue permits in accordance with the applicable nonattainment permitting requirements contained in 40 CFR part 51, appendix S, which would apply to the revised primary annual $PM_{2.5}$ NAAQS upon its effective date. *See* 73 FR 28321, 28340, May 16, 2008.

Finally, the EPA has released several documents that discuss air permitting

[226] 40 CFR 51.166(k) states that SIPs must require that the owner or operator of the proposed source or modification demonstrate that allowable emission increases from the proposed source or modification, in conjunction with all other applicable emissions increases or reductions (including secondary emissions), would not cause or contribute to air pollution in violation of: (i) Any national ambient air quality standard in any air quality control region; or (ii) any applicable maximum allowable increase over the baseline concentration in any area.

[227] *See, e.g.,* Memorandum from Stephen D. Page, Director, Office of Air Quality Planning and Standards to Regional Air Division Directors, Guidance Concerning Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program. August 23, 2010. Office of Air Quality Planning and Standards U.S. EPA, Research Triangle Park. Available at: *https://www.epa.gov/sites/default/files/2015-07/documents/appwso2.pdf;* 44 FR 3274, 3278, January 16, 1979; See also *In re Interpower of New York, Inc.,* 5 E.A.D. 130, 141 (EAB 1994) (describing an EPA Region 2 PSD permit that relied in part on offsets to demonstrate the source would not cause or contribute to a violation of the NAAQS). 52 FR 24634, 24684, July 1, 1987; 78 FR 3085, 3261–62, January 15, 2013. The EPA has recognized the ability of sources to obtain offsets in the context of PSD though the PSD provisions of the Act do not expressly reference offsets as the NNSR provisions of the Act do. *See* 80 FR 65292, 65441, October 26, 2015.

[228] All of these pollutants are identified as precursors to $PM_{2.5}$ in NNSR regulations. *See* 40 CFR 51.165(a)(1)(xxxvii)(C)(*2*). No significant emission rate is established by the EPA for ammonia, and states are required to define ''significant'' for ammonia for their respective areas unless the state pursues the optional precursor demonstration to exclude ammonia from planning requirements. *See* 40 CFR 51.165(a)(1)(x)(F); 40 CFR 51.165(a)(13).

and environmental justice, including, for example, a memorandum [229] and attached permitting principles.[230] The EPA recommends that PSD and NNSR permitting authorities review this memorandum and the principles and consider applying them in their air permitting actions as appropriate to help identify, analyze, and address environmental justice concerns in those air permitting actions to help ensure that the NAAQS achieve their intended health benefits for at-risk populations.

F. Transportation Conformity Program

Transportation conformity is required under CAA section 176(c) to ensure that transportation plans, transportation improvement programs (TIPs) and federally supported highway and transit projects will not cause or contribute to any new air quality violation, increase the frequency or severity of any existing violation, or delay timely attainment or any required interim emissions reductions or other milestones. Transportation conformity applies to areas that are designated as nonattainment or nonattainment areas that have been redesignated to attainment with an approved CAA section 175A maintenance plan (*i.e.,* maintenance areas) for transportation-related criteria pollutants: carbon monoxide, ozone, NO_2, $PM_{2.5}$, and PM_{10}. Transportation conformity for the revised primary annual $PM_{2.5}$ NAAQS does not apply until one year after the effective date of nonattainment designations for that NAAQS. *See* CAA section 176(c)(6) and 40 CFR 93.102(d)). The EPA's Transportation Conformity Rule [231] establishes the criteria and procedures for determining whether transportation activities conform to the SIP. No changes are being made to the transportation conformity rule in this final rulemaking. The EPA notes that the transportation conformity rule already addresses the $PM_{2.5}$ and PM_{10} NAAQS. However, in the future, the EPA intends to review the need to issue or revise guidance describing how the current conformity rule applies in nonattainment and maintenance areas for the revised primary annual $PM_{2.5}$ NAAQS, as needed.

G. General Conformity Program

The conformity requirement under CAA section 176(c) ensures that federal activities implemented by federal agencies will not interfere with a State's ability to attain and maintain the NAAQS. Under CAA 176(c)(1), the requirement prohibits Federal agencies from approving, permitting, licensing, or funding activities that do not conform to the purpose of the applicable SIP for the control and prevention of air pollution. *See* CAA 176(c)(1)(A). Under CAA 176(c)(1)(B), conformity to an implementation plan means that federal activities will not cause or contribute to any new violations of the NAAQS, increase the frequency or severity of any existing NAAQS violation, or delay timely attainment or any required interim emissions reductions or other milestones contained in the applicable SIP.

The general conformity program [232] implements CAA section 176(c)(4)(A), and the criteria and procedures for determining conformity of federal activities to the applicable SIP are established under 40 CFR part 93 subpart B, sections 93.150 through 93.165. General Conformity applies to federal activities that (1) would cause emissions of relevant criteria or precursor pollutants to originate within nonattainment areas or areas that have been redesignated to attainment with an approved CAA section 175A maintenance plan (*i.e.,* maintenance areas), as set forth under 40 CFR 93.153, and (2) are not Federal Highway Administration (FHWA) or Federal Transit Administration (FTA) transportation projects as defined in 40 CFR 93.101 under the transportation conformity requirements. *See* 40 CFR 93.153. General conformity for the revised primary annual $PM_{2.5}$ NAAQS does not apply until one year after the effective date of the nonattainment designation for that NAAQS. *See* 40 CFR 93.153(k).

With regard to issues regarding prescribed fires, which were addressed earlier in this action, here is some additional information regarding prescribed fires and General Conformity regulations. Under the General Conformity regulations at 40 CFR 93.153(c)(4), a conformity evaluation is not required to support a decision by a federal agency to conduct or carry out prescribed burning when the burn is consistent with the terms of a land management plan or other plan that includes the prescribed burn at issue, where the overall plan that includes the burn was previously evaluated under 40 CFR part 93 subpart B by the responsible federal agency, and the agency found the plan conforms under CAA paragraphs 176(c)(1)(A) and (1)(B). This assumes the burn at issue will be conducted by meeting any conditions specified as necessary for meeting conformity in the agency's decision to approve the plan. Alternatively, a presumption of conformity applies also under 40 CFR 93.153(i)(2) for prescribed fires conducted in accordance with a Smoke Management Program that meets the requirements of the EPA's 1998 Interim Air Quality Policy on Wildland and Prescribed Fires or an equivalent replacement EPA policy. The preamble to the Exceptional Events Rule explains that the EPA adapted language associated with the six basic components of a certifiable Smoke Management Program for exceptional events purposes from the 1998 Interim Air Quality Policy on Wildland and Prescribed Fires (*see, e.g.,* 81 FR 68216, 68252 (including footnote 75), 68256, October 2, 2016). The Exceptional Events Rule at 40 CFR 50.14(a)(3)(ii)(A) also indicates that certain requirements within the Exceptional Events Rule can be satisfied if a prescribed fire is conducted under a certified Smoke Management Program or using appropriate basic smoke management practices such as those identified in Table 1 to 40 CFR 50.14 (*see e.g.,* 81 FR 68216, 68250–68257, 68277–68278, October 3, 2016).

No changes are being made to the general conformity regulations in this final rulemaking and the EPA notes that the courts recognize the regulations constitute control for the established $PM_{2.5}$ and PM_{10} NAAQS. However, in the future, the EPA intends to review the need to issue or revise guidance describing how the current General Conformity regulations apply within nonattainment and maintenance areas for the revised primary annual $PM_{2.5}$ NAAQS, as needed.[233]

IX. Statutory and Executive Order Reviews

Additional information about these statutes and Executive orders can be

[229] Memorandum from Joseph Goffman, Principal Deputy Assistant Administrator, Office of Air and Radiation, to Air and Radiation Division Directors, ''Principles for Addressing Environmental Justice in Air Permitting'' (December 22, 2022), available at *https://www.epa.gov/caa-permitting/ej-air-permitting-principles-addressing-environmental-justice-concerns-air.*

[230] *Id.,* Attachment, ''EJ in Air Permitting: Principles for Addressing Environmental Justice Concerns in Air Permitting'' (December 2022), available at *https://www.epa.gov/caa-permitting/ej-air-permitting-principles-addressing-environmental-justice-concerns-air.*

[231] 40 CFR part 93, subpart A.

[232] 40 CFR part 93 subpart B.

[233] Further, the EPA's current Unified Agenda and Regulatory Plan includes its intention to issue a proposed rule to amend the General Conformity Regulations. The EPA intends to address in that regulatory action topics regarding prescribed fire, including consideration of smoke management approaches such as those discussed in the Exceptional Events Rule, among other topics. See, *e.g., https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202310&RIN=2060-AV28.*

found at *https://www.epa.gov/laws-regulations/laws-and-executive-orders.*

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 14094: Modernizing Regulatory Review

This action is ''significant regulatory action'' as defined under section 3(f)(1) of Executive Order 12866, as amended by Executive Order 14094. Accordingly, the EPA submitted this action to the Office of Management and Budget (OMB) for review. Documentation of any changes made in response to the Executive Order 12866 review is available in the docket. The EPA prepared an illustrative analysis of the potential costs and benefits associated with this action. This analysis, ''Regulatory Impact Analysis for the Reconsideration of the National Ambient Air Quality Standards for Particulate Matter,'' is available in the Regulatory Impact Analysis (RIA) docket (EPA–HQ–OAR–2019–0587) and briefly summarized below. However, the CAA and judicial decisions make clear that the economic and technical feasibility of attaining ambient standards are not to be considered in setting or revising NAAQS, although such factors may be considered in the development of State plans to implement the standards. Accordingly, although an RIA has been prepared, the results of the RIA have not been considered in issuing this final rule.

The RIA estimates the costs and monetized human health benefits in 2032, after implementing existing and expected regulations and assessing emissions reductions to meet the current primary annual and 24-hour particulate matter NAAQS (12/35 μg/m^3), associated with applying national control strategies for the revised annual and 24-hour standard levels of 9/35 μg/m^3, as well as the following less and more stringent alternative standard levels: (1) A less stringent alternative annual standard level of 10 μg/m^3 in combination with the current 24-hour standard (*i.e.,* 10/35 μg/m^3), (2) a more stringent alternative annual standard level of 8 μg/m^3 in combination with the current 24-hour standard (*i.e.,* 8/35 μg/m^3), and (3) a more stringent alternative 24-hour standard level of 30 μg/m^3 in combination with an annual standard level of 10 μg/m^3 (*i.e.,* 10/30 μg/m^3). Table 3 provides a summary of the estimated monetized benefits, costs, and net benefits associated with applying national control strategies toward reaching the revised and alternative standard levels.

TABLE 3—ESTIMATED MONETIZED BENEFITS, COSTS, AND NET BENEFITS OF THE ILLUSTRATIVE CONTROL STRATEGIES APPLIED TOWARD THE PRIMARY REVISED AND ALTERNATIVE ANNUAL AND DAILY STANDARD LEVELS OF 10/35 μg/m^3, 10/30 μg/m^3, 9/35 μg/m^3, AND 8/35 μg/m^3 IN 2032 FOR THE U.S.

[Millions of 2017$]

	10/35	10/30	9/35	8/35
Benefits[a]	$8,500 and $17,000	$10,000 and $21,000	$22,000 and $46,000	$48,000 and $99,000.
Costs[b]	$200	$340	$590	$1,500.
Net Benefits	$8,300 and $17,000	$9,900 and $21,000	$22,000 and $46,000	$46,000 and $97,000.

Notes: Rows may not appear to add correctly due to rounding. We provide a snapshot of costs and benefits in 2032, using the best available information to approximate social costs and social benefits recognizing uncertainties and limitations in those estimates. The estimated costs and monetized human health benefits associated with applying national control strategies do not fully account for all the emissions reductions needed to reach the final and more stringent alternative standard levels for some standard levels analyzed.

[a] We assume that there is a cessation lag between the change in PM exposures and the total realization of changes in mortality effects. Specifically, we assume that some of the incidences of premature mortality related to $PM_{2.5}$ exposures occur in a distributed fashion over the 20 years following exposure, which affects the valuation of mortality benefits at different discount rates. Similarly, we assume there is a cessation lag between the change in PM exposures and both the development and diagnosis of lung cancer. The benefits are associated with two point estimates from two different epidemiologic studies, and we present the benefits calculated at a real discount rate of 3 percent. The monetized benefits exclude additional health and welfare benefits that could not be quantified.

[b] The costs are annualized using a 7 percent interest rate.

B. Paperwork Reduction Act (PRA)

This action does not impose any new information collection burden under the PRA. OMB has previously approved the information collection activities contained in the existing regulations and has assigned OMB control number 2060–0084. The data collected through this information collection consist of ambient air concentration measurements for the seven air pollutants with national ambient air quality standards (*i.e.,* ozone, sulfur dioxide, nitrogen dioxide, lead, carbon monoxide, $PM_{2.5}$ and PM_{10}), ozone precursors, air toxics, meteorological variables at a select number of sites, and other supporting measurements. Accompanying the pollutant concentration data are quality assurance/quality control data and air monitoring network design information. The EPA and others (*e.g.,* State and local air quality management agencies, tribal entities, environmental organizations, academic institutions, industrial groups) use the ambient air quality data for many purposes including informing the public and other interested parties of an area's air quality, judging an area's air quality in comparison with the established health or welfare standards, evaluating an air quality management agency's progress in achieving or maintaining air pollutant levels below the national and local standards, developing and revising State Implementation Plans (SIPs), evaluating air pollutant control strategies, developing or revising national control policies, providing data for air quality model development and validation, supporting enforcement actions, documenting episodes and initiating episode controls, assessing air quality trends, and conducting air pollution research.

C. Regulatory Flexibility Act (RFA)

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. This action will not impose any requirements on small entities. Rather, this final rule establishes national standards for allowable concentrations of PM in ambient air as required by section 109 of the CAA. See also *American Trucking Associations* v. *EPA,* 175 F.3d 1027, 1044–45 (D.C. Cir. 1999) (NAAQS do not have significant impacts upon small entities because NAAQS themselves impose no regulations upon small entities), rev'd in part on other grounds, *Whitman* v. *American Trucking Associations,* 531 U.S. 457 (2001).

D. Unfunded Mandates Reform Act (UMRA)

This action does not contain an unfunded mandate of $100 million or more as described in the Unfunded Mandates Reform Act (UMRA), 2 U.S.C. 1531–1538, and does not significantly or uniquely affect small governments. Furthermore, as indicated previously, in setting a NAAQS the EPA cannot consider the economic or technological feasibility of attaining ambient air quality standards, although such factors may be considered to a degree in the development of State plans to implement the standards. See also *American Trucking Associations* v. *EPA,* 175 F. 3d at 1043 (noting that because the EPA is precluded from considering costs of implementation in establishing NAAQS, preparation of the RIA pursuant to the Unfunded Mandates Reform Act would not furnish any information that the court could consider in reviewing the NAAQS).

E. Executive Order 13132: Federalism

This action will not have substantial direct effects on the States, on the relationship between the National Government and the States, or on the distribution of power and responsibilities among the various levels of government. However, the EPA recognizes that States will have a substantial interest in this action and any future revisions to associated requirements.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have Tribal implications, as specified in Executive Order 13175. It does not have a substantial direct effect on one or more Indian Tribes as Tribes are not obligated to adopt or implement any NAAQS. In addition, Tribes are not obligated to conduct ambient monitoring for PM or to adopt the ambient monitoring requirements of 40 CFR part 58. Thus, Executive Order 13175 does not apply to this action. However, consistent with the *EPA Policy on Consultation and Coordination with Indian Tribes,* the EPA offered consultation to all 574 Federally Recognized Tribes during the development of this action. Although no Tribes requested consultation, the EPA provided informational meetings including an informational meeting with the Pueblo de San Ildefonso and provided information on the monthly National Tribal Air Association calls.

G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

Executive Order 13045 directs federal agencies to include an evaluation of the health and safety effects of the planned regulation on children in federal health and safety standards and explain why the regulation is preferable to potentially effective and reasonably feasible alternatives. This action is subject to Executive Order 13045 because it is a significant regulatory action under section 3(f)(1) of Executive Order 12866, and the EPA believes that the environmental health or safety risk addressed by this action may have a disproportionate effect on children. Accordingly, we have evaluated the environmental health or safety effects of PM exposures on children. The protection offered by these standards may be especially important for children because childhood represents a lifestage associated with increased susceptibility to PM-related health effects. Because children have been identified as a susceptible population, we have carefully evaluated the environmental health effects of exposure to PM pollution among children. Children make up a substantial fraction of the U.S. population, and often have unique factors that contribute to their increased risk of experiencing a health effect due to exposures to ambient air pollutants because of their continuous growth and development. As described in the 2019 Integrated Science Assessment, children may be particularly at risk for health effects related to ambient air $PM_{2.5}$ exposures compared with adults because they have (1) a developing respiratory system, (2) increased ventilation rates relative to body mass compared with adults, and (3) an increased proportion of oral breathing, particularly in boys, relative to adults. More detailed information on the evaluation of the scientific evidence and policy considerations pertaining to children, including an explanation for why the Administrator judges the revised standards to be requisite to protect public health, including the health of children, with an adequate margin of safety, are contained in section II.A.2. ''Overview of the Health Effects Evidence'', section II.A.2.b ''Public Health Implications and At-Risk Populations'' and II.B ''Conclusions on the Primary $PM_{2.5}$ Standards'' of this preamble. Copies of all documents have been placed in the public docket for this action. The Administrator judges that revising the primary annual $PM_{2.5}$ standard to a level of 9.0 $\mu g/m^3$ and retaining the primary 24-hour $PM_{2.5}$ standard provides requisite public health protection with an adequate margin of safety, including for children. Furthermore, the Policy on Children's Health also applies to this action. Information on how the Policy was applied is described in section II.A.2 ''Overview of the Health Effects Evidence'', section II.A.2.b ''Public Health Implications and At-Risk Populations'' and II.B ''Conclusions on the Primary $PM_{2.5}$ Standards'' of this preamble.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution or Use

This action is not a ''significant energy action'' because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. The purpose of this action is to revise level of the primary annual $PM_{2.5}$ NAAQS. The action does not prescribe specific pollution control strategies by which these ambient standards and monitoring revisions will be met. Such strategies will be developed by States on a case-by-case basis, and the EPA cannot predict whether the control options selected by States will include regulations on energy suppliers, distributors, or users. Thus, the EPA concludes that this action does not constitute a significant energy action as defined in Executive Order 13211.

I. National Technology Transfer and Advancement Act (NTTAA)

This rulemaking involved environmental monitoring or measurement. The EPA has decided it will continue to use the existing indicators for fine ($PM_{2.5}$) and coarse (PM_{10}) particles. The indicator for fine particles is measured using the Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere (appendix L to 40 CFR part 50), which is known as the $PM_{2.5}$ FRM, and the indicator for coarse particles is measured using the Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere (appendix J to 40 CFR part 50), which is known as the PM_{10} FRM.

To the extent feasible, the EPA employs a Performance-Based Measurement System (PBMS), which does not require the use of specific, prescribed analytic methods. The PBMS is defined as a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner.

It is intended to be more flexible and cost effective for the regulated community; it is also intended to encourage innovation in analytical technology and improved data quality. Though the FRM defines the particular specifications for ambient monitors, there is some variability with regard to how monitors measure PM, depending on the type and size of PM and environmental conditions. Therefore, it is not practically possible to fully define the FRM in performance terms to account for this variability. Nevertheless, our approach in the past has resulted in multiple brands of monitors being approved as FRM for PM, and we expect this to continue. Also, the FRMs described in 40 CFR part 50 and the equivalency criteria described in 40 CFR part 53, constitute a performance-based measurement system for PM, since methods that meet the field testing and performance criteria can be approved as FEMs. Since finalized in 2006 (71 FR 61236, October 17, 2006) the new field and performance criteria for approval of $PM_{2.5}$ continuous FEMs has resulted in the approval of 13 approved FEMs. In summary, for measurement of $PM_{2.5}$ and PM_{10}, the EPA relies on both FRMs and FEMs, with FEMs relying on a PBMS approach for their approval. The EPA is not precluding the use of any other method, whether it constitutes a voluntary consensus standard or not, as long as it meets the specified performance criteria.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations and Executive Order 14096: Revitalizing Our Nation's Commitment to Environmental Justice for All

The EPA believes that the human health or environmental conditions associated with the primary $PM_{2.5}$ NAAQS that exist prior to this action result in or have the potential to result in disproportionate and adverse human health or environmental effects on communities with environmental justice concerns. There is strong evidence for racial and ethnic disparities in $PM_{2.5}$ exposures and $PM_{2.5}$-related health risk, as assessed in the 2019 Integrated Science Assessment and with even more evidence available since the literature cutoff date for the 2019 Integrated Science Assessment and evaluated in the Supplement to the 2019 Integrated Science Assessment. There is strong evidence demonstrating that Black and Hispanic populations, in particular, have higher $PM_{2.5}$ exposures than non-Hispanic White populations. Black populations or individuals that live in predominantly Black neighborhoods experience higher $PM_{2.5}$ exposures, in comparison to non-Hispanic White populations. There is also consistent evidence across multiple studies that demonstrate increased risk of $PM_{2.5}$-related health effects, with the strongest evidence for health risk disparities for mortality. There is also evidence of health risk disparities for both Hispanic and non-Hispanic Black populations compared to non-Hispanic White populations for cause-specific mortality and incident hypertension.

Socioeconomic status (SES) is a composite measure that includes metrics such as income, occupation, or education, and can play a role in access to healthy environments as well as access to healthcare. SES may be a factor that contributes to differential risk from $PM_{2.5}$-related health effects. Studies assessed in the 2019 Integrated Science Assessment and Supplement to the 2019 Integrated Science Assessment provide evidence that lower SES communities are exposed to higher concentrations of $PM_{2.5}$ compared to higher SES communities. Studies using composite measures of neighborhood SES consistently demonstrated a disparity in both $PM_{2.5}$ exposure and the risk of $PM_{2.5}$-related health outcomes. There is some evidence that supports associations larger in magnitude between mortality and long-term $PM_{2.5}$ exposures for those with low income or living in lower income areas compared to those with higher income or living in higher income neighborhoods. Additionally, evidence supports conclusions that lower SES is associated with cause-specific mortality and certain health endpoints (*i.e.,* HI and CHF), but less so for all-cause or total (non-accidental) mortality.

The EPA believes that this action is likely to reduce existing disproportionate and adverse effects on communities with environmental justice concerns.

The EPA additionally identified and addressed environmental justice concerns by providing opportunities for public input on the proposed decisions. The EPA held a multi-day virtual public hearing for the public to provide oral testimony and there was a 60-day public comment period for the proposed action. As described in section II.A.3 above, the EPA conducted a risk assessment to support this action that included an at-risk analysis that evaluates exposure and $PM_{2.5}$ mortality risk for older adults (*e.g.,* 65 years and older), stratified for White, Black, Asian, Native American, Non-Hispanic, and Hispanic individuals. This at-risk analysis found that compared to a primary annual $PM_{2.5}$ standard with a level of 12.0 $\mu g/m^3$, meeting a revised annual standard with a level of 9.0 $\mu g/m^3$ is estimated to reduce $PM_{2.5}$-associated health risks in the 30 study areas controlled by the annual standard by about 22–28% and is expected to reduce disparities in exposure and risk among these populations.

The information supporting this Executive Order review is is contained in sections II.A.2, II.B.3.a, II.B.3.c, II.B.2, and II.B.4. of this preamble and also in the 2019 Integrated Science Assessment, Supplement to the 2019 Integrated Science Assessment, and 2022 Policy Assessment. The EPA has carefully evaluated the potential impacts on minority populations and low SES populations as discussed in sections II.A.2, II.A.3, II.B.2, and II.B.4 of this preamble. The 2019 Integrated Science Assessment, Supplement to the Integrated Science Assessment, and 2022 Policy Assessment contain the evaluation of the scientific evidence, quantitative risk analyses and policy considerations that pertain to these populations. These documents are available in the public docket for this action.

K. Congressional Review Act (CRA)

This action is subject to the CRA, and the EPA will submit a rule report to each House of the Congress and to the Comptroller General of the United States. This action meets the criteria set forth in 5 U.S.C. 804(2).

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List of Subjects

40 CFR Part 50

Environmental protection, Air pollution control, Carbon monoxide, Lead, Nitrogen dioxide, Ozone, Particulate matter, Sulfur oxides.

40 CFR Part 53

Environmental protection, Administrative practice and procedure, Air pollution control, Reporting and recordkeeping requirements.

40 CFR Part 58

Environmental protection, Administrative practice and procedure, Air pollution control, Intergovernmental relations, Reporting and recordkeeping requirements.

Michael S. Regan,

Administrator.

For the reasons set forth in the preamble, chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

■ 1. The authority citation for part 50 continues to read as follows:

Authority: 42 U.S.C. 7401, *et seq.*

■ 2. Add § 50.20 to read as follows:

§ 50.20 National primary ambient air quality standards for $PM_{2.5}$.

(a) The national primary ambient air quality standards for $PM_{2.5}$ are 9.0 micrograms per cubic meter ($\mu g/m^3$) annual arithmetic mean concentration and 35 $\mu g/m^3$ 24-hour average concentration measured in the ambient air as $PM_{2.5}$ (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers) by either:

(1) A reference method based on appendix L to this part and designated in accordance with part 53 of this chapter; or

(2) An equivalent method designated in accordance with part 53 of this chapter.

(b) The primary annual $PM_{2.5}$ standard is met when the annual arithmetic mean concentration, as determined in accordance with appendix N to this part, is less than or equal to 9.0 $\mu g/m^3$.

(c) The primary 24-hour $PM_{2.5}$ standard is met when the 98th percentile 24-hour concentration, as determined in accordance with appendix N to this part, is less than or equal to 35 $\mu g/m^3$.

■ 3. Amend appendix K to part 50 by:

■ a. In section 1.0 revising paragraph (b);

■ b. In section 2.3 adding paragraph (d); and

■ c. In section 3.0 adding paragraphs (a) and (b).

The revision and additions read as follows:

Appendix K to Part 50—Interpretation of the National Ambient Air Quality Standards for Particulate Matter

1.0 General

* * * * *

(b) The terms used in this appendix are defined as follows:

Average refers to the arithmetic mean of the estimated number of exceedances per year, as per section 3.1 of this appendix.

Collocated monitors refer to two or more air measurement instruments for the same parameter (*e.g.,* PM_{10} mass) operated at the same site location, and whose placement is consistent with part 53 of this chapter. For purposes of considering a combined site record in this appendix, when two or more monitors are operated at the same site, one

monitor is designated as the ''primary'' monitor with any additional monitors designated as ''collocated.'' It is implicit in these appendix procedures that the primary monitor and collocated monitor(s) are all reference or equivalent methods; however, it is not a requirement that the primary and collocated monitors utilize the same specific sampling and analysis method.

Combined site data record is the data set used for performing computations in this appendix and represents data for the primary monitors augmented with data from collocated monitors according to the procedure specified in section 3.0(a) of this appendix.

Daily value for PM_{10} refers to the 24-hour average concentration of PM_{10} calculated or measured from midnight to midnight (local time).

Exceedance means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 $\mu g/m^3$ (*i.e.,* values ending in 5 or greater are to be rounded up).

Expected annual value is the number approached when the annual values from an increasing number of years are averaged, in the absence of long-term trends in emissions or meteorological conditions.

Primary monitors are suitable monitors designated by a State or local agency in their annual network plan as the default data source for creating a combined site data record. If there is only one suitable monitor at a particular site location, then it is presumed to be a primary monitor.

Year refers to a calendar year.

* * * * *

2.3 Data Requirements

* * * * *

(d) 24-hour average concentrations will be computed from submitted hourly PM_{10} concentration data for each corresponding day of the year and the result will be stored in the first, or start, hour (*i.e.,* midnight, hour '0') of the 24-hour period. A 24-hour average concentration shall be considered valid if at least 75 percent of the hourly averages (*i.e.,* 18 hourly values) for the 24-hour period are available. In the event that fewer than all 24 hourly average concentrations are available (*i.e.,* fewer than 24 but at least 18), the 24-hour average concentration shall be computed on the basis of the hours available using the number of available hours within the 24-hour period as the divisor (*e.g.,* the divisor is 19 if 19 hourly values are available). 24-hour periods with 7 or more missing hours shall also be considered for computations in this appendix if, after substituting zero for all missing hourly concentrations, the resulting 24-hour average daily value exceeds the level of the 24-hour standard specified in § 50.6 after rounding to the nearest 10 $\mu g/m^3$.

* * * * *

3.0 Computational Equations for the 24-Hour Standards

(a) All computations shown in this appendix shall be implemented on a site-level basis. Site level concentration data shall be processed as follows:

(1) The default dataset for PM_{10} mass concentrations for a site shall consist of the measured concentrations recorded from the designated primary monitor(s). All daily values produced by the primary monitor are considered part of the site record.

(2) If a daily value is not produced by the primary monitor for a particular day, but a value is available from a single collocated monitor, then that collocated monitor value shall be considered part of the combined site data record. If daily value data is available from two or more collocated monitors, the average of those collocated values shall be used as the daily value. The data record resulting from this procedure is referred to as the ''combined site data record.''

(b) In certain circumstances, including but not limited to site closures or relocations, data from two nearby sites may be combined into a single site data record for the purpose of calculating a valid design value. The appropriate Regional Administrator may approve such combinations if the Regional Administrator determines that the measured concentrations do not differ substantially between the two sites, taking into consideration factors such as distance between sites, spatial and temporal patterns in air quality, local emissions and meteorology, jurisdictional boundaries, and terrain features.

* * * * *

■ 4. Amend appendix L to part 50 by revising section 7.3.4 and adding section 7.3.4.5 to read as follows:

Appendix L to Part 50—Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere

* * * * *

7.3.4 *Particle size separator.* The sampler shall be configured with one of the three alternative particle size separators described in this section. One separator is an impactor-type separator (WINS impactor) described in sections 7.3.4.1, 7.3.4.2, and 7.3.4.3 of this appendix. One alternative separator is a cyclone-type separator (VSCC™) described in section 7.3.4.4 of this appendix. The other alternative separator is also a cyclone-type separator (TE–$PM_{2.5}$C) described in section 7.3.4.5 of this appendix.

* * * * *

7.3.4.5 A second cyclone-type separator is identified as a Tisch TE–$PM_{2.5}$C Cyclone particle size separator specified as part of EPA-designated reference method RFPS–1014–219 and as manufactured by Tisch Environmental Incorporated, 145 S. Miami Avenue, Village of Cleves, Ohio 45002.

* * * * *

■ 5. Amend appendix N to part 50 by:
■ a. In section 1.0 revising paragraph (a);
■ b. In section 3.0 adding paragraph (d)(3);
■ c. In section 4.1 revising paragraph (a); and
■ d. In section 4.2 revising paragraph (a).

The addition and revisions read as follows.

Appendix N to Part 50—Interpretation of the National Ambient Air Quality Standards for $PM_{2.5}$

1.0 General

(a) This appendix explains the data handling conventions and computations necessary for determining when the national ambient air quality standards (NAAQS) for $PM_{2.5}$ are met, specifically the primary and secondary annual and 24-hour $PM_{2.5}$ NAAQS specified in §§ 50.7, 50.13, 50.18, and 50.20. $PM_{2.5}$ is defined, in general terms, as particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. $PM_{2.5}$ mass concentrations are measured in the ambient air by a Federal Reference Method (FRM) based on appendix L to this part, as applicable, and designated in accordance with part 53 of this chapter or by a Federal Equivalent Method (FEM) designated in accordance with part 53 of this chapter. Only those FRM and FEM measurements that are derived in accordance with part 58 of this chapter (*i.e.,* that are deemed ''suitable'') shall be used in comparisons with the $PM_{2.5}$ NAAQS. The data handling and computation procedures to be used to construct annual and 24-hour NAAQS metrics from reported $PM_{2.5}$ mass concentrations, and the associated instructions for comparing these calculated metrics to the levels of the $PM_{2.5}$ NAAQS, are specified in sections 2.0, 3.0, and 4.0 of this appendix.

* * * * *

3.0 Requirements for Data Use and Data Reporting for Comparisons With the NAAQS for $PM_{2.5}$

* * * * *

(d) * * *

(3) In certain circumstances, including but not limited to site closures or relocations, data from two nearby sites may be combined into a single site data record for the purpose of calculating a valid design value. The appropriate Regional Administrator may approve such site combinations if the Regional Administrator determines that the measured concentrations do not differ substantially between the two sites, taking into consideration factors such as distance between sites, spatial and temporal patterns in air quality, local emissions and meteorology, jurisdictional boundaries, and terrain features.

* * * * *

4.1 Annual $PM_{2.5}$ NAAQS

(a) Levels of the primary and secondary annual $PM_{2.5}$ NAAQS are specified in §§ 50.7, 50.13, 50.18, and 50.20 as applicable.

* * * * *

4.2 Twenty-Four-Hour $PM_{2.5}$ NAAQS

(a) Levels of the primary and secondary 24-hour $PM_{2.5}$ NAAQS are specified in §§ 50.7, 50.13, 50.18, and 50.20 as applicable.

* * * * *

PART 53—AMBIENT AIR MONITORING REFERENCE AND EQUIVALENT METHODS

■ 6. The authority citation for part 53 continues to read as follows:

Authority: Sec. 301(a) of the Clean Air Act (42 U.S.C. 1857g(a)), as amended by sec. 15(c)(2) of Pub. L. 91–604, 84 Stat. 1713, unless otherwise noted.

Subpart A—General Provisions

■ 7. Amend § 53.4 by:
■ a. Revising paragraph (a);
■ b. Adding paragraph (b)(7); and
■ c. Revising paragraph (d).

The revisions and addition read as follows:

§ 53.4 Applications for reference or equivalent method determinations.

(a) Applications for FRM or FEM determinations and modification requests of existing designated instruments shall be submitted to: U.S. Environmental Protection Agency, Director, Center for Environmental Measurement and Modeling, Reference and Equivalent Methods Designation Program (MD–D205–03), 109 T.W. Alexander Drive, P.O. Box 12055, Research Triangle Park, North Carolina 27711 (commercial delivery address: 4930 Old Page Road, Durham, North Carolina 27703).

* * * * *

(b) * * *

(7) All written materials for new FRM and FEM applications and modification requests must be submitted in English in MS Word format. For any calibration certificates originally written in a non-English language, the original non-English version of the certificate must be submitted to EPA along with a version of the certificate translated to English. All laboratory and field data associated with new FRM and FEM applications and modification requests must be submitted in MS Excel format. All worksheets in MS Excel must be unprotected to enable full inspection as part of the application review process.

* * * * *

(d) For candidate reference or equivalent methods or for designated instruments that are the subject of a modification request, the applicant, if requested by EPA, shall provide to EPA a representative sampler or analyzer for test purposes. The sampler or analyzer shall be shipped free on board (FOB) destination to Director, Center for Environmental Measurements and Modeling, Reference and Equivalent Methods Designation Program (MD D205–03), U.S. Environmental Protection Agency, 4930 Old Page Road, Durham, North Carolina 27703, scheduled to arrive concurrently with or within 30 days of the arrival of the other application materials. This sampler or analyzer may be subjected to various tests that EPA determines to be necessary or appropriate under § 53.5(f), and such tests may include special tests not described in this part. If the instrument submitted under this paragraph (d) malfunctions, becomes inoperative, or fails to perform as represented in the application before the necessary EPA testing is completed, the applicant shall be afforded the opportunity to repair or replace the device at no cost to the EPA. Upon completion of EPA testing, the sampler or analyzer submitted under this paragraph (d) shall be repacked by EPA for return shipment to the applicant, using the same packing materials used for shipping the instrument to EPA unless alternative packing is provided by the applicant. Arrangements for, and the cost of, return shipment shall be the responsibility of the applicant. The EPA does not warrant or assume any liability for the condition of the sampler or analyzer upon return to the applicant.

■ 8. Amend § 53.8 by revising paragraph (a) to read as follows:

§ 53.8 Designation of reference and equivalent methods.

(a) A candidate method determined by the Administrator to satisfy the applicable requirements of this part shall be designated as an FRM or FEM (as applicable) by and upon publication of the designation in the **Federal Register**. Applicants shall not publicly announce, market, or sell the candidate sampler and analyzer as an approved FRM or FEM (as applicable) until the designation is published in the **Federal Register**.

* * * * *

■ 9. Amend § 53.14 by revising paragraphs (c)(4), (5), and (6) to read as follows:

§ 53.14 Modification of a reference or equivalent method.

* * * * *

(c) * * *

(4) Send notice to the applicant that additional information must be submitted before a determination can be made and specify the additional information that is needed (in such cases, the 90-day period shall commence upon receipt of the additional information).

(5) Send notice to the applicant that additional tests are necessary and specify which tests are necessary and how they shall be interpreted (in such cases, the 90-day period shall commence upon receipt of the additional test data).

(6) Send notice to the applicant that additional tests will be conducted by the Administrator and specify the reasons for and the nature of the additional tests (in such cases, the 90-day period shall commence 1 calendar day after the additional tests are completed).

* * * * *

■ 10. Revise table A–1 to subpart A of part 53 to read as follows:

TABLE A–1 TO SUBPART A OF PART 53—SUMMARY OF APPLICABLE REQUIREMENTS FOR REFERENCE AND EQUIVALENT METHODS FOR AIR MONITORING OF CRITERIA POLLUTANTS

Pollutant	Reference or equivalent	Manual or automated	Applicable appendix of part 50 of this chapter	Applicable subparts of this part					
				A	B	C	D	E	F
SO_2	Reference	Manual	A–2						
		Automated	A–1	✓	✓				
	Equivalent	Manual	A–1	✓		✓			
		Automated	A–1	✓	✓	✓			
CO	Reference	Automated	C	✓	✓				
	Equivalent	Manual	C	✓		✓			
		Automated	C	✓	✓	✓			
O_3	Reference	Automated	D	✓	✓				
	Equivalent	Manual	D	✓		✓			
		Automated	D	✓	✓	✓			
NO_2	Reference	Automated	F	✓	✓				
	Equivalent	Manual	F	✓		✓			
		Automated	F	✓	✓	✓			

TABLE A–1 TO SUBPART A OF PART 53—SUMMARY OF APPLICABLE REQUIREMENTS FOR REFERENCE AND EQUIVALENT METHODS FOR AIR MONITORING OF CRITERIA POLLUTANTS—Continued

Pollutant	Reference or equivalent	Manual or automated	Applicable appendix of part 50 of this chapter	Applicable subparts of this part					
				A	B	C	D	E	F
Pb	Reference	Manual	G						
	Equivalent	Manual	G	✓		✓			
		Automated	G	✓		✓			
PM_{10}-Pb	Reference	Manual	Q						
	Equivalent	Manual	Q	✓		✓			
		Automated	Q	✓		✓			
PM_{10}	Reference	Manual	J	✓			✓		
	Equivalent	Manual	J	✓		✓	✓		
		Automated	J	✓		✓	✓		
$PM_{2.5}$	Reference	Manual	L	✓				✓	
	Equivalent Class I	Manual	L	✓		✓		✓	
	Equivalent Class II	Manual	L[1]	✓		[2]✓		✓	[1 2]✓
	Equivalent Class III	Automated	L[1]	✓		✓		✓	[1]✓
$PM_{10-2.5}$	Reference	Manual	L,[2] O	✓				✓	
	Equivalent Class I	Manual	L,[2] O	✓		✓		✓	
	Equivalent Class II	Manual	L,[2] O	✓		[2]✓		✓	[1,2]✓
	Equivalent Class III	Automated	[1] L, [1 2] O	✓		✓		✓	[1]✓

[1] Some requirements may apply, based on the nature of each particular candidate method, as determined by the Administrator.
[2] Alternative Class III requirements may be substituted.

Subpart B—Procedures for Testing Performance Characteristics of Automated Methods for SO_2, CO, O_3, and NO_2

■ 11. Amend table B–1 to subpart B of part 53 by revising footnote 4 to read as follows:

Table B–1 to Subpart B of Part 53—Performance Limit Specifications for Automated Methods

* * * * *

[4] For nitric oxide interference for the SO_2 ultraviolet fluorescence (UVF) method, interference equivalent is ±0.003 ppm for the lower range.

* * * * *

■ 12. Revise table B–3 to subpart B of part 53 to read as follows:

TABLE B–3 TO SUBPART B OF PART 53—INTERFERENT TEST CONCENTRATION [1]

[Parts per million]

Pollutant	Analyzer type [2]	Hydrochloric acid	Ammonia	Hydrogen sulfide	Sulfur dioxide	Nitrogen dioxide	Nitric oxide	Carbon dioxide	Ethylene	Ozone	M-xylene	Water vapor	Carbon monoxide	Methane	Ethane	Naphthalene
SO_2	Ultraviolet fluorescence			[5] 0.1	[4] 0.14	0.5	0.5			0.5	0.2	20,000				[6] 0.05
SO_2	Flame photometric			0.01	[4] 0.14			750				[3] 20,000	50			
SO_2	Gas chromatography			0.1	[4] 0.14			750				[3] 20,000	50			
SO_2	Spectrophotometric-wet chemical (pararosanaline)	0.2	0.1	0.1	[4] 0.14	0.5		750		0.5						
SO_2	Electrochemical	0.2	0.1	0.1	[4] 0.14	0.5	0.5		0.2	0.5		[3] 20,000				
SO_2	Conductivity	0.2	0.1		[4] 0.14	0.5		750								
SO_2	Spectrophotometric-gas phase, including DOAS				[4] 0.14	0.5	0.5			0.5	0.2					
O_3	Ethylene Chemiluminescence			[3] 0.1				750		[4] 0.08		[3] 20,000				
O_3	NO-chemiluminescence			[3] 0.1		0.5		750		[4] 0.08		[3] 20,000				
O_3	Electrochemical		[3] 0.1		0.5	0.5				[4] 0.08		[3] 20,000				
O_3	Spectrophotometric-wet chemical (potassium iodide)		[3] 0.1		0.5	0.5	[3] 0.5			[4] 0.08						
O_3	Spectrophotometric-gas phase, including ultraviolet absorption and DOAS.				0.5	0.5	[3] 0.5			[4] 0.08	0.02	20,000				
CO	Non-dispersive Infrared							750				20,000	[4] 10			
CO	Gas chromatography with flame ionization detector											20,000	[4] 10		0.5	
CO	Electrochemical						0.5		0.2			20,000	[4] 10			
CO	Catalytic combustion-thermal detection		0.1					750	0.2			20,000	[4] 10	5.0	0.5	
CO	IR fluorescence							750				20,000	[4] 10		0.5	
CO	Mercury replacement-UV photometric								0.2				[4] 10		0.5	
NO_2	Chemiluminescent		[3] 0.1		0.5	[4] 0.1	0.5					20,000				
NO_2	Spectrophotometric-wet chemical (azo-dye reaction)				0.5	[4] 0.1	0.5	750		0.5						
NO_2	Electrochemical	0.2	[3] 0.1		0.5	[4] 0.1	0.5	750		0.5		20,000	50			
NO_2	Spectrophotometric-gas phase		[3] 0.1		0.5	[4] 0.1	0.5			0.5		20,000	50			

[1] Concentrations of interferent listed must be prepared and controlled to ±10 percent of the stated value.
[2] Analyzer types not listed will be considered by the Administrator as special cases.
[3] Do not mix interferent with the pollutant.
[4] Concentration of pollutant used for test. These pollutant concentrations must be prepared to ±10 percent of the stated value.
[5] If candidate method utilizes an elevated-temperature scrubber for removal of aromatic hydrocarbons, perform this interference test.
[6] If naphthalene test concentration cannot be accurately quantified, remove the scrubber, use a test concentration that causes a full-scale response, reattach the scrubber, and evaluate response for interference.

■ 13. Amend appendix A to subpart B of part 53 by revising figures B–3 and B–5 to read as follows:

Appendix A to Subpart B of Part 53—Optional Forms for Reporting Test Results

* * * * *

Figure B–3 to Appendix A to Subpart B of Part 53—Form for Test Data and Calculations for Lower Detectable Limit (LDL) and Interference Equivalent (IE) (see § 53.23(c) and (d))

Analyzer _____
Date _____
Pollutant _____

LDL Interference Test Data

Applicant _____

TEST PARAMETER		READING or CALCULATION	TEST NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LOWER DETECTABLE LIMIT		B_Z															
		B_L															
		$LDL = B_L - B_Z$															
INTER-FERENCE EQUIV-ALENT	1	R_1															
		R_{I1}															
		$IE = R_{I1} - R_1$															
	2	R_2															
		R_{I2}															
		$IE = R_{I2} - R_2$															
	3*	R_3															
		R_{I3}															
		$IE = R_{I3} - R_3$															
	4*	R_4															
		R_{I4}															
		$IE = R_{I4} - R_4$															
	5*	R_5															
		R_{I5}															
		$IE = R_{I5} - R_5$															
	TOTAL*	$\sum_{i=1}^{n} \lvert IE_i \rvert$															

*If required.

* * * * *

Figure B–5 to Appendix A to Subpart B of Part 53—Form for Calculating Zero Drift, Span Drift and Precision (see § 53.23(e))

Analyzer _____
Date _____
Pollutant _____

Calculation of Zero Drift, Span Drift, and Precision

Applicant _____

TEST PARAMETER		CALCULATION	TEST DAY (n)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ZERO DRIFT	12 HOUR	$12ZD = C_{max} - C_{min}$															
	24 HOUR	$Z = (L_1 + L_2)/2$															
		$24ZD = Z_n - Z_{n-1}$															
		$24ZD = Z'_n - Z'_{n-1}$															
SPAN DRIFT	24 HOUR	$S_n = \frac{1}{6}\sum_{i=7}^{12} P_i$															
		$SD_n = \frac{S_n - S_{n-1}}{S_{n-1}} \times 100\%$															
		$SD_n = \frac{S_n - S'_{n-1}}{S'_{n-1}} \times 100\%$															
PREC-ISION	20% URL (P_{20})	P20 = % STANDARD DEVIATION of ($P_1 \ldots P_6$)															
	80% URL (P_{80})	P20 = % STANDARD DEVIATION of ($P_7 \ldots P_{12}$)															

* * * * *

Subpart C—Procedures for Determining Comparability Between Candidate Methods and Reference Methods

■ 14. Amend § 53.35 by revising paragraph (b)(1)(ii)(D) to read as follows:

§ 53.35 Test procedure for Class II and Class III methods for $PM_{2.5}$ and $PM_{10-2.5}$.

* * * * *

(b) * * *

(1) * * *

(ii) * * *

(D) Site D shall be in a large city east of the Mississippi River, having characteristically high humidity levels.

* * * * *

■ 15. Revise table C–4 to subpart C of part 53 to read as follows:

TABLE C–4 TO SUBPART C OF PART 53—TEST SPECIFICATIONS FOR PM_{10}, $PM_{2.5}$, AND $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS

Specification	PM_{10}	$PM_{2.5}$			$PM_{10-2.5}$	
		Class I	Class II	Class III	Class II	Class III
Acceptable concentration range (R_j), μg/m³.	5–300	3–200	3–200	3–200	3–200	3–200.
Minimum number of test sites.	2	1	2	4	2	4.
Minimum number of candidate method samplers or analyzers per site.	3	3	3[1]	3[1]	3[1]	3.[1]
Number of reference method samplers per site.	3	3	3[1]	3[1]	3[1]	3.[1]
Minimum number of acceptable sample sets per site for PM_{10} methods:						
$R_j < 20$ μg/m³	3					
$R_j > 20$ μg/m³	3					
Total	10					
Minimum number of acceptable sample sets per site for $PM_{2.5}$ and $PM_{10-2.5}$ candidate equivalent methods:						
$R_j < 15$ μg/m³ for 24-hr or $R_j < 8$ μg/m³ for 48-hr samples..		3	3	3	3	3.
$Rj > 15$ μg/m³ for 24-hr or $R_j > 8$ μg/m³ for 48-hr samples.		3	3	3	3	3.
Each season		10	23	23	23	23.
Total, each site.		10	23	23 (46 for two-season sites).	23	23 (46 for two-season sites).
Precision of replicate reference method measurements, P_{Rj} or RP_{Rj}, respectively; RP for Class II or III $PM_{2.5}$ or $PM_{10-2.5}$, maximum.	5 μg/m³ or 7%.	2 μg/m³ or 5%.	10%[2]	10%[2]	10%[2]	10%.[2]
Precision of $PM_{2.5}$ or $PM_{10-2.5}$ candidate method, CP, each site.			10%[2]	15%[2]	15%[2]	15%.[2]
Slope of regression relationship.	1 ±0.10	1 ±0.05	1 ±0.10	1 ±0.10	1 ±0.10	1 ±0.12.
Intercept of regression relationship, μg/m³.	0 ±5	0 ±1	Between: 13.55—(15.05 × slope), but not less than—1.5; and 16.56—(15.05 × slope), but not more than +1.5.	Between: 15.05—(17.32 × slope), but not less than—2.0; and 15.05—(13.20 × slope), but not more than +2.0.	Between: 62.05—(70.5 × slope), but not less than—3.5; and 78.95—(70.5 × slope), but not more than +3.5.	Between: 70.50—(82.93 × slope), but not less than—7.0; and 70.50—(61.16 × slope), but not more than +7.0.
Correlation of reference method and candidate method measurements.	≥ 0.97	≥ 0.97	≥ 0.93—for CCV ≤ 0.4; ≥ 0.85 + 0.2 × CCV—for 0.4 ≤ CCV ≤ 0.5; ≥ 0.95—for CCV ≥ 0.5			

[1] Some missing daily measurement values may be permitted; see test procedure.
[2] Calculated as the root mean square over all measurement sets.

Subpart D—Procedures for Testing Performance Characteristics of Methods for PM_{10}

■ 16. Amend § 53.43 by revising the formula in paragraph (a)(2)(xvi) and the formula in paragraph (c)(2)(iv) to read as follows:

§ 53.43 Test procedures.

(a) * * *

(2) * * *

$$CV_E = \left. \sqrt{\frac{\sum_{i=1}^{n} E^2(i) - \frac{1}{n}\left(\sum_{i=1}^{n} E\,(i)\right)^2}{n-1}} \right/ \bar{E}$$

(xvi) * * *

* * * * *

(c) * * *

(2) * * *

(iv) * * *

$$Pj = \sqrt{\frac{\sum_{i=1}^{3} C^2(i)(j) - \frac{1}{3}\left(\sum_{i=1}^{3} C\,(i)(j)\right)^2}{2}}$$

if $\bar{C}_j$ is below 80 μg/m³, or

$$RP_j = \ 100\%\ x \left. \sqrt{\frac{\sum_{i=1}^{3} C^2(i)\,(j) - \frac{1}{3}\left(\sum_{i=1}^{3} C\,(i)(j)\right)^2}{2}} \right/ \overline{C}_{(j)}$$

if $\bar{C}_j$ is above 80 μg/m³.

Subpart E—Procedures for Testing Physical (Design) and Performance Characteristics of Reference Methods and Class I and Class II Equivalent Methods for $PM_{2.5}$ or PM_{10}–2.5

■ 17. Amend § 53.51 by revising paragraph (d)(2) to read as follows:

§ 53.51 Demonstration of compliance with design specifications and manufacturing and test requirements.

* * * * *

(d) * * *

(2) *VSCC and TE–$PM_{2.5}$C separators.* For samplers and monitors utilizing the BGI VSCC or Tisch TE–$PM_{2.5}$C particle size separators specified in sections 7.3.4.4 and 7.3.4.5 of appendix L to part 50 of this chapter, respectively, the respective manufacturers shall identify the critical dimensions and manufacturing tolerances for the separator, devise appropriate test procedures to verify that the critical dimensions and tolerances are maintained during the manufacturing process, and carry out those procedures on each separator manufactured to verify conformance of the manufactured products. The manufacturer shall also maintain records of these tests and their test results and submit evidence that this procedure is incorporated into the manufacturing procedure, that the test is or will be routinely implemented, and that an appropriate procedure is in place for the disposition of units that fail this tolerance tests.

* * * * *

Subpart F—Procedures for Testing Performance Characteristics of Class II Equivalent Methods for $PM_{2.5}$

■ 18. Amend § 53.61 by revising paragraph (g) introductory text, the first sentence of paragraph (g)(1), the first sentence of (g)(1)(i), (g)(2)(i) and adding paragraph (g)(2)(iii) to read as follows:

§ 53.61 Test conditions.

* * * * *

(g) *Vibrating Orifice Aerosol Generator (VOAG) and Flow-Focusing Monodisperse Aerosol Generator (FMAG) conventions.* This section prescribes conventions regarding the use of the vibrating orifice aerosol generator (VOAG) and the flow-focusing monodisperse aerosol generator (FMAG) for the size-selective performance tests outlined in §§ 53.62, 53.63, 53.64, and 53.65.

(1) *Particle aerodynamic diameter.* The VOAG and FMAG produce near-monodisperse droplets through the controlled breakup of a liquid jet. * * *

(i) The physical diameter of a generated spherical particle can be calculated from the operational parameters of the VOAG and FMAG as:

* * * * *

(2) * * *

(i) Solid particle tests performed in this subpart shall be conducted using particles composed of ammonium fluorescein. For use in the VOAG or FMAG, liquid solutions of known volumetric concentration can be prepared by diluting fluorescein powder ($C_2OH_{12}O_5$, FW = 332.31, CAS 2321–07–5) with aqueous ammonia. Guidelines for preparation of fluorescein solutions of the desired volume concentration (C_{vol}) are presented in Vanderpool and Rubow (1988) (Reference 2 in appendix A to this subpart). For purposes of converting particle physical diameter to aerodynamic diameter, an ammonium fluorescein particle density of 1.35 g/cm³ shall be used.

* * * * *

(iii) Calculation of the physical diameter of the particles produced by the VOAG and FMAG requires

knowledge of the liquid solution's volume concentration (C_{vol}). Because uranine is essentially insoluble in oleic acid, the total particle volume is the sum of the oleic acid volume and the uranine volume. The volume concentration of the liquid solution shall be calculated as:

Equation 5 to Paragraph (g)(2)(iii)

$$C_{vol} = \frac{V_u + V_{oleic}}{V_{sol}} = \frac{(M_u/P_u) + (M_{oleic}/P_{oleic})}{V_{sol}}$$

Where:
V_u = uranine volume, ml;
V_{oleic} = oleic acid volume, ml;
V_{sol} = total solution volume, ml;
M_u = uranine mass, g;
P_u = uranine density, g/cm^3;
M_{oleic} = oleic acid mass, g; and
P_{oleic} = oleic acid density, g/cm^3.
* * * * *

PART 58—AMBIENT AIR QUALITY SURVEILLANCE

■ 19. The authority citation for part 58 continues to read as follows:

Authority: 42 U.S.C. 7403, 7405, 7410, 7414, 7601, 7611, 7614, and 7619.

Subpart A—General Provisions

■ 20. Amend § 58.1 by:
■ a. Removing the definition for ''Approved regional method (ARM)''; and
■ b. Revising the definition for ''Traceable.''

The revision reads as follows:

§ 58.1 Definitions.

* * * * *

Traceable means a measurement result from a local standard whereby the result can be related to the International System of Units (SI) through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. Traceable measurement results must be compared and certified, either directly or via not more than one intermediate standard, to a National Institute of Standards and Technology (NIST)-certified reference standard. Examples include but are not limited to NIST Standard Reference Material (SRM), NIST-traceable Reference Material (NTRM), or a NIST-certified Research Gas Mixture (RGM). Traceability to the SI through other National Metrology Institutes (NMIs) in addition to NIST is allowed if a Declaration of Equivalence (DoE) exists between NIST and that NMI.
* * * * *

Subpart B—Monitoring Network

■ 21. Amend § 58.10 by:
■ a. Revising paragraphs (a)(1) and (b)(10) and (13);
■ b. Adding paragraph (b)(14); and
■ c. Revising paragraph (d).

The revisions and addition read as follows:

§ 58.10 Annual monitoring network plan and periodic network assessment.

(a)(1) Beginning July 1, 2007, the State, or where applicable local, agency shall submit to the Regional Administrator an annual monitoring network plan which shall provide for the documentation of the establishment and maintenance of an air quality surveillance system that consists of a network of SLAMS monitoring stations that can include FRM and FEM monitors that are part of SLAMS, NCore, CSN, PAMS, and SPM stations. The plan shall include a statement of whether the operation of each monitor meets the requirements of appendices A, B, C, D, and E to this part, where applicable. The Regional Administrator may require additional information in support of this statement. The annual monitoring network plan must be made available for public inspection and comment for at least 30 days prior to submission to the EPA and the submitted plan shall include and address, as appropriate, any received comments.
* * * * *

(b) * * *

(10) Any monitors for which a waiver has been requested or granted by the EPA Regional Administrator as allowed for under appendix D or appendix E to this part. For those monitors where a waiver has been approved, the annual monitoring network plan shall include the date the waiver was approved.
* * * * *

(13) The identification of any $PM_{2.5}$ FEMs used in the monitoring agency's network where the data are not of sufficient quality such that data are not to be compared to the national ambient air quality standards (NAAQS). For required SLAMS where the agency identifies that the $PM_{2.5}$ Class III FEM does not produce data of sufficient quality for comparison to the NAAQS, the monitoring agency must ensure that an operating FRM or filter-based FEM meeting the sample frequency requirements described in § 58.12 or other Class III $PM_{2.5}$ FEM with data of sufficient quality is operating and reporting data to meet the network design criteria described in appendix D to this part.

(14) The identification of any site(s) intended to address being sited in an at-risk community where there are anticipated effects from sources in the area as required in section 4.7.1(b)(3) of appendix D to this part. An initial approach to the question of whether any new or moved sites are needed and to identify the communities in which they intend to add monitoring for meeting the requirement in this paragraph (b)(14), if applicable, shall be submitted in accordance with the requirements of section 4.7.1(b)(3) of appendix D to this part, which includes submission to the EPA Regional Administrator no later than July 1, 2024. Specifics on the resulting proposed new or moved sites for $PM_{2.5}$ network design to address at-risk communities, if applicable, would need to be detailed in annual monitoring network plans due to each applicable EPA Regional office no later than July 1, 2025. The plan shall provide for any required sites to be operational no later than 24 months from date of approval of a plan or January 1, 2027, whichever comes first.
* * * * *

(d) The State, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of

susceptible individuals (*e.g.,* children with asthma) and other at-risk populations, and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The assessments are due every 5 years beginning July 1, 2010.

* * * * *

■ 22. Amend § 58.11 by revising paragraphs (a)(2) and (e) to read as follows:

§ 58.11 Network technical requirements.

(a) * * *

(2) Beginning January 1, 2009, State and local governments shall follow the quality assurance criteria contained in appendix A to this part that apply to SPM sites when operating any SPM site which uses an FRM or an FEM and meets the requirements of appendix E to this part, unless the Regional Administrator approves an alternative to the requirements of appendix A with respect to such SPM sites because meeting those requirements would be physically and/or financially impractical due to physical conditions at the monitoring site and the requirements are not essential to achieving the intended data objectives of the SPM site. Alternatives to the requirements of appendix A may be approved for an SPM site as part of the approval of the annual monitoring plan, or separately.

* * * * *

(e) State and local governments must assess data from Class III $PM_{2.5}$ FEM monitors operated within their network using the performance criteria described in table C–4 to subpart C of part 53 of this chapter, for cases where the data are identified as not of sufficient comparability to a collocated FRM, and the monitoring agency requests that the FEM data should not be used in comparison to the NAAQS. These assessments are required in the monitoring agency's annual monitoring network plan described in § 58.10(b) for cases where the FEM is identified as not of sufficient comparability to a collocated FRM. For these collocated $PM_{2.5}$ monitors, the performance criteria apply with the following additional provisions:

(1) The acceptable concentration range (Rj), $\mu g/m^3$ may include values down to 0 $\mu g/m^3$.

(2) The minimum number of test sites shall be at least one; however, the number of test sites will generally include all locations within an agency's network with collocated FRMs and FEMs.

(3) The minimum number of methods shall include at least one FRM and at least one FEM.

(4) Since multiple FRMs and FEMs may not be present at each site, the precision statistic requirement does not apply, even if precision data are available.

(5) All seasons must be covered with no more than 36 consecutive months of data in total aggregated together.

(6) The key statistical metric to include in an assessment is the bias (both additive and multiplicative) of the $PM_{2.5}$ continuous FEM(s) compared to a collocated FRM(s). Correlation is required to be reported in the assessment, but failure to meet the correlation criteria, by itself, is not cause to exclude data from a continuous FEM monitor.

■ 23. Amend § 58.12 by revising paragraph (d)(1):

§ 58.12 Operating schedules.

* * * * *

(d) * * *

(1)(i) Manual $PM_{2.5}$ samplers at required SLAMS stations without a collocated continuously operating $PM_{2.5}$ monitor must operate on at least a 1-in-3 day schedule unless a waiver for an alternative schedule has been approved per paragraph (d)(1)(ii) of this section.

(ii) For SLAMS $PM_{2.5}$ sites with both manual and continuous $PM_{2.5}$ monitors operating, the monitoring agency may request approval for a reduction to 1-in-6 day $PM_{2.5}$ sampling or for seasonal sampling from the EPA Regional Administrator. Other requests for a reduction to 1-in-6 day $PM_{2.5}$ sampling or for seasonal sampling may be approved on a case-by-case basis. The EPA Regional Administrator may grant sampling frequency reductions after consideration of factors (including but not limited to the historical $PM_{2.5}$ data quality assessments, the location of current $PM_{2.5}$ design value sites, and their regulatory data needs) if the Regional Administrator determines that the reduction in sampling frequency will not compromise data needed for implementation of the NAAQS. Required SLAMS stations whose measurements determine the design value for their area and that are within plus or minus 10 percent of the annual NAAQS, and all required sites where one or more 24-hour values have exceeded the 24-hour NAAQS each year for a consecutive period of at least 3 years are required to maintain at least a 1-in-3 day sampling frequency until the design value no longer meets the criteria in this paragraph (d)(1)(ii) for 3 consecutive years. A continuously operating FEM $PM_{2.5}$ monitor satisfies the requirement in this paragraph (d)(1)(ii) unless it is identified in the monitoring agency's annual monitoring network plan as not appropriate for comparison to the NAAQS and the EPA Regional Administrator has approved that the data from that monitor may be excluded from comparison to the NAAQS.

(iii) Required SLAMS stations whose measurements determine the 24-hour design value for their area and whose data are within plus or minus 5 percent of the level of the 24-hour $PM_{2.5}$ NAAQS must have an FRM or FEM operate on a daily schedule if that area's design value for the annual NAAQS is less than the level of the annual $PM_{2.5}$ standard. A continuously operating FEM or $PM_{2.5}$ monitor satisfies the requirement in this paragraph (d)(1)(iii) unless it is identified in the monitoring agency's annual monitoring network plan as not appropriate for comparison to the NAAQS and the EPA Regional Administrator has approved that the data from that monitor may be excluded from comparison to the NAAQS. The daily schedule must be maintained until the referenced design values no longer meets the criteria in this paragraph (d)(1)(iii) for 3 consecutive years.

(iv) Changes in sampling frequency attributable to changes in design values shall be implemented no later than January 1 of the calendar year following the certification of such data as described in § 58.15.

* * * * *

■ 24. Revise § 58.15 to read as follows:

§ 58.15 Annual air monitoring data certification.

(a) The State, or where appropriate local, agency shall submit to the EPA Regional Administrator an annual air monitoring data certification letter to certify data collected by FRM and FEM monitors at SLAMS and SPM sites that meet criteria in appendix A to this part from January 1 to December 31 of the previous year. The head official in each monitoring agency, or his or her designee, shall certify that the previous year of ambient concentration and quality assurance data are completely submitted to AQS and that the ambient concentration data are accurate to the best of her or his knowledge, taking into consideration the quality assurance findings. The annual data certification letter is due by May 1 of each year.

(b) Along with each certification letter, the State shall submit to the Regional Administrator an annual

summary report of all the ambient air quality data collected by FRM and FEM monitors at SLAMS and SPM sites. The annual report(s) shall be submitted for data collected from January 1 to December 31 of the previous year. The annual summary serves as the record of the specific data that is the object of the certification letter.

(c) Along with each certification letter, the State shall submit to the Regional Administrator a summary of the precision and accuracy data for all ambient air quality data collected by FRM and FEM monitors at SLAMS and SPM sites. The summary of precision and accuracy shall be submitted for data collected from January 1 to December 31 of the previous year.

Subpart C—Special Purpose Monitors

■ 25. Amend § 58.20 by revising paragraphs (b) through (e) to read as follows:

§ 58.20 Special purpose monitors (SPM).

* * * * *

(b) Any SPM data collected by an air monitoring agency using a Federal reference method (FRM) or Federal equivalent method (FEM) must meet the requirements of §§ 58.11 and 58.12 and appendix A to this part or an approved alternative to appendix A. Compliance with appendix E to this part is optional but encouraged except when the monitoring agency's data objectives are inconsistent with the requirements in appendix E. Data collected at an SPM using a FRM or FEM meeting the requirements of appendix A must be submitted to AQS according to the requirements of § 58.16. Data collected by other SPMs may be submitted. The monitoring agency must also submit to AQS an indication of whether each SPM reporting data to AQS monitor meets the requirements of appendices A and E.

(c) All data from an SPM using an FRM or FEM which has operated for more than 24 months are eligible for comparison to the relevant NAAQS, subject to the conditions of §§ 58.11(e) and 58.30, unless the air monitoring agency demonstrates that the data came from a particular period during which the requirements of appendix A, appendix C, or appendix E to this part were not met, subject to review and EPA Regional Office approval as part of the annual monitoring network plan described in § 58.10.

(d) If an SPM using an FRM or FEM is discontinued within 24 months of start-up, the Administrator will not base a NAAQS violation determination for the $PM_{2.5}$ or ozone NAAQS solely on data from the SPM.

(e) If an SPM using an FRM or FEM is discontinued within 24 months of start-up, the Administrator will not designate an area as nonattainment for the CO, SO_2, NO_2, or 24-hour PM_{10} NAAQS solely on the basis of data from the SPM. Such data are eligible for use in determinations of whether a nonattainment area has attained one of these NAAQS.

* * * * *

■ 26. Amend appendix A to part 58 by:
■ a. Revising section 2.6.1 and adding sections 2.6.1.1 and 2.6.1.2;
■ b. Removing section 3.1.2.2 and redesignating sections 3.1.2.3, 3.1.2.4, 3.1.2.5, and 3.1.2.6 as sections 3.1.2.2, 3.1.2.3, 3.1.2.4, and 3.1.2.5, respectively;
■ c. Revising sections 3.1.3.3, 3.2.4, 4.2.1, and 4.2.5; and
■ d. In section 6 revising References (1), (4), (6), (7), (9), (10), and (11) and table A–1.

The revisions and additions read as follows:

Appendix A to Part 58—Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards

* * * * *

2.6.1 Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for CO, SO_2, NO, and NO_2 must be EPA Protocol Gases certified in accordance with one of the procedures given in Reference 4 of this appendix.

2.6.1.1 The concentrations of EPA Protocol Gas standards used for ambient air monitoring must be certified with a 95-percent confidence interval to have an analytical uncertainty of no more than ±2.0 percent (inclusive) of the certified concentration (tag value) of the gas mixture. The uncertainty must be calculated in accordance with the statistical procedures defined in Reference 4 of this appendix.

2.6.1.2 Specialty gas producers advertising certification with the procedures provided in Reference 4 of this appendix and distributing gases as ''EPA Protocol Gas'' for ambient air monitoring purposes must adhere to the regulatory requirements specified in 40 CFR 75.21(g) or not use ''EPA'' in any form of advertising. Monitoring organizations must provide information to the EPA on the specialty gas producers they use on an annual basis. PQAOs, when requested by the EPA, must participate in the EPA Ambient Air Protocol Gas Verification Program at least once every 5 years by sending a new unused standard to a designated verification laboratory.

* * * * *

3.1.3.3 Using audit gases that are verified against the NIST standard reference methods or special review procedures and validated per the certification periods specified in Reference 4 of this appendix (EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards) for CO, SO_2, and NO_2 and using O_3 analyzers that are verified quarterly against a standard reference photometer.

* * * * *

3.2.4 *$PM_{2.5}$ Performance Evaluation Program (PEP) Procedures.* The PEP is an independent assessment used to estimate total measurement system bias. These evaluations will be performed under the national performance evaluation program (NPEP) as described in section 2.4 of this appendix or a comparable program. A prescribed number of Performance evaluation sampling events will be performed annually within each PQAO. For PQAOs with less than or equal to five monitoring sites, five valid performance evaluation audits must be collected and reported each year. For PQAOs with greater than five monitoring sites, eight valid performance evaluation audits must be collected and reported each year. A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and equal to or greater than 2 µg/m3. Siting of the PEP monitor must be consistent with section 3.2.3.4(c) of this appendix. However, any horizontal distance greater than 4 meters and any vertical distance greater than one meter must be reported to the EPA regional PEP coordinator. Additionally for every monitor designated as a primary monitor, a primary quality assurance organization must:

* * * * *

4.2.1 *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$, and Pb.* Precision is estimated via duplicate measurements from collocated samplers. It is recommended that the precision be aggregated at the PQAO level quarterly, annually, and at the 3-year level. The data pair would only be considered valid if both concentrations are greater than or equal to the minimum values specified in section 4(c) of this appendix. For each collocated data pair, calculate t_i, using equation 6 to this appendix:

Equation 6 to Section 4.2.1 of Appendix A

$$t_i = \frac{X_i - Y_i}{\sqrt{(X_i - Y_i)/2}}$$

Where X_i is the concentration from the primary sampler and Y_i is the concentration value from the audit sampler. The coefficient of variation upper bound is calculated using equation 7 to this appendix:

Equation 7 to Section 4.2.1 of Appendix A

$$CV90_{NAAQS} = 100 * \sqrt{\frac{k \times \sum_{i=1}^{k} t_i^2 - \left(\sum_{i=1}^{k} t_i\right)^2}{2k(k-1)}} \times \sqrt{\frac{k-1}{NAAQS\ Concentration * X^2_{0.1,k-1}}}$$

Where k is the number of valid data pairs being aggregated, and $X^2_{0.1,k-1}$ is the 10th percentile of a chi-squared distribution with k-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each t_i is calculated from two values with error.

* * * * *

4.2.5 *Performance Evaluation Programs Bias Estimate for $PM_{2.5}$.* The bias estimate is calculated using the PEP audits described in section 3.2.4. of this appendix. The bias estimator is based on, s_i, the absolute difference in concentrations divided by the square root of the PEP concentration.

Equation 8 to Section 4.2.5 of Appendix A

$$100 \times \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}}$$

* * * * *

6. References

(1) American National Standard Institute—Quality Management Systems For Environmental Information And Technology Programs—Requirements With Guidance For Use. ASQ/ANSI E4–2014. February 2014. Available from ANSI Webstore *https://webstore.ansi.org/.*

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(4) EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards. EPA–600/R–12/531. May, 2012. Available from U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Research Triangle Park NC 27711. *https://www.epa.gov/nscep.*

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(6) List of Designated Reference and Equivalent Methods. Available from U.S. Environmental Protection Agency, Center for Environmental Measurements and Modeling, Air Methods and Characterization Division, MD–D205–03, Research Triangle Park, NC 27711. *https://www.epa.gov/amtic/air-monitoring-methods-criteria-pollutants.*

(7) Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone. EPA–454/B–13–004 U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, October, 2013. *https://www.epa.gov/sites/default/files/2020-09/documents/ozonetransferstandardguidance.pdf.*

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(9) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 1—A Field Guide to Environmental Quality Assurance. EPA–600/R–94/038a. April 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#documents.*

(10) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program Quality System Development. EPA–454/B–13–003. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#documents.*

(11) National Performance Evaluation Program Standard Operating Procedures. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#npep.*

TABLE A–1 TO SECTION 6 OF APPENDIX A—MINIMUM DATA ASSESSMENT REQUIREMENTS FOR NAAQS RELATED CRITERIA POLLUTANT MONITORS

Method	Assessment method	Coverage	Minimum frequency	Parameters reported	AQS assessment type
Gaseous Methods (CO, NO_2, SO_2, O_3):					

TABLE A–1 TO SECTION 6 OF APPENDIX A—MINIMUM DATA ASSESSMENT REQUIREMENTS FOR NAAQS RELATED CRITERIA POLLUTANT MONITORS—Continued

Method	Assessment method	Coverage	Minimum frequency	Parameters reported	AQS assessment type
One-Point QC for SO_2, NO_2, O_3, CO.	Response check at concentration 0.005–0.08 ppm SO_2, NO_2, O_3, and. 0.5 and 5 ppm CO	Each analyzer	Once per 2 weeks [5] ..	Audit concentration [1] and measured concentration.[2].	One-Point QC.
Annual performance evaluation for SO_2, NO_2, O_3, CO.	See section 3.1.2 of this appendix.	Each analyzer	Once per year	Audit concentration [1] and measured concentration [2] for each level.	Annual PE.
NPAP for SO_2, NO_2, O_3, CO.	Independent Audit	20% of sites each year.	Once per year	Audit concentration[1] and measured concentration [2] for each level.	NPAP.
Particulate Methods:					
Continuous [4] method—collocated quality control sampling $PM_{2.5}$.	Collocated samplers	15%	1-in-12 days	Primary sampler concentration and duplicate sampler concentration.[3].	No Transaction reported as raw data.
Manual method—collocated quality control sampling PM_{10}, $PM_{2.5}$, Pb-TSP, Pb-PM_{10}.	Collocated samplers	15%	1-in-12 days	Primary sampler concentration and duplicate sampler concentration.[3].	No Transaction reported as raw data.
Flow rate verification PM_{10} (low Vol) $PM_{2.5}$, Pb-PM_{10}.	Check of sampler flow rate.	Each sampler	Once every month [5] ..	Audit flow rate and measured flow rate indicated by the sampler.	Flow Rate Verification.
Flow rate verification PM_{10} (High-Vol), Pb-TSP.	Check of sampler flow rate.	Each sampler	Once every quarter [5]	Audit flow rate and measured flow rate indicated by the sampler.	Flow Rate Verification.
Semi-annual flow rate audit PM_{10}, TSP, PM_{10}–2.5, $PM_{2.5}$, Pb-TSP, Pb-PM_{10}.	Check of sampler flow rate using independent standard.	Each sampler	Once every 6 months [5].	Audit flow rate and measured flow rate indicated by the sampler.	Semi Annual Flow Rate Audit.
Pb analysis audits Pb-TSP, Pb-PM_{10}.	Check of analytical system with Pb audit strips/filters.	Analytical	Once each quarter [5] ..	Measured value and audit value (ug Pb/filter) using AQS unit code 077.	Pb Analysis Audits.
Performance Evaluation Program $PM_{2.5}$.	Collocated samplers	(1) 5 valid audits for primary QA orgs, with ≤5 sites. (2) 8 valid audits for primary QA orgs, with >5 sites. (3) All samplers in 6 years.	Distributed over all 4 quarters [5].	Primary sampler concentration and performance evaluation sampler concentration.	PEP.
Performance Evaluation Program Pb-TSP, Pb-PM_{10}.	Collocated samplers	(1) 1 valid audit and 4 collocated samples for primary QA orgs, with ≤5 sites. (2) 2 valid audits and 6 collocated samples for primary QA orgs with >5 sites.	Distributed over all 4 quarters [5].	Primary sampler concentration and performance evaluation sampler concentration. Primary sampler concentration and duplicate sampler concentration.	PEP.

[1] Effective concentration for open path analyzers.
[2] Corrected concentration, if applicable for open path analyzers.
[3] Both primary and collocated sampler values are reported as raw data.
[4] $PM_{2.5}$ is the only particulate criteria pollutant requiring collocation of continuous and manual primary monitors.
[5] EPA's recommended maximum number of days that should exist between checks to ensure that the checks are routinely conducted over time and to limit data impacts resulting from a failed check.

* * * * *

■ 27. Amend appendix B to part 58 by:

■ a. Revising section 2.6.1 and adding sections 2.6.1.1 and 2.6.1.2;

■ b. Removing and reserving section 3.1.2.2;

■ c. Revising sections 3.1.3.3 and 3.2.4;
■ d. Adding sections 3.2.4.1 through 3.2.4.3;
■ e. Revising sections 4.2.1, and 4.2.5; and
■ f. In section 6 revising References (1), (4), (6), (7), (9), (10), and (11) and table B–1.

The revisions and additions read as follows:

Appendix B to Part 58—Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring

* * * * *

2.6.1 Gaseous pollutant concentration standards (permeation devices or cylinders of compressed gas) used to obtain test concentrations for CO, SO_2, NO, and NO_2 must be EPA Protocol Gases certified in accordance with one of the procedures given in Reference 4 of this appendix.

2.6.1.1 The concentrations of EPA Protocol Gas standards used for ambient air monitoring must be certified with a 95-percent confidence interval to have an analytical uncertainty of no more than ±2.0 percent (inclusive) of the certified concentration (tag value) of the gas mixture. The uncertainty must be calculated in accordance with the statistical procedures defined in Reference 4 of this appendix.

2.6.1.2 Specialty gas producers advertising certification with the procedures provided in Reference 4 of this appendix and distributing gases as ''EPA Protocol Gas'' for ambient air monitoring purposes must adhere to the regulatory requirements specified in 40 CFR 75.21(g) or not use ''EPA'' in any form of advertising. The PSD PQAOs must provide information to the PSD reviewing authority on the specialty gas producers they use (or will use) for the duration of the PSD monitoring project. This information can be provided in the QAPP or monitoring plan but must be updated if there is a change in the specialty gas producers used.

* * * * *

3.1.3.3 Using audit gases that are verified against the NIST standard reference methods or special review procedures and validated per the certification periods specified in Reference 4 of this appendix (EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards) for CO, SO_2, and NO_2 and using O_3 analyzers that are verified quarterly against a standard reference photometer.

* * * * *

3.2.4 *$PM_{2.5}$ Performance Evaluation Program (PEP) Procedures.* The PEP is an independent assessment used to estimate total measurement system bias. These evaluations will be performed under the NPEP as described in section 2.4 of this appendix or a comparable program. Performance evaluations will be performed annually within each PQAO. For PQAOs with less than or equal to five monitoring sites, five valid performance evaluation audits must be collected and reported each year. For PQAOs with greater than five monitoring sites, eight valid performance evaluation audits must be collected and reported each year. A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and equal to or greater than 2 µg/m3. Siting of the PEP monitor must be consistent with section 3.2.3.4(c) of this appendix. However, any horizontal distance greater than 4 meters and any vertical distance greater than one meter must be reported to the EPA regional PEP coordinator. Additionally for every monitor designated as a primary monitor, a primary quality assurance organization must:

3.2.4.1 Have each method designation evaluated each year; and,

3.2.4.2 Have all FRM and FEM samplers subject to a PEP audit at least once every 6 years, which equates to approximately 15 percent of the monitoring sites audited each year.

3.2.4.3 Additional information concerning the PEP is contained in Reference 10 of this appendix. The calculations for evaluating bias between the primary monitor and the performance evaluation monitor for $PM_{2.5}$ are described in section 4.2.5 of this appendix.

* * * * *

4.2.1 *Collocated Quality Control Sampler Precision Estimate for PM_{10}, $PM_{2.5}$, and Pb.* Precision is estimated via duplicate measurements from collocated samplers. It is recommended that the precision be aggregated at the PQAO level quarterly, annually, and at the 3-year level. The data pair would only be considered valid if both concentrations are greater than or equal to the minimum values specified in section 4(c) of this appendix. For each collocated data pair, calculate t_i, using equation 6 to this appendix:

Equation 6 to Section 4.2.1 of Appendix B

$$t_i = \frac{X_i - Y_i}{\sqrt{(X_i - Y_i)/2}}$$

Where X_i is the concentration from the primary sampler and Y_i is the concentration value from the audit sampler. The coefficient of variation upper bound is calculated using equation 7 to this appendix:

Equation 7 to Section 4.2.1 of Appendix B

$$CV90_{NAAQS} = 100 * \sqrt{\frac{k \times \sum_{i=1}^{k} t_i^2 - \left(\sum_{i=1}^{k} t_i\right)^2}{2k(k-1)}} \times \sqrt{\frac{k-1}{NAAQS\ Concentration * X^2_{0.1,k-1}}}$$

Where k is the number of valid data pairs being aggregated, and $X^2_{0.1,k-1}$ is the 10th percentile of a chi-squared distribution with k-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that

each t_i is calculated from two values with error.

* * * * *

4.2.5 *Performance Evaluation Programs Bias Estimate for $PM_{2.5}$.* The bias estimate is calculated using the PEP audits described in section 3.2.4. of this appendix. The bias estimator is based on, s_i, the absolute difference in concentrations divided by the square root of the PEP concentration.

Equation 8 to Section 4.2.5 of Appendix B

$$100 \times \frac{\sum_{i=1}^{n} s_i}{n\sqrt{NAAQS\ concentration}} \quad \text{where} \quad s_i = \frac{meas - audit}{\sqrt{audit}}$$

* * * * *

6. References

(1) American National Standard Institute—Quality Management Systems For Environmental Information And Technology Programs—Requirements With Guidance For Use. ASQ/ANSI E4–2014. February 2014. Available from ANSI Webstore *https://webstore.ansi.org/.*

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(4) EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards. EPA–600/R–12/531. May, 2012. Available from U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Research Triangle Park NC 27711. *https://www.epa.gov/nscep.*

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(6) List of Designated Reference and Equivalent Methods. Available from U.S. Environmental Protection Agency, Center for Environmental Measurements and Modeling, Air Methods and Characterization Division, MD–D205–03, Research Triangle Park, NC 27711. *https://www.epa.gov/amtic/air-monitoring-methods-criteria-pollutants.*

(7) Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone. EPA–454/B–13–004 U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, October, 2013. *https://www.epa.gov/sites/default/files/2020-09/documents/ozonetransferstandardguidance.pdf.*

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(9) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 1—A Field Guide to Environmental Quality Assurance. EPA–600/R–94/038a. April 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#documents.*

(10) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program Quality System Development. EPA–454/B–13–003. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#documents.*

(11) National Performance Evaluation Program Standard Operating Procedures. *https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#npep.*

TABLE B–1 TO SECTION 6 OF APPENDIX B- MINIMUM DATA ASSESSMENT REQUIREMENTS FOR NAAQS RELATED CRITERIA POLLUTANT PSD MONITORS

Method	Assessment method	Coverage	Minimum frequency	Parameters reported	AQS Assessment type
Gaseous Methods (CO, NO_2, SO_2, O_3):					
One-Point QC for SO_2, NO_2, O_3, CO.	Response check at concentration 0.005–0.08 ppm SO_2, NO_2, O_3, & 0.5 and 5 ppm CO.	Each analyzer	Once per 2 weeks[5] ...	Audit concentration[1] and measured concentration[2].	One-Point QC.
Quarterly performance evaluation for SO_2, NO_2, O_3, CO.	See section 3.1.2 of this appendix.	Each analyzer	Once per quarter[5]	Audit concentration[1] and measured concentration[2] for each level.	Annual PE.
NPAP for SO_2, NO_2, O_3, CO[3].	Independent Audit	Each primary monitor	Once per year	Audit concentration[1] and measured concentration[2] for each level.	NPAP.
Particulate Methods:					
Collocated sampling PM_{10}, $PM_{2.5}$, Pb.	Collocated samplers	1 per PSD Network per pollutant.	Every 6 days or every 3 days if daily monitoring required.	Primary sampler concentration and duplicate sampler concentration[4].	No Transaction reported as raw data.
Flow rate verification PM_{10}, $PM_{2.5}$, Pb.	Check of sampler flow rate.	Each sampler	Once every month[5] ...	Audit flow rate and measured flow rate indicated by the sampler.	Flow Rate Verification.
Semi-annual flow rate audit PM_{10}, $PM_{2.5}$, Pb.	Check of sampler flow rate using independent standard.	Each sampler	Once every 6 months or beginning, middle and end of monitoring[5].	Audit flow rate and measured flow rate indicated by the sampler.	Semi Annual Flow Rate Audit.

TABLE B–1 TO SECTION 6 OF APPENDIX B- MINIMUM DATA ASSESSMENT REQUIREMENTS FOR NAAQS RELATED CRITERIA POLLUTANT PSD MONITORS—Continued

Method	Assessment method	Coverage	Minimum frequency	Parameters reported	AQS Assessment type
Pb analysis audits Pb-TSP, Pb-PM_{10}.	Check of analytical system with Pb audit strips/filters.	Analytical	Each quarter[5]	Measured value and audit value (ug Pb/filter) using AQS unit code 077 for parameters:. 14129—Pb (TSP) LC FRM/FEM. 85129—Pb (TSP) LC Non-FRM/FEM..	Pb Analysis Audits.
Performance Evaluation Program $PM_{2.5}$[3].	Collocated samplers	(1) 5 valid audits for PQAOs with <= 5 sites.. (2) 8 valid audits for PQAOs with > 5 sites.. (3) All samplers in 6 years.	Over all 4 quarters[5] ..	Primary sampler concentration and performance evaluation sampler concentration.	PEP.
Performance Evaluation Program Pb[3].	Collocated samplers	(1) 1 valid audit and 4 collocated samples for PQAOs, with <=5 sites.. (2) 2 valid audits and 6 collocated samples for PQAOs with >5 sites..	Over all 4 quarters[5] ..	Primary sampler concentration and performance evaluation sampler concentration. Primary sampler concentration and duplicate sampler concentration.	PEP.

[1] Effective concentration for open path analyzers.
[2] Corrected concentration, if applicable for open path analyzers.
[3] NPAP, $PM_{2.5}$, PEP, and Pb-PEP must be implemented if data is used for NAAQS decisions otherwise implementation is at PSD reviewing authority discretion.
[4] Both primary and collocated sampler values are reported as raw data
[5] A maximum number of days should be between these checks to ensure the checks are routinely conducted over time and to limit data impacts resulting from a failed check.

■ 28. Amend appendix C to part 58 by:
■ a. Adding sections 2.2 and 2.2.1 through 2.2.19;
■ b. Removing and reserving sections 2.4, 2.4.1;
■ c. Removing sections 2.4.1.1 through 2.4.1.7; and
■ d. Revising section 2.7.1.

The additions and revision reads as follows:

Appendix C to Part 58—Ambient Air Quality Monitoring Methodology

* * * * *

2.2 PM_{10}, $PM_{2.5}$, or $PM_{10-2.5}$ continuous FEMs with existing valid designations may be calibrated using network data from collocated FRM and continuous FEM data under the following provisions:

2.2.1 Data to demonstrate a calibration may include valid data from State, local, or Tribal air agencies or data collected by instrument manufacturers in accordance with 40 CFR 53.35 or other data approved by the Administrator.

2.2.2 A request to update a designated methods calibration may be initiated by the instrument manufacturer of record or the EPA Administrator. State, local, Tribal, and multijusistincional organizations of these entities may work with an instrument manufacture to update a designated method calibration.

2.2.3 Requests for approval of an updated PM_{10}, $PM_{2.5}$, or $PM_{10-2.5}$ continuous FEM calibration must meet the general submittal requirements of section 2.7 of this appendix.

2.2.4 Data included in the request should represent a subset of representative locations where the method is operational. For cases with a small number of collocated FRMs and continuous FEMs sites, an updated candidate calibration may be limited to the sites where both methods are in use.

2.2.5 Data included in a candidate method updated calibration may include a subset of sites where there is a large grouping of sites in one part of the country such that the updated calibration would be representative of the country as a whole.

2.2.6 Improvements should be national in scope and ideally implemented through a firmware change.

2.2.7 The goal of a change to a methods calibration is to increase the number of sites meeting measurements quality objectives of the method as identified in section 2.3.1.1 of appendix A to this part.

2.2.8 For meeting measurement quality objectives (MQOs), the primary objective is to meet the bias goal as this statistic will likely have the most influence on improving the resultant data collected.

2.2.9 Precision data are to be included, but so long as precision data are at least as good as existing network data or meet the MQO referenced in section 2.2.8 of this appendix, no further work is necessary with precision.

2.2.10 Data available to use may include routine primary and collocated data.

2.2.11 Audit data may be useful to confirm the performance of a candidate updated calibration but should not be used as the basis of the calibration to keep the independence of the audit data.

2.2.12 Data utilized as the basis of the updated calibration may be obtained by accessing EPA's AQS database or future analogous EPA database.

2.2.13 Years of data to use in a candidate method calibration should include two recent years where we are past the certification period for the previous year's data, which is May 1 of each year.

2.2.14 Data from additional years is to be used to test an updated calibration such that the calibration is independent of the test years of interest. Data from these additional years need to minimally demonstrate that a larger number of sites are expected to meet bias MQO especially at sites near the level of the NAAQS for the PM indicator of interest.

2.2.15 Outliers may be excluded using routine outlier tests.

2.2.16 The range of data used in a calibration may include all data available or alternatively use data in the range from the lowest measured data available up to 125% of the 24-hour NAAQS for the PM indicator of interest.

2.2.17 Other improvements to a PM continuous method may be included as part of a recommended update so long as appropriate testing is conducted with input from EPA's Office of Research and Development (ORD) Reference and Equivalent (R&E) Methods Designation program.

2.2.18 EPA encourages early communication by instrument manufacturers considering an update to a PM method. Instrument companies should initiate such dialogue by contacting EPA's ORD R&E Methods Designation program. The contact information for this can be found at 40 CFR 53.4.

2.2.19 Manufacturers interested in improving instrument's performance through an updated factory calibration must submit a written modification request to EPA with supporting rationale. Because the testing requirements and acceptance criteria of any field and/or lab tests can depend upon the nature and extent of the intended modification, applicants should contact EPA's R&E Methods Designation program for guidance prior to development of the modification request.

* * * * *

2.7.1 Requests for approval under sections 2.2, 2.4, 2.6.2, or 2.8 of this appendix must be submitted to: Director, Center for Environmental Measurement and Modeling, Reference and Equivalent Methods Designation Program (MD–D205–03), U.S. Environmental Protection Agency, P.O. Box 12055, Research Triangle Park, North Carolina 27711.

■ 29. Amend appendix D to part 58 by revising sections 1 and 1.1(b), the introductory text before the table in section 4.7.1(a), and sections 4.7.1(b)(3) and 4.7.2 to read as follows:

Appendix D to Part 58—Network Design Criteria for Ambient Air Quality Monitoring

* * * * *

1. Monitoring Objectives and Spatial Scales

The purpose of this appendix is to describe monitoring objectives and general criteria to be applied in establishing the required SLAMS ambient air quality monitoring stations and for choosing general locations for additional monitoring sites. This appendix also describes specific requirements for the number and location of FRM and FEM sites for specific pollutants, NCore multipollutant sites, PM_{10} mass sites, $PM_{2.5}$ mass sites, chemically-speciated $PM_{2.5}$ sites, and O_3 precursor measurements sites (PAMS). These criteria will be used by EPA in evaluating the adequacy of the air pollutant monitoring networks.

1.1 * * *

(b) Support compliance with ambient air quality standards and emissions strategy development. Data from FRM and FEM monitors for NAAQS pollutants will be used for comparing an area's air pollution levels against the NAAQS. Data from monitors of various types can be used in the development of attainment and maintenance plans. SLAMS, and especially NCore station data, will be used to evaluate the regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality. In monitoring locations near major air pollution sources, source-oriented monitoring data can provide insight into how well industrial sources are controlling their pollutant emissions.

* * * * *

4.7.1 * * *

(a) State and where applicable, local, agencies must operate the minimum number of required $PM_{2.5}$ SLAMS sites listed in table D–5 to this appendix. The NCore sites are expected to complement the $PM_{2.5}$ data collection that takes place at non-NCore SLAMS sites, and both types of sites can be used to meet the minimum $PM_{2.5}$ network requirements. For many State and local networks, the total number of $PM_{2.5}$ sites needed to support the basic monitoring objectives of providing air pollution data to the general public in a timely manner, support compliance with ambient air quality standards and emission strategy development, and support for air pollution research studies will include more sites than the minimum numbers required in table D–5 to this appendix. Deviations from these $PM_{2.5}$ monitoring requirements must be approved by the EPA Regional Administrator.

* * * * *

(b) * * *

(3) For areas with additional required SLAMS, a monitoring station is to be sited in an at-risk community with poor air quality, particularly where there are anticipated effects from sources in the area (*e.g.,* a major industrial area, point source(s), port, rail yard, airport, or other transportation facility or corridor).

* * * * *

4.7.2 Requirement for Continuous $PM_{2.5}$ Monitoring. The State, or where appropriate, local agencies must operate continuous $PM_{2.5}$ analyzers equal to at least one-half (round up) the minimum required sites listed in table D–5 to this appendix. At least one required continuous analyzer in each MSA must be collocated with one of the required FRM/FEM monitors, unless at least one of the required FRM/FEM monitors is itself a continuous FEM monitor in which case no collocation requirement applies. State and local air monitoring agencies must use methodologies and quality assurance/quality control (QA/QC) procedures approved by the EPA Regional Administrator for these required continuous analyzers.

* * * * *

■ 30. Revise appendix E to part 58 to read as follows:

Appendix E to Part 58—Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring

1. Introduction
2. Monitors and Samplers with Probe Inlets
3. Open Path Analyzers
4. Waiver Provisions
5. References

1. Introduction

1.1 Applicability

(a) This appendix contains specific location criteria applicable to ambient air quality monitoring probes, inlets, and optical paths of SLAMS, NCore, PAMS, and other monitor types whose data are intended to be used to determine compliance with the NAAQS. These specific location criteria are relevant after the general location has been selected based on the monitoring objectives and spatial scale of representation discussed in appendix D to this part. Monitor probe material and sample residence time requirements are also included in this appendix. Adherence to these siting criteria is necessary to ensure the uniform collection of compatible and comparable air quality data.

(b) The probe and monitoring path siting criteria discussed in this appendix must be followed to the maximum extent possible. It is recognized that there may be situations where some deviation from the siting criteria may be necessary. In any such case, the reasons must be thoroughly documented in a written request for a waiver that describes whether the resulting monitoring data will be representative of the monitoring area and how and why the proposed or existing siting must deviate from the criteria. This documentation should help to avoid later questions about the validity of the resulting monitoring data. Conditions under which the EPA would consider an application for waiver from these siting criteria are discussed in section 4 of this appendix.

(c) The pollutant-specific probe and monitoring path siting criteria generally apply to all spatial scales except where noted otherwise. Specific siting criteria that are phrased with ''shall'' or ''must'' are defined as requirements and exceptions must be granted through the waiver provisions. However, siting criteria that are phrased with ''should'' are defined as goals to meet for consistency but are not requirements.

2. Monitors and Samplers with Probe Inlets

2.1 Horizontal and Vertical Placement

(a) For O_3 and SO_2 monitoring, and for neighborhood or larger spatial scale Pb, PM_{10}, $PM_{10–2.5}$, $PM_{2.5}$, NO_2, and CO sites, the probe must be located greater than or equal to 2.0 meters and less than or equal to 15 meters above ground level.

(b) Middle scale CO and NO_2 monitors must have sampler inlets greater than or equal to 2.0 meters and less than or equal to 15 meters above ground level.

(c) Middle scale $PM_{10–2.5}$ sites are required to have sampler inlets greater than or equal to 2.0 meters and less than or equal to 7.0 meters above ground level.

(d) Microscale Pb, PM_{10}, $PM_{10–2.5}$, and $PM_{2.5}$ sites are required to have sampler inlets greater than or equal to 2.0 meters and less than or equal to 7.0 meters above ground level.

(e) Microscale near-road NO_2 monitoring sites are required to have sampler inlets greater than or equal to 2.0 meters and less than or equal to 7.0 meters above ground level.

(f) The probe inlets for microscale carbon monoxide monitors that are being used to

measure concentrations near roadways must be greater than or equal to 2.0 meters and less than or equal to 7.0 meters above ground level. Those probe inlets for microscale carbon monoxide monitors measuring concentrations near roadways in downtown areas or urban street canyons must be greater than or equal to 2.5 meters and less than or equal to 3.5 meters above ground level. The probe must be at least 1.0 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc., and away from dusty or dirty areas. If the probe is located near the side of a building or wall, then it should be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

2.2 Spacing From Minor Sources

(a) It is important to understand the monitoring objective for a particular site in order to interpret this requirement. Local minor sources of a primary pollutant, such as SO_2, lead, or particles, can cause high concentrations of that particular pollutant at a monitoring site. If the objective for that monitoring site is to investigate these local primary pollutant emissions, then the site will likely be properly located nearby. This type of monitoring site would, in all likelihood, be a microscale-type of monitoring site. If a monitoring site is to be used to determine air quality over a much larger area, such as a neighborhood or city, a monitoring agency should avoid placing a monitor probe inlet near local, minor sources, because a plume from a local minor source should not be allowed to inappropriately impact the air quality data collected at a site. Particulate matter sites should not be located in an unpaved area unless there is vegetative ground cover year-round, so that the impact of windblown dusts will be kept to a minimum.

(b) Similarly, local sources of nitric oxide (NO) and ozone-reactive hydrocarbons can have a scavenging effect causing unrepresentatively low concentrations of O_3 in the vicinity of probes for O_3. To minimize these potential interferences from nearby minor sources, the probe inlet should be placed at a distance from furnace or incineration flues or other minor sources of SO_2 or NO. The separation distance should take into account the heights of the flues, type of waste or fuel burned, and the sulfur content of the fuel.

2.3 Spacing From Obstructions

(a) Obstacles may scavenge SO_2, O_3, or NO_2, and can act to restrict airflow for any pollutant. To avoid this interference, the probe inlet must have unrestricted airflow pursuant to paragraph (b) of this section and should be located at a distance from obstacles. The horizontal distance from the obstacle to the probe inlet must be at least twice the height that the obstacle protrudes above the probe inlet. An obstacle that does not meet the minimum distance requirement is considered an obstruction that restricts airflow to the probe inlet. The EPA does not generally consider objects or obstacles such as flag poles or site towers used for NOy convertors and meteorological sensors, etc. to be deemed obstructions.

(b) A probe inlet located near or along a vertical wall is undesirable because air moving along the wall may be subject to removal mechanisms. A probe inlet must have unrestricted airflow with no obstructions (as defined in paragraph (a) of this section) in a continuous arc of at least 270 degrees. An unobstructed continuous arc of 180 degrees is allowable when the applicable network design criteria specified in appendix D of this part require monitoring in street canyons and the probe is located on the side of a building. This arc must include the predominant wind direction for the season of greatest pollutant concentration potential. For particle sampling, there must be a minimum of 2.0 meters of horizontal separation from walls, parapets, and structures for rooftop site placement.

(c) A sampling station with a probe inlet located closer to an obstacle than required by the criteria in this section should be classified as middle scale or microscale, rather than neighborhood or urban scale, since the measurements from such a station would more closely represent these smaller scales.

(d) For near-road monitoring stations, the monitor probe shall have an unobstructed air flow, where no obstacles exist at or above the height of the monitor probe, between the monitor probe and the outside nearest edge of the traffic lanes of the target road segment.

2.4 Spacing From Trees

(a) Trees can provide surfaces for SO_2, O_3, or NO_2 adsorption or reactions and surfaces for particle deposition. Trees can also act as obstructions in locations where the trees are between the air pollutant sources or source areas and the monitoring site and where the trees are of a sufficient height and leaf canopy density to interfere with the normal airflow around the probe inlet. To reduce this possible interference/obstruction, the probe inlet should be 20 meters or more from the drip line of trees and must be at least 10 meters from the drip line of trees. If a tree or group of trees is an obstacle, the probe inlet must meet the distance requirements of section 2.3 of this appendix.

(b) The scavenging effect of trees is greater for O_3 than for other criteria pollutants. Monitoring agencies must take steps to consider the impact of trees on ozone monitoring sites and take steps to avoid this problem.

(c) Beginning January 1, 2024, microscale sites of any air pollutant shall have no trees or shrubs located at or above the line-of-sight fetch between the probe and the source under investigation, *e.g.,* a roadway or a stationary source.

2.5 Spacing From Roadways

TABLE E–1 TO SECTION 2.5 OF APPENDIX E—MINIMUM SEPARATION DISTANCE BETWEEN ROADWAYS AND PROBES FOR MONITORING NEIGHBORHOOD AND URBAN SCALE OZONE (O_3) AND OXIDES OF NITROGEN (NO, NO_2, NO_X, NO_y)

Roadway average daily traffic, vehicles per day	Minimum distance[1] [3] (meters)	Minimum distance[1] [2] [3] (meters)
≤1,000	10	10
10,000	10	20
15,000	20	30
20,000	30	40
40,000	50	60
70,000	100	100
≥110,000	250	250

[1] Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count./ TNOTE≤

[2] Applicable for ozone monitors whose placement was not approved as of December 18, 2006.

[3] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

2.5.1 Spacing for Ozone Probes

In siting an O_3 monitor, it is important to minimize destructive interferences from sources of NO, since NO readily reacts with O_3. Table E–1 of this appendix provides the required minimum separation distances between a roadway and a probe inlet for various ranges of daily roadway traffic. A sampling site with a monitor probe located closer to a roadway than allowed by the Table E–1 requirements should be classified as middle scale or microscale, rather than neighborhood or urban scale, since the measurements from such a site would more closely represent these smaller scales.

2.5.2 Spacing for Carbon Monoxide Probes

(a) Near-road microscale CO monitoring sites, including those located in downtown areas, urban street canyons, and other near-road locations such as those adjacent to highly trafficked roads, are intended to provide a measurement of the influence of the immediate source on the pollution exposure on the adjacent area.

(b) Microscale CO monitor probe inlets in downtown areas or urban street canyon locations shall be located a minimum distance of 2.0 meters and a maximum distance of 10 meters from the edge of the nearest traffic lane.

(c) Microscale CO monitor probe inlets in downtown areas or urban street canyon locations shall be located at least 10 meters from an intersection, preferably at a midblock location. Midblock locations are preferable to intersection locations because intersections represent a much smaller portion of downtown space than do the streets between

them. Pedestrian exposure is probably also greater in street canyon/corridors than at intersections.

(d) Neighborhood scale CO monitor probe inlets in downtown areas or urban street canyon locations shall be located according to the requirements in Table E–2 of this appendix.

TABLE E–2 TO SECTION 2.5.2 OF APPENDIX E—MINIMUM SEPARATION DISTANCE BETWEEN ROADWAYS AND PROBES FOR MONITORING NEIGHBORHOOD SCALE CARBON MONOXIDE

Roadway average daily traffic, vehicles per day	Minimum distance [1] [2] (meters)
≤10,000	10
15,000	25
20,000	45
30,000	80
40,000	115
50,000	135
≥60,000	150

[1] Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

[2] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

2.5.3 Spacing for Particulate Matter ($PM_{2.5}$, $PM_{2.5–10}$, PM_{10}, Pb) Inlets

(a) Since emissions associated with the operation of motor vehicles contribute to urban area particulate matter ambient levels, spacing from roadway criteria are necessary for ensuring national consistency in PM sampler siting.

(b) The intent is to locate localized hot-spot sites in areas of highest concentrations, whether it be caused by mobile or multiple stationary sources. If the area is primarily affected by mobile sources and the maximum concentration area(s) is judged to be a traffic corridor or street canyon location, then the monitors should be located near roadways with the highest traffic volume and at separation distances most likely to produce the highest concentrations. For microscale traffic corridor sites, the location must be greater than or equal 5.0 meters and less than or equal to 15 meters from the major roadway. For the microscale street canyon site, the location must be greater than or equal 2.0 meters and less than or equal to 10 meters from the roadway. For the middle scale site, a range of acceptable distances from the roadway is shown in Figure E–1 of this appendix. This figure also includes separation distances between a roadway and neighborhood or larger scale sites by default. Any PM probe inlet at a site, 2.0 to 15 meters high, and further back than the middle scale requirements will generally be neighborhood, urban or regional scale. For example, according to Figure E–1 of this appendix, if a PM sampler is primarily influenced by roadway emissions and that sampler is set back 10 meters from a 30,000 ADT (average daily traffic) road, the site should be classified as microscale, if the sampler's inlet height is between 2.0 and 7.0 meters. If the sampler's inlet height is between 7.0 and 15 meters, the site should be classified as middle scale. If the sampler is 20 meters from the same road, it will be classified as middle scale; if 40 meters, neighborhood scale; and if 110 meters, an urban scale.

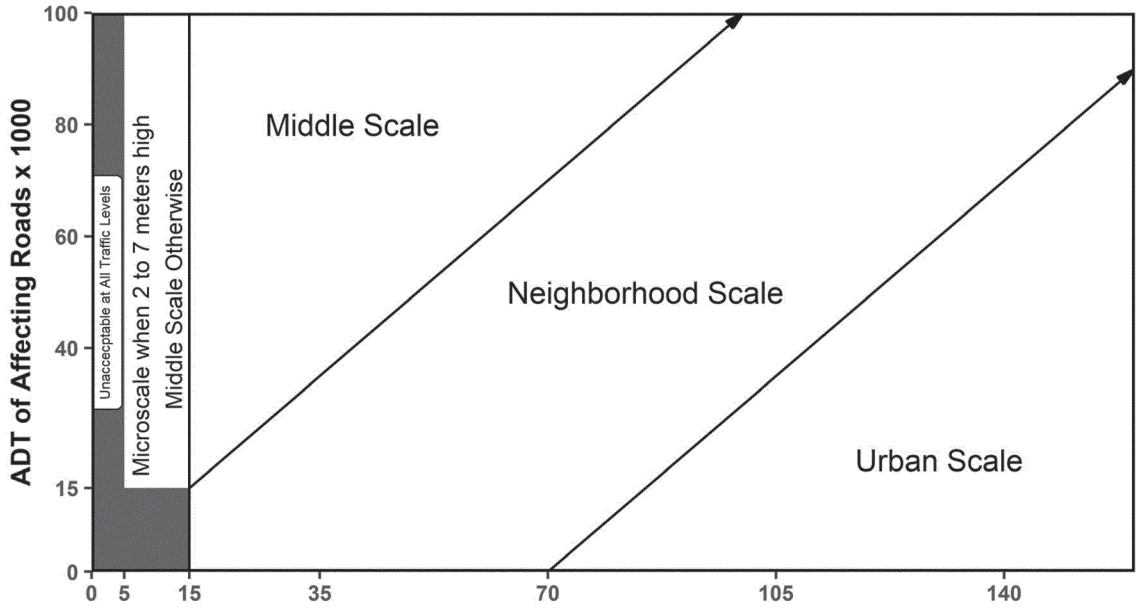

Figure E-1. Distance of PM Samplers to nearest traffic lane (meters)

Notes: Microscale street canyon sites must reside between 2 and 10 meters from the roadway.
Near-Road sites must be within 50 meters of the roadway.
The slopes of the lines between monitoring scales are one to one.

2.5.4 Spacing for Nitrogen Dioxide (NO_2) Probes

(a) In siting near-road NO_2 monitors as required in section 4.3.2 of appendix D of this part, the monitor probe shall be as near as practicable to the outside nearest edge of the traffic lanes of the target road segment but shall not be located at a distance greater than 50 meters, in the horizontal, from the outside nearest edge of the traffic lanes of the target road segment. Where possible, the near-road NO_2 monitor probe should be within 20 meters of the target road segment.

(b) In siting NO_2 monitors for neighborhood and larger scale monitoring, it is important to minimize near-road influences. Table E–1 of this appendix provides the required minimum separation distances between a roadway and a probe inlet for various ranges of daily roadway traffic. A site with a monitor probe located closer to a roadway than allowed by the Table E–1 requirements should be classified

as microscale or middle scale rather than neighborhood or urban scale.

2.6 Probe Material and Pollutant Sampler Residence Time

(a) For the reactive gases (SO_2, NO_2, and O_3), approved probe materials must be used for monitors. Studies[25 34] have been conducted to determine the suitability of materials such as polypropylene, polyethylene, polyvinyl chloride, Tygon®, aluminum, brass, stainless steel, copper, borosilicate glass, polyvinylidene fluoride (PVDF), polytetrafluoroethylene (PTFE), perfluoroalkoxy (PFA), and fluorinated ethylene propylene (FEP) for use as intake sampling lines. Of the above materials, only borosilicate glass, PVDF, PTFE, PFA, and FEP have been found to be acceptable for use as intake sampling lines for all the reactive gaseous pollutants. Furthermore, the EPA [25] has specified borosilicate glass, FEP Teflon®, or their equivalents as the only acceptable probe materials for delivering test atmospheres in the determination of reference or equivalent methods. Therefore, borosilicate glass, PVDF, PTFE, PFA, FEP, or their equivalents must be the only material in the sampling train (from probe inlet to the back of the monitor) that can be in contact with the ambient air sample for reactive gas monitors. Nafion™, which is composed primarily of PTFE, can be considered equivalent to PTFE; it has been shown in tests to exhibit virtually no loss of ozone at 20-second residence times.[35]

(b) For volatile organic compound (VOC) monitoring at PAMS, FEP Teflon® is unacceptable as the probe material because of VOC adsorption and desorption reactions on the FEP Teflon®. Borosilicate glass, stainless steel, or their equivalents are the acceptable probe materials for VOC and carbonyl sampling. Care must be taken to ensure that the sample residence time is kept to 20 seconds or less.

(c) No matter how nonreactive the sampling probe material is initially, after a period of use, reactive particulate matter is deposited on the probe walls. Therefore, the time it takes the gas to transfer from the probe inlet to the sampling device is critical. Ozone in the presence of nitrogen oxide (NO) will show significant losses, even in the most inert probe material, when the residence time exceeds 20 seconds.[26] Other studies [27 28]indicate that a 10-second or less residence time is easily achievable. Therefore, sampling probes for all reactive gas monitors for SO_2, NO_2, and O_3 must have a sample residence time less than 20 seconds.

2.7 Summary

Table E–3 of this appendix presents a summary of the general requirements for probe siting criteria with respect to distances and heights. Table E–3 requires different elevation distances above the ground for the various pollutants. The discussion in this appendix for each of the pollutants describes reasons for elevating the monitor or probe inlet. The differences in the specified range of heights are based on the vertical concentration gradients. For source oriented and near-road monitors, the gradients in the vertical direction are very large for the microscale, so a small range of heights are used. The upper limit of 15 meters is specified for the consistency between pollutants and to allow the use of a single manifold for monitoring more than one pollutant.

TABLE E–3 TO SECTION 2.7 OF APPENDIX E—SUMMARY OF PROBE SITING CRITERIA

Pollutant	Scale [9]	Height from ground to probe [8] (meters)	Horizontal or vertical distance from supporting structures [1 8] to probe inlet (meters)	Distance from drip line of trees to probe [8] (meters)	Distance from roadways to probe [8] (meters)
SO_2 [2 3 4 5]	Middle, Neighborhood, Urban, and Regional.	2.0–15	≥1.0	≥10	N/A.
CO [3 4 6]	Micro [downtown or street canyon sites].	2.5–3.5			2.0–10 for downtown areas or street canyon microscale.
	Micro [Near-Road sites]	2.0–7.0	≥1.0	≥10	≤50 for near-road microscale.
	Middle and Neighborhood	2.0–15			*See* Table E–2 of this appendix for middle and neighborhood scales.
O_3 [2 3 4]	Middle, Neighborhood, Urban, and Regional.	2.0–15	≥1.0	≥10	*See* Table E–1.
	Micro	2.0–7.0			≤50 for near-road micro-scale.
NO_2 [2 3 4]	Middle, Neighborhood, Urban, and Regional.	2.0–15	≥1.0	≥10	*See* Table E–1.
PAMS [2 3 4] Ozone precursors	Neighborhood and Urban	2.0–15	≥1.0	≥10	*See* Table E–1.
PM, Pb [2 3 4 7]	Micro	2.0–7.0			
	Middle, Neighborhood, Urban and Regional.	2.0–15	≥2.0 (horizontal distance only)	≥10	*See* Figure E–1.

N/A—Not applicable.

[1] When a probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.

[2] Should be greater than 20 meters from the dripline of tree(s) and must be 10 meters from the dripline.

[3] Distance from sampler or probe inlet to obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler or probe inlet. Sites not meeting this criterion may be classified as microscale or middle scale (*see* paragraphs 2.3(a) and 2.3(c)).

[4] Must have unrestricted airflow in a continuous arc of at least 270 degrees around the probe or sampler; 180 degrees if the probe is on the side of a building or a wall for street canyon monitoring.

[5] The probe or sampler should be away from minor sources, such as furnace or incineration flues. The separation distance is dependent on the height of the minor source emission point(s), the type of fuel or waste burned, and the quality of the fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.

[6] For microscale CO monitoring sites, the probe must be ≥10 meters from a street intersection and preferably at a midblock location.

[7] Collocated monitor inlets must be within 4.0 meters of each other and at least 2.0 meters apart for flow rates greater than 200 liters/min or at least 1.0 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference, unless a waiver has been granted by the Regional Administrator pursuant to paragraph 3.3.4.2(c) of appendix A of part 58. For $PM_{2.5}$, collocated monitor inlet heights should be within 1.0 meter of each other vertically.

[8] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

[9] See section 1.2 of appendix D for definitions of monitoring scales.

3. Open Path Analyzers

3.1 Horizontal and Vertical Placement

(a) For all O_3 and SO_2 monitoring sites and for neighborhood or larger spatial scale NO_2, and CO sites, at least 80 percent of the monitoring path must be located greater than or equal 2.0 meters and less than or equal to 15 meters above ground level.

(b) Middle scale CO and NO_2 sites must have monitoring paths greater than or equal 2.0 meters and less than or equal to 15 meters above ground level.

(c) Microscale near-road monitoring sites are required to have monitoring paths greater than or equal 2.0 meters and less than or equal to 7.0 meters above ground level.

(d) For microscale carbon monoxide monitors that are being used to measure concentrations near roadways, the monitoring path must be greater than or equal 2.0 meters and less than or equal to 7.0 meters above ground level. If the microscale carbon monoxide monitors measuring concentrations near roadways are in downtown areas or urban street canyons, the monitoring path must be greater than or equal 2.5 meters and less than or equal to 3.5 meters above ground level and at least 90

percent of the monitoring path must be at least 1.0 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc., and away from dusty or dirty areas. If a significant portion of the monitoring path is located near the side of a building or wall, then it should be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

3.2 Spacing From Minor Sources

(a) It is important to understand the monitoring objective for a particular site in order to interpret this requirement. Local minor sources of a primary pollutant, such as SO_2 can cause high concentrations of that particular pollutant at a monitoring site. If the objective for that monitoring site is to investigate these local primary pollutant emissions, then the site will likely be properly located nearby. This type of monitoring site would, in all likelihood, be a microscale type of monitoring site. If a monitoring site is to be used to determine air quality over a much larger area, such as a neighborhood or city, a monitoring agency should avoid placing a monitoring path near local, minor sources, because a plume from a local minor source should not be allowed to inappropriately impact the air quality data collected at a site.

(b) Similarly, local sources of nitric oxide (NO) and ozone-reactive hydrocarbons can have a scavenging effect causing unrepresentatively low concentrations of O_3 in the vicinity of monitoring paths for O_3. To minimize these potential interferences from nearby minor sources, at least 90 percent of the monitoring path should be at a distance from furnace or incineration flues or other minor sources of SO_2 or NO. The separation distance should take into account the heights of the flues, type of waste or fuel burned, and the sulfur content of the fuel.

3.3 Spacing From Obstructions

(a) Obstacles may scavenge SO_2, O_3, or NO_2, and can act to restrict airflow for any pollutant. To avoid this interference, at least 90 percent of the monitoring path must have unrestricted airflow and should be located at a distance from obstacles. The horizontal distance from the obstacle to the monitoring path must be at least twice the height that the obstacle protrudes above the monitoring path. An obstacle that does not meet the minimum distance requirement is considered an obstruction that restricts airflow to the monitoring path. The EPA does not generally consider objects or obstacles such as flag poles or site towers used for NOy convertors and meteorological sensors, etc. to be deemed obstructions.

(b) A monitoring path located near or along a vertical wall is undesirable because air moving along the wall may be subject to removal mechanisms. At least 90 percent of the monitoring path for open path analyzers must have unrestricted airflow with no obstructions (as defined in paragraph (a) of this section) in a continuous arc of at least 270 degrees. An unobstructed continuous arc of 180 degrees is allowable when the applicable network design criteria specified in appendix D of this part require monitoring in street canyons and the monitoring path is located on the side of a building. This arc must include the predominant wind direction for the season of greatest pollutant concentration potential.

(c) Special consideration must be given to the use of open path analyzers given their inherent potential sensitivity to certain types of interferences and optical obstructions. A monitoring path must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc. Temporary optical obstructions, such as rain, particles, fog, or snow, should be considered when siting an open path analyzer. Any of these temporary obstructions that are of sufficient density to obscure the light beam will negatively affect the ability of the open path analyzer to continuously measure pollutant concentrations. Transient, but significant obscuration of especially longer measurement paths, could occur as a result of certain meteorological conditions (*e.g.,* heavy fog, rain, snow) and/or aerosol levels that are of a sufficient density to prevent the open path analyzer's light transmission. If certain compensating measures are not otherwise implemented at the onset of monitoring (*e.g.,* shorter path lengths, higher light source intensity), data recovery during periods of greatest primary pollutant potential could be compromised. For instance, if heavy fog or high particulate levels are coincident with periods of projected NAAQS-threatening pollutant potential, the representativeness of the resulting data record in reflecting maximum pollution concentrations may be substantially impaired despite the fact that the site may otherwise exhibit an acceptable, even exceedingly high, overall valid data capture rate.

(d) A sampling station with a monitoring path located closer to an obstacle than required by the criteria in this section should be classified as middle scale or microscale, rather than neighborhood or urban scale, since the measurements from such a station would more closely represent these smaller scales.

(e) For near-road monitoring stations, the monitoring path shall have an unobstructed air flow, where no obstacles exist at or above the height of the monitoring path, between the monitoring path and the outside nearest edge of the traffic lanes of the target road segment.

3.4 Spacing From Trees

(a) Trees can provide surfaces for SO_2, O_3, or NO_2 adsorption or reactions. Trees can also act as obstructions in locations where the trees are located between the air pollutant sources or source areas and the monitoring site, and where the trees are of a sufficient height and leaf canopy density to interfere with the normal airflow around the monitoring path. To reduce this possible interference/obstruction, at least 90 percent of the monitoring path should be 20 meters or more from the drip line of trees and must be at least 10 meters from the drip line of trees. If a tree or group of trees could be considered an obstacle, the monitoring path must meet the distance requirements of section 3.3 of this appendix.

(b) The scavenging effect of trees is greater for O_3 than for other criteria pollutants. Monitoring agencies must take steps to consider the impact of trees on ozone monitoring sites and take steps to avoid this problem.

(c) Beginning January 1, 2024, microscale sites of any air pollutant shall have no trees or shrubs located at or above the line-of-sight fetch between the monitoring path and the source under investigation, *e.g.,* a roadway or a stationary source.

3.5 Spacing from Roadways

TABLE E–4 OF SECTION 3.5 OF APPENDIX E—MINIMUM SEPARATION DISTANCE BETWEEN ROADWAYS AND MONITORING PATHS FOR MONITORING NEIGHBORHOOD AND URBAN SCALE OZONE (O**3**) AND OXIDES OF NITROGEN (NO, NO**2**, NO**X**, NO**y**)

Roadway average daily traffic, vehicles per day	Minimum distance [1] [3] (meters)	Minimum distance [1] [2] [3] (meters)
≤1,000	10	10
10,000	10	20
15,000	20	30
20,000	30	40
40,000	50	60
70,000	100	100
≥110,000	250	250

[1] Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

[2] Applicable for ozone open path monitors whose placement was not approved as of December 18, 2006.

[3] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

3.5.1 Spacing for Ozone Monitoring Paths

In siting an O_3 open path analyzer, it is important to minimize destructive interferences form sources of NO, since NO readily reacts with O_3. Table E–4 of this appendix provides the required minimum separation distances between a roadway and at least 90 percent of a monitoring path for various ranges of daily roadway traffic. A monitoring site with a monitoring path located closer to a roadway than allowed by the Table E–4 requirements should be classified as microscale or middle scale, rather than neighborhood or urban scale, since the measurements from such a site would more closely represent these smaller scales. The monitoring path(s) must not cross over a roadway with an average daily traffic count of 10,000 vehicles per day or more. For locations where a monitoring path crosses a roadway with fewer than 10,000 vehicles per day, monitoring agencies must consider the entire segment of the monitoring path in the area of potential atmospheric interference from automobile emissions. Therefore, this

calculation must include the length of the monitoring path over the roadway plus any segments of the monitoring path that lie in the area between the roadway and minimum separation distance, as determined from Table E–4 of this appendix. The sum of these distances must not be greater than 10 percent of the total monitoring path length.

3.5.2 Spacing for Carbon Monoxide Monitoring Paths

(a) Near-road microscale CO monitoring sites, including those located in downtown areas, urban street canyons, and other near-road locations such as those adjacent to highly trafficked roads, are intended to provide a measurement of the influence of the immediate source on the pollution exposure on the adjacent area.

(b) Microscale CO monitoring paths in downtown areas or urban street canyon locations shall be located a minimum distance of 2.0 meters and a maximum distance of 10 meters from the edge of the nearest traffic lane.

(c) Microscale CO monitoring paths in downtown areas or urban street canyon locations shall be located at least 10 meters from an intersection, preferably at a midblock location. Midblock locations are preferable to intersection locations because intersections represent a much smaller portion of downtown space than do the streets between them. Pedestrian exposure is probably also greater in street canyon/corridors than at intersections.

(d) Neighborhood scale CO monitoring paths in downtown areas or urban street canyon locations shall be located according to the requirements in Table E–5 of this appendix.

TABLE E–5 SECTION 3.5.2 OF APPENDIX E—MINIMUM SEPARATION DISTANCE BETWEEN ROADWAYS AND MONITORING PATHS FOR MONITORING NEIGHBORHOOD SCALE CARBON MONOXIDE

Roadway average daily traffic, vehicles per day	Minimum distance [1] [2] (meters)
≤10,000	10
15,000	25
20,000	45
30,000	80
40,000	115
50,000	135
≥60,000	150

[1] Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

[2] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

3.5.3 Spacing for Nitrogen Dioxide (NO_2) Monitoring Paths

(a) In siting near-road NO_2 monitors as required in section 4.3.2 of appendix D of this part, the monitoring path shall be as near as practicable to the outside nearest edge of the traffic lanes of the target road segment but shall not be located at a distance greater than 50 meters, in the horizontal, from the outside nearest edge of the traffic lanes of the target road segment.

(b) In siting NO_2 open path monitors for neighborhood and larger scale monitoring, it is important to minimize near-road influences. Table E–5 of this appendix provides the required minimum separation distances between a roadway and at least 90 percent of a monitoring path for various ranges of daily roadway traffic. A site with a monitoring path located closer to a roadway than allowed by the Table E–4 requirements should be classified as microscale or middle scale rather than neighborhood or urban scale. The monitoring path(s) must not cross over a roadway with an average daily traffic count of 10,000 vehicles per day or more. For locations where a monitoring path crosses a roadway with fewer than 10,000 vehicles per day, monitoring agencies must consider the entire segment of the monitoring path in the area of potential atmospheric interference form automobile emissions. Therefore, this calculation must include the length of the monitoring path over the roadway plus any segments of the monitoring path that lie in the area between the roadway and minimum separation distance, as determined from Table E–5 of this appendix. The sum of these distances must not be greater than 10 percent of the total monitoring path length.

3.6 Cumulative Interferences on a Monitoring Path

The cumulative length or portion of a monitoring path that is affected by minor sources, trees, or roadways must not exceed 10 percent of the total monitoring path length.

3.7 Maximum Monitoring Path Length

The monitoring path length must not exceed 1.0 kilometer for open path analyzers in neighborhood, urban, or regional scale. For middle scale monitoring sites, the monitoring path length must not exceed 300 meters. In areas subject to frequent periods of dust, fog, rain, or snow, consideration should be given to a shortened monitoring path length to minimize loss of monitoring data due to these temporary optical obstructions. For certain ambient air monitoring scenarios using open path analyzers, shorter path lengths may be needed in order to ensure that the monitoring site meets the objectives and spatial scales defined in appendix D to this part. The Regional Administrator may require shorter path lengths, as needed on an individual basis, to ensure that the SLAMS sites meet the appendix D requirements. Likewise, the Administrator may specify the maximum path length used at NCore monitoring sites.

3.8 Summary

Table E–6 of this appendix presents a summary of the general requirements for monitoring path siting criteria with respect to distances and heights. Table E–6 requires different elevation distances above the ground for the various pollutants. The discussion in this appendix for each of the pollutants describes reasons for elevating the monitoring path. The differences in the specified range of heights are based on the vertical concentration gradients. For source oriented and near-road monitors, the gradients in the vertical direction are very large for the microscale, so a small range of heights are used. The upper limit of 15 meters is specified for the consistency between pollutants and to allow the use of a monitoring path for monitoring more than one pollutant.

TABLE E–6 SECTION 3.8 OF APPENDIX E—SUMMARY OF MONITORING PATH SITING CRITERIA

Pollutant	Maximum monitoring path length [9] [10]	Height from ground to 80% of monitoring path [1] [8] (meters)	Horizontal or vertical distance from supporting structures [2] to 90% of monitoring path [1] [8] (meters)	Distance from trees to 90% of monitoring path [1] [8] (meters)	Distance from roadways to monitoring path [1] [8] (meters)
SO_2 [3] [4] [5] [6]	<= 300 m for Middle <= 1.0 km for Neighborhood, Urban, and Regional	2.0–15	≥1.0	≥10	N/A.
CO [4] [5] [7]	<= 300 m for Micro [downtown or street canyon sites].	2.5–3.5	≥1.0	≥10	2.0–10 for downtown areas or street canyon microscale.
	<= 300 m for Micro [Near-Road sites].	2.0–7.0			≤50 for near-road microscale.

TABLE E–6 SECTION 3.8 OF APPENDIX E—SUMMARY OF MONITORING PATH SITING CRITERIA—Continued

Pollutant	Maximum monitoring path length [9] [10]	Height from ground to 80% of monitoring path [1] [8] (meters)	Horizontal or vertical distance from supporting structures [2] to 90% of monitoring path [1] [8] (meters)	Distance from trees to 90% of monitoring path [1] [8] (meters)	Distance from roadways to monitoring path [1] [8] (meters)
	<= 300 m for Middle	2.0–15			*See* Table E–5 of this appendix for middle and neighborhood scales.
	<= 1.0 km for Neighborhood.				
O_3 [3] [4] [5]	<= 300 m for Middle.				
	<= 1.0 km for Neighborhood, Urban, and Regional.	2.0–15	≥1.0	≥10	*See* Table E–4.
NO_2 [3] [4] [5]	Between 50 m–300 m for Micro (Near-Road).	2.0–7.0			≤50 for near-road micro-scale.
	<= 300 m for Middle		≥1.0	≥10	
	<= 1.0 km for Neighborhood, Urban, and Regional.	2.0–15			*See* Table E–4.
PAMS [3] [4] [5] Ozone precursors	<= 1.0 km for Neighborhood and Urban.	2.0–15	≥1.0	≥10	*See* Table E–4.

N/A—Not applicable.

[1] Monitoring path for open path analyzers is applicable only to middle or neighborhood scale CO monitoring, middle, neighborhood, urban, and regional scale NO_2 monitoring, and all applicable scales for monitoring SO_2, O_3, and O_3 precursors.

[2] When the monitoring path is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on roof.

[3] At least 90 percent of the monitoring path should be greater than 20 meters from the dripline of tree(s) and must be 10-meters from the dripline.

[4] Distance from 90 percent of monitoring path to obstacle, such as a building, must be at least twice the height the obstacle protrudes above the monitoring path. Sites not meeting this criterion may be classified as microscale or middle scale (*see* text).

[5] Must have unrestricted airflow 270 degrees around at least 90 percent of the monitoring path; 180 degrees if the monitoring path is adjacent to the side of a building or a wall for street canyon monitoring.

[6] The monitoring path should be away from minor sources, such as furnace or incineration flues. The separation distance is dependent on the height of the minor source's emission point (such as a flue), the type of fuel or waste burned, and the quality of the fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.

[7] For microscale CO monitoring sites, the monitoring path must be ≥10. meters from a street intersection and preferably at a midblock location.

[8] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.

[9] See section 1.2 of appendix D for definitions of monitoring scales.

[10] See section 3.7 of this appendix.

4. Waiver Provisions

Most sampling probes or monitors can be located so that they meet the requirements of this appendix. New sites, with rare exceptions, can be located within the limits of this appendix. However, some existing sites may not meet these requirements and may still produce useful data for some purposes. The EPA will consider a written request from the State, or where applicable local, agency to waive one or more siting criteria for some monitoring sites providing that the State or their designee can adequately demonstrate the need (purpose) for monitoring or establishing a monitoring site at that location.

4.1 For a proposed new site, a waiver may be granted only if both the following criteria are met:

4.1.1 The proposed new site can be demonstrated to be as representative of the monitoring area as it would be if the siting criteria were being met.

4.1.2 The monitor or probe cannot reasonably be located so as to meet the siting criteria because of physical constraints (*e.g.,* inability to locate the required type of site the necessary distance from roadways or obstructions).

4.2 For an existing site, a waiver may be granted if either the criterion in section 4.1.1 or the criterion in 4.1.2 of this appendix is met.

4.3 Cost benefits, historical trends, and other factors may be used to add support to the criteria in sections 4.1.1 and 4.1.2 of this appendix; however, by themselves, they will not be acceptable reasons for the EPA to grant a waiver. Written requests for waivers must be submitted to the Regional Administrator. Granted waivers must be renewed minimally every 5 years and ideally as part of the network assessment as defined in § 58.10(d). The approval date of the waiver must be documented in the annual monitoring network plan to support the requirements of § 58.10(a)(1) and 58.10(b)(10).

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■ 31. Revise appendix G to part 58 to read as follows:

Appendix G to Part 58—Uniform Air Quality Index (AQI) and Daily Reporting

1. General Information
2. Reporting Requirements
3. Data Handling

1. General Information

1.1 *AQI Overview.* The AQI is a tool that simplifies reporting air quality to the public in a nationally uniform and easy to understand manner. The AQI converts concentrations of pollutants, for which the EPA has established a national ambient air quality standard (NAAQS), into a uniform scale from 0–500. These pollutants are ozone (O_3), particulate matter ($PM_{2.5}$, PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). The scale of the index is divided into general categories that are associated with health messages.

2. Reporting Requirements

2.1 *Applicability.* The AQI must be reported daily for a metropolitan statistical area (MSA) with a population over 350,000. When it is useful and possible, it is recommended, but not required for an area to report a sub-daily AQI as well.

2.2 *Contents of AQI Report.*

2.2.1 *Content of AQI Report Requirements.* An AQI report must contain the following:

a. The reporting area(s) (the MSA or subdivision of the MSA).

b. The reporting period (the day for which the AQI is reported).

c. The main pollutant (the pollutant with the highest index value).

d. The AQI (the highest index value).

e. The category descriptor and index value associated with the AQI and, if choosing to report in a color format, the associated color. Use only the following descriptors and colors for the six AQI categories:

TABLE 1 TO SECTION 2 OF APPENDIX G—AQI CATEGORIES

For this AQI	Use this descriptor	And this color [1]
0 to 50	"Good"	Green.
51 to 100	"Moderate"	Yellow.
101 to 150	"Unhealthy for Sensitive Groups"	Orange.
151 to 200	"Unhealthy"	Red.
201 to 300	"Very Unhealthy"	Purple.
301 and above	"Hazardous"	Maroon[1].

[1]Specific color definitions can be found in the most recent reporting guidance (Technical Assistance Document for the Reporting of Daily Air Quality), which can be found at *https://www.airnow.gov/publications/air-quality-index/technical-assistance-document-for-reporting-the-daily-aqi/.*

f. The pollutant specific sensitive groups for any reported index value greater than 100. The sensitive groups for each pollutant are identified as part of the periodic review of the air quality criteria and the NAAQS. For convenience, the EPA lists the relevant groups for each pollutant in the most recent reporting guidance (Technical Assistance Document for the Reporting of Daily Air Quality), which can be found at *https://www.airnow.gov/publications/air-quality-index/technical-assistance-document-for-reporting-the-daily-aqi/.*

2.2.2 *Contents of AQI Report When Applicable.* When appropriate, the AQI report may also contain the following, but such information is not required:

a. Appropriate health and cautionary statements.

b. The name and index value for other pollutants, particularly those with an index value greater than 100.

c. The index values for sub-areas of your MSA.

d. Causes for unusually high AQI values.

e. Pollutant concentrations.

f. Generally, the AQI report applies to an area's MSA only. However, if a significant air quality problem exists (AQI greater than 100) in areas significantly impacted by the MSA but not in it (for example, O_3 concentrations are often highest downwind and outside an urban area), the report should identify these areas and report the AQI for these areas as well.

2.3. *Communication, Timing, and Frequency of AQI Report.* The daily AQI must be reported 7 days per week and made available via website or other means of public access. The daily AQI report represents the air quality for the previous day. Exceptions to this requirement are in section 2.4 of this appendix.

a. Reporting the AQI sub-daily is recommended, but not required, to provide more timely air quality information to the public for making health-protective decisions.

b. Submitting hourly data in real-time to the EPA's AirNow (or future analogous) system is recommended, but not required, and assists the EPA in providing timely air quality information to the public for making health-protective decisions.

c. Submitting hourly data for appropriate monitors (referenced in section 3.2 of this appendix) satisfies the daily AQI reporting requirement because the AirNow system makes daily and sub-daily AQI reports widely available through its website and other communication tools.

d. Forecasting the daily AQI provides timely air quality information to the public and is recommended but not required. Sub-daily forecasts are also recommended, especially when air quality is expected to vary substantially throughout the day, like during wildfires. Long-term (multi-day) forecasts can also be made available when useful.

2.4. *Exceptions to Reporting Requirements.*

a. If the index value for a particular pollutant remains below 50 for a season or year, then it may be excluded from the calculation of the AQI in section 3 of this appendix.

b. If all index values remain below 50 for a year, then the AQI may be reported at the discretion of the reporting agency. In subsequent years, if pollutant levels rise to where the AQI would be above 50, then the AQI must be reported as required in section 2 of this appendix.

c. As previously mentioned in section 2.3 of this appendix, submitting hourly data in real-time from appropriate monitors (referenced in section 3.2 of this appendix) to the EPA's AirNow (or future analogous) system satisfies the daily AQI reporting requirement.

3. Data Handling.

3.1 *Relationship of AQI and pollutant concentrations.* For each pollutant, the AQI transforms ambient concentrations to a scale from 0 to 500. As appropriate, the AQI is associated with the NAAQS for each pollutant. In most cases, the index value of 100 is associated with the numerical level of the short-term standard (*i.e.,* averaging time of 24-hours or less) for each pollutant. The index value of 50 is associated with the numerical level of the annual standard for a pollutant, if there is one, at one-half the level of the short-term standard for the pollutant or at the level at which it is appropriate to begin to provide guidance on cautionary language. Higher categories of the index are based on the potential for increasingly serious health effects to occur following exposure and increasing proportions of the population that are likely to be affected. The reported AQI corresponds to the pollutant with the highest calculated AQI. For the purposes of reporting the AQI, the sub-indexes for PM_{10} and $PM_{2.5}$ are to be considered separately. The pollutant responsible for the highest index value (the reported AQI) is called the ''main'' pollutant for that day.

3.2 *Monitors Used for AQI Reporting.* Concentration data from State/Local Air Monitoring Station (SLAMS) or parts of the SLAMS required by 40 CFR 58.10 must be used for each pollutant except PM. For PM, calculate and report the AQI on days for which air quality data has been measured (*e.g.,* from continuous $PM_{2.5}$ monitors required in appendix D to this part). PM measurements may be used from monitors that are not reference or equivalent methods (for example, continuous PM_{10} or $PM_{2.5}$ monitors). Detailed guidance for relating non-approved measurements to approved methods by statistical linear regression is referenced here:

Reference for relating non-approved PM measurements to approved methods (Eberly, S., T. Fitz-Simons, T. Hanley, L. Weinstock., T. Tamanini, G. Denniston, B. Lambeth, E. Michel, S. Bortnick. Data Quality Objectives (DQOs) For Relating Federal Reference Method (FRM) and Continuous $PM_{2.5}$ Measurements to Report an Air Quality Index (AQI). U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA–454/B–02–002, November 2002).

3.3 *AQI Forecast.* The AQI can be forecasted at least 24-hours in advance using the most accurate and reasonable procedures considering meteorology, topography, availability of data, and forecasting expertise. The guidance document, ''Guidelines for Developing an Air Quality (Ozone and $PM_{2.5}$) Forecasting Program,'' can be found at *https://www.airnow.gov/publications/weathercasters/guidelines-developing-air-quality-forecasting-program/.*

3.4 *Calculation and Equations.*

a. The AQI is the highest value calculated for each pollutant as follows:

i. Identify the highest concentration among all of the monitors within each reporting area and truncate as follows:

(A) Ozone—truncate to 3 decimal places
$PM_{2.5}$—truncate to 1 decimal place
PM_{10}—truncate to integer
CO—truncate to 1 decimal place
SO_2—truncate to integer
NO_2—truncate to integer

(B) [Reserved]

ii. Using table 2 to this appendix, find the two breakpoints that contain the concentration.

iii. Using equation 1 to this appendix, calculate the index.

iv. Round the index to the nearest integer.

TABLE 2 TO SECTION 3.4 OF APPENDIX G—BREAKPOINTS FOR THE AQI

These breakpoints							Equal these AQI's	
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ (µg/m^3) 24-hour	PM_{10} (µg/m^3) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	Category
0.000–0.054	.....	0.0–9.0	0–54	0.0–4.4	0–35	0–53	0–50	Good.
0.055–0.070	.....	9.1–35.4	55–154	4.5–9.4	36–75	54–100	51–100	Moderate.
0.071–0.085	0.125–0.164	35.5–55.4	155–254	9.5–12.4	76–185	101–360	101–150	Unhealthy for Sensitive Groups.
0.086–0.105	0.165–0.204	55.5–125.4	255–354	12.5–15.4	[3]186–304	361–649	151–200	Unhealthy.
0.106–0.200	0.205–0.404	125.5—225.4	355–424	15.5–30.4	[3]305–604	650–1249	201–300	Very Unhealthy.

TABLE 2 TO SECTION 3.4 OF APPENDIX G—BREAKPOINTS FOR THE AQI—Continued

These breakpoints							Equal these AQI's	
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ (µg/m³) 24-hour	PM_{10} (µg/m³) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	Category
0.201 – (2)	0.405+	225.5+	425+	30.5+	[3] 605+	1250+	301+	[4] Hazardous.

[1] Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.
[2] 8-hour O_3 concentrations do not define higher AQI values (≤301). AQI values > 301 are calculated with 1-hour O_3 concentrations.
[3] 1-hr SO_2 concentrations do not define higher AQI values (≥200). AQI values of 200 or greater are calculated with 24-hour SO_2 concentration.
[4] AQI values between breakpoints are calculated using equation 1 to this appendix. For AQI values in the hazardous category, AQI values greater than 500 should be calculated using equation 1 and the concentration specified for the AQI value of 500. The AQI value of 500 are as follows: O_3 1-hour—0.604 ppm; $PM_{2.5}$ 24-hour—325.4 µg/m³; PM_{10} 24-hour—604 µg/m³; CO ppm—50.4 ppm; SO_2 1-hour—1004 ppb; and NO_2 1-hour—2049 ppb.

b. If the concentration is equal to a breakpoint, then the index is equal to the corresponding index value in table 2 to this appendix. However, equation 1 to this appendix can still be used. The results will be equal. If the concentration is between two breakpoints, then calculate the index of that pollutant with equation 1. It should also be noted that in some areas, the AQI based on 1-hour O_3 will be more precautionary than using 8-hour values (*see* footnote 1 to table 2). In these cases, the 1-hour values as well as 8-hour values may be used to calculate index values and then use the maximum index value as the AQI for O_3.

Equation 1 to Appendix G to Part 58

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}\left(C_p - BP_{Lo}\right) + I_{Lo}$$

Where:
I_p = the index value for pollutant$_p$.
C_p = the truncated concentration of pollutant$_p$.
BP_{Hi} = the breakpoint that is greater than or equal to C_p.
BP_{Lo} = the breakpoint that is less than or equal to C_p.
I_{Hi} = the AQI value corresponding to BP_{Hi}.
I_{lo} = the AQI value corresponding to BP_{Lo}.

c. If the concentration is larger than the highest breakpoint in table 2 to this appendix then the last two breakpoints in table 2 may be used when equation 1 to this appendix is applied.
Example:

d. Using table 2 and equation 1 to this appendix, calculate the index value for each of the pollutants measured and select the one that produces the highest index value for the AQI. For example, if a PM_{10} value of 210 µg/m³ is observed, a 1-hour O_3 value of 0.156 ppm, and an 8-hour O_3 value of 0.130 ppm, then do this:

i. Find the breakpoints for PM_{10} at 210 µg/m³ as 155 µg/m³ and 254 µg/m³, corresponding to index values 101 and 150;

ii. Find the breakpoints for 1-hour O_3 at 0.156 ppm as 0.125 ppm and 0.164 ppm, corresponding to index values 101 and 150;

iii. Find the breakpoints for 8-hour O_3 at 0.130 ppm as 0.116 ppm and 0.374 ppm, corresponding to index values 201 and 300;

iv. Apply equation 21 to this appendix for 210 µg/m³, PM_{10}:

Equation 2 to Appendix G to Part 58

$$\frac{150 - 101}{254 - 155}(210 - 155) + 101 = 128$$

v. Apply equation 3 to this appendix for 0.156 ppm, 1-hour O_3:

Equation 3 to Appendix G to Part 58

$$\frac{150 - 101}{0.164 - 0.125}(0.156 - 0.125) + 101 = 140$$

vi. Apply equation 4 to this appendix for 0.130 ppm, 8-hour O_3:

Equation 4 to Appendix G to Part 58

$$\frac{300 - 201}{0.374 - 0.116}(0.130 - 0.116) + 201 = 206$$

vii. Find the maximum, 206. This is the AQI. A minimal AQI report could read: ''Today, the AQI for my city is 206, which is Very Unhealthy, due to ozone.'' It would then reference the associated sensitive groups.

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EPA finalizes stronger standards for harmful soot pollution, significantly increasing health and clean air protections for families, workers, and communities

Stronger standard will yield up to $46B in net health benefits, save lives, and build healthier communities, while supporting economic growth across America

February 7, 2024

Contact Information
EPA Press Office (press@epa.gov)

WASHINGTON — The Biden-Harris Administration on Wednesday finalized a significantly stronger air quality standard that will better protect America's families, workers, and communities from the dangerous and costly health effects of fine particle pollution, also known as soot. By strengthening the annual health-based national ambient air quality standard for fine particulate matter ($PM_{2.5}$) from a level of 12 micrograms per cubic meter to 9 micrograms per cubic meter, the U.S. Environmental Protection Agency's updated standard will save lives — preventing up to 4,500 premature deaths and 290,000 lost workdays, yielding up to $46 billion in net health benefits in 2032. For every $1 spent from this action, there could be as much as $77 in human health benefits in 2032.

Today's action is based on the best available science, as required by the Clean Air Act, and sets an air quality level that EPA will help states and Tribal Nations achieve over the coming years — including through complementary EPA standards to reduce pollution from power plants, vehicles, and industrial facilities, paired with historic investments under President Biden's Inflation Reduction Act and the Bipartisan Infrastructure Law. These actions bolster the U.S. economy by deploying billions of dollars and creating good-paying jobs across the transition to cleaner technologies. This strategy will make Americans healthier

and more productive, while underpinning a manufacturing resurgence in America. Since 2000, $PM_{2.5}$ concentrations in the outdoor air have decreased by 42% while the U.S. Gross Domestic Product increased by 52% during that time.

“This final air quality standard will save lives and make all people healthier, especially within America’s most vulnerable and overburdened communities,” **said EPA Administrator Michael S. Regan**. “Cleaner air means that our children have brighter futures, and people can live more productive and active lives, improving our ability to grow and develop as a nation. EPA looks forward to continuing our decades of success in working with states, counties, Tribes, and industry to ensure this critical health standard is implemented effectively to improve the long-term health and productivity of our nation.”

Along with strengthening the primary annual $PM_{2.5}$ standard, EPA is modifying the $PM_{2.5}$ monitoring network design criteria to include a factor that accounts for proximity of populations at increased risk of $PM_{2.5}$-related health effects to sources of air pollution. This will advance environmental justice by ensuring localized data collection in overburdened areas to inform future NAAQS reviews.

Particle pollution is of great concern to those with heart or lung disease and other vulnerable communities, including children, older adults, and people with health conditions like asthma, as well as already overburdened communities, including many communities of color and low-income communities throughout the United States. Strengthening the Clean Air Act standard for fine particle pollution improves air quality nationally for everyone, ensuring that communities that are overburdened by pollution are not left behind.

“The Biden administration is taking life-saving action to protect people and rein in deadly pollution,” **said Abigail Dillen, President of Earthjustice**. “The science is crystal clear. Soot, otherwise known as fine particle pollution, is a killer. It is driving heart disease, our asthma epidemic, and other serious illnesses. The people who suffer most are children and older Americans who live in communities of color and low-income communities. This federal standard will ensure that states respond to the ongoing public health and environmental justice crisis, saving thousands of lives and avoiding 800,000 asthma symptom cases every year.”

“Administrator Regan and President Biden deserve thanks for taking this vital step to curb soot pollution - a dangerous and even deadly pollutant that has taken an oversized toll on underrepresented and overburdened communities less equipped to deal with its severe health impacts,” **said Dr. Doris Browne, 118th President of the National Medical Association**. “This new standard of 9 micrograms per cubic meter will save lives based on scientific evidence. That is the bottom line. And as a physician, an advocate for clean air, and the past president of the National Medical Association representing physicians, our ultimate goal is health equity.”

“President Biden and EPA Administrator Regan’s new soot pollution limits will save thousands of lives and slash air pollution for people across the country, especially those disproportionately impacted by deadly particle pollution,” **said Margie Alt, Director of the Climate Action Campaign**. “This standard makes meaningful progress toward protecting our health and addressing the administration’s environmental justice commitments.”

"Particle pollution is a killer. In the United States alone, it cuts thousands of lives short, taking a staggering toll. Children's bodies are uniquely vulnerable to the harms of soot pollution," **said Dominique Browning, Director and Co-Founder of Moms Clean Air Force**.[1] "Moms Clean Air Force commends EPA for taking a significant step forward in strengthening the annual standard for particle pollution, also known as soot, to 9 micrograms per cubic meter from its current level at 12. EPA's new national health standard for particle pollution is the first improvement in over a decade. Soot is associated with increased infant mortality, hospital admissions for heart and lung diseases, cancer, and increased asthma severity. EPA's finalized protection is an important step towards cleaner, healthier air for all children."

"I applaud U.S. EPA Administrator Michael Regan for today's action to reduce fine particle pollution and protect communities. These standards will build upon the significant progress already made in improving air quality throughout New York and help prevent the many serious health effects plaguing our most at-risk populations," said **New York State Department of Environmental Conservation Commissioner Basil Seggos. "**Last year, historic smoke plumes from wildfires across Canada increased New Yorkers' awareness of how fine particulate pollution from natural and man-made sources affects the air we breathe, particularly for the most vulnerable among us."[2]

In June 2021, EPA announced it would reconsider the December 2020 decision to retain the 2012 standards because the available scientific evidence and technical information indicated that the standards may not be adequate to protect public health and welfare. EPA considered the available science and technical information, as well as the recommendations of the independent advisors comprising the Clean Air Scientific Advisory Committee and CASAC PM expert panel when making the decision on whether to strengthen the PM standards.

Based on the scientific evidence, technical information, recommendations from CASAC, and public comments on the 2023 proposed standards, EPA has set two primary standards for $PM_{2.5}$, which work together to protect public health: the annual standard, which EPA has revised, and a 24-hour standard, which the agency retained. EPA also retained the current primary 24-hour standard for PM_{10}, which provides protection against coarse particles. EPA is also not changing the secondary (welfare-based) standards for fine particles and coarse particles at this time.

A broad and growing body of science links particle pollution to a range of serious and sometimes deadly illnesses. Many studies show that these microscopic fine particles can penetrate deep into the lungs and that long- and short-term exposure can lead to asthma attacks, missed days of school or work, heart attacks, expensive emergency room visits and premature death.

Due to the efforts that states, Tribes, industry, communities, and EPA have already taken to reduce dangerous pollution in communities across the country, 99% of U.S. counties are projected to meet the more protective standard in 2032, likely the earliest year that states would need to meet the revised standard. That's even before accounting for additional actions on the horizon to implement the Bipartisan Infrastructure Law and Inflation Reduction Act investments and to update source-specific emission standards.

Most Counties with Monitors Already Meet the Strengthened Particle Pollution Standard
(Based on 2020-2022 Air Monitoring Data)

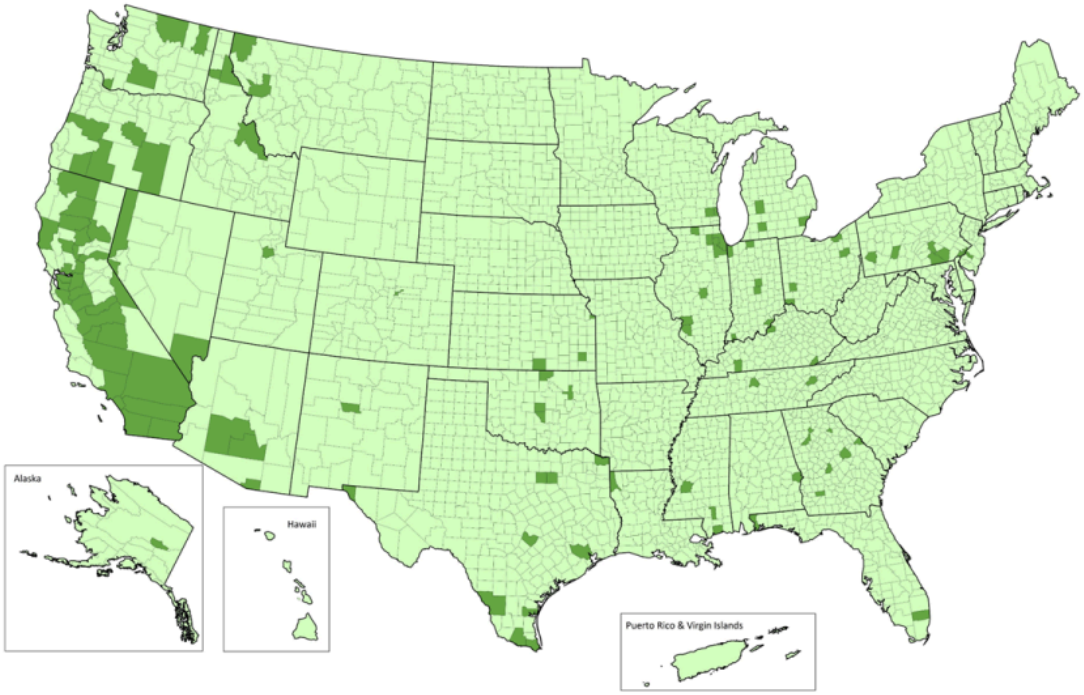

Figure 1: Based on 2020-2022 air monitoring data, the dark green areas on the map indicate counties that do not meet the annual PM2.5 standard of 9 ug/m3. View the data (pdf) <https://epa.gov/system/files/documents/2024-02/table_annual-pm25-county-design-values-2020-2022-for-web.pdf>. (courtesy U.S. EPA)

Note: The map above reflects monitored counties with complete monitoring data. Future final designations of attainment/nonattainment will not be based on these data, but likely on monitoring data collected between 2022 and 2024. Of the 119 counties with 2020-2022 design values above 9 ug/m3, 59 counties are totally or partially contained in nonattainment areas for current PM2.5 standards. In years 2021 and 2022, EPA is aware that some states have already identified possible exceptional events that may have impacted air quality in the U.S. and may be relevant to designations decisions. (This information is provided for illustrative purposes only and is not intended to predict the outcome of any forthcoming designations process.)

See projected progress in 2032 <https://epa.gov/system/files/documents/2024-02/2024-pm-naaqs-final-2032-projections-map.pdf>.

EPA is also revising the Air Quality Index to improve public communications about the health risks from $PM_{2.5}$ exposures.

Some PM is emitted directly from combustion sources, construction sites, industrial processes, and older diesel engines, while other particles are formed in the atmosphere in complex chemical reactions with other pollutants such as sulfur dioxide and nitrogen oxides that are emitted from power plants, gasoline and diesel engines, and certain industrial processes. Particle pollution from industrial processes and other sources is controllable, with readily available and cost-effective technologies to manage emissions, and EPA will build on decades of experience in providing flexible options to states and Tribes across the implementation process.

EPA carefully considered extensive public input as it determined the final standards. The agency held a virtual public hearing and received about 700,000 written comments before finalizing today's updated air quality standards.

See more information on today's final standards at Final Reconsideration of the National Ambient Air Quality Standards for Particulate Matter <https://epa.gov/pm-pollution/final-reconsideration-national-ambient-air-quality-standards-particulate-matter-pm>.

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[1]An earlier version of this release misspelled Moms Clean Air Force. It is "Moms Clean Air Force" not "Mom's Clean Air Force."

[2]This release was updated to include a quote from New York State Department of Environmental Conservation Commissioner Basil Seggos.

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LAST UPDATED ON FEBRUARY 7, 2024

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Fine Particle Concentrations for Counties with Monitors Based on Air Quality Data from 2020 - 2022

This information is provided for illustrative purposes only and is not intended to predict the outcome of any forthcoming designations process.Future designations of attainment/nonattainment will not be based on these data, but likely on monitoring data collected between 2022 and 2024.

Does not meet the revised annual primary fine partcle ($PM_{2.5}$) standard of 9.0 ug/m^3

State	County	2020-2022 PM2.5 Annual Design Value (ug/m3)	Previous PM2.5 Nonattainment Area
Alabama	Baldwin County	7.5	No
Alabama	Clay County	6.8	No
Alabama	DeKalb County	7.2	No
Alabama	Etowah County	8.2	No
Alabama	Jefferson County	8.4	Yes
Alabama	Madison County	7.1	No
Alabama	Mobile County	7.9	No
Alabama	Morgan County	7.4	No
Alabama	Russell County	9.1	No
Alabama	Tuscaloosa County	7.6	No
Alaska	Anchorage Municipality	5.6	No
Alaska	Fairbanks North Star Borough	12.2	Yes
Alaska	Juneau City and Borough	4.9	No
Alaska	Matanuska-Susitna Borough	4.5	No
Arizona	La Paz County	4.1	No
Arizona	Maricopa County	10.5	No
Arizona	Pima County	6.1	No
Arizona	Pinal County	12.4	Yes
Arizona	Santa Cruz County	10.2	Yes
Arizona	Yuma County	8.9	No
Arkansas	Arkansas County	7.5	No
Arkansas	Crittenden County	7.8	No
Arkansas	Polk County	7.8	No
Arkansas	Pulaski County	8.8	No
Arkansas	Washington County	7.5	No
California	Alameda County	9.4	Yes
California	Butte County	11.6	Yes
California	Calaveras County	9	No
California	Colusa County	10.5	No
California	Contra Costa County	10	Yes
California	Fresno County	17.5	Yes
California	Humboldt County	7.4	No
California	Imperial County	11.1	Yes
California	Inyo County	8.8	No
California	Kern County	18.8	Yes
California	Kings County	16.6	Yes
California	Lake County	6.6	No
California	Los Angeles County	13.4	Yes
California	Madera County	13.2	Yes
California	Marin County	7.5	Yes
California	Mendocino County	11.1	No
California	Merced County	12.3	Yes
California	Mono County	19.5	No

California	Monterey County	6.9	No
California	Nevada County	8.9	No
California	Orange County	11.2	Yes
California	Placer County	10.9	Yes
California	Plumas County	17	Yes
California	Riverside County	13.6	Yes
California	Sacramento County	11.7	Yes
California	San Benito County	6.5	No
California	San Bernardino County	14	Yes
California	San Diego County	10	No
California	San Francisco County	8.2	Yes
California	San Joaquin County	12.3	Yes
California	San Luis Obispo County	8.7	No
California	San Mateo County	7.6	Yes
California	Santa Barbara County	8	No
California	Santa Clara County	10.7	Yes
California	Santa Cruz County	7.2	No
California	Shasta County	9.3	No
California	Siskiyou County	11.6	No
California	Solano County	9.4	Yes
California	Sonoma County	7.3	Yes
California	Stanislaus County	14.3	Yes
California	Sutter County	13.8	Yes
California	Tehama County	9.9	No
California	Tulare County	18.4	Yes
California	Ventura County	7.8	No
Colorado	Arapahoe County	6.1	No
Colorado	Boulder County	8.7	No
Colorado	Denver County	9.3	No
Colorado	Douglas County	6.7	No
Colorado	El Paso County	5.5	No
Colorado	Larimer County	7.7	No
Colorado	Mesa County	5.8	No
Colorado	Rio Blanco County	8.5	No
Colorado	Weld County	8.8	No
Connecticut	Fairfield County	8	Yes
Connecticut	Hartford County	7.5	No
Connecticut	Litchfield County	5.1	No
Connecticut	New Haven County	8.2	Yes
Connecticut	New London County	6.9	No
District of Columbia	District of Columbia	8.6	Yes
Florida	Alachua County	7.1	No
Florida	Brevard County	7.9	No
Florida	Broward County	9.4	No
Florida	Duval County	8.7	No
Florida	Escambia County	9.5	No
Florida	Hillsborough County	8.3	No
Florida	Leon County	7.2	No
Florida	Miami-Dade County	7.1	No
Florida	Palm Beach County	6.7	No
Florida	Pinellas County	7.7	No
Florida	Polk County	8.3	No
Florida	Sarasota County	7.9	No
Florida	Seminole County	7.5	No
Florida	Volusia County	8.3	No
Georgia	Bibb County	8.8	Yes
Georgia	Clarke County	9.2	No
Georgia	Clayton County	8.4	Yes
Georgia	Cobb County	8.4	Yes
Georgia	Coffee County	6.9	No

Georgia	DeKalb County	9	Yes
Georgia	Dougherty County	9.2	No
Georgia	Fulton County	9.4	Yes
Georgia	Glynn County	8.1	No
Georgia	Gwinnett County	8.8	Yes
Georgia	Hall County	8.8	Yes
Georgia	Houston County	9.1	No
Georgia	Lowndes County	8.6	No
Georgia	Muscogee County	8.3	No
Georgia	Richmond County	10.4	No
Georgia	Washington County	10.2	No
Hawaii	Hawaii County	3.4	No
Hawaii	Honolulu County	3.7	No
Hawaii	Maui County	4	No
Idaho	Ada County	8.1	No
Idaho	Benewah County	10.2	No
Idaho	Franklin County	6.6	Yes
Idaho	Lemhi County	11.3	No
Idaho	Shoshone County	10.7	Yes
Illinois	Champaign County	7.8	No
Illinois	Cook County	10.5	Yes
Illinois	DuPage County	9.5	Yes
Illinois	Hamilton County	8.8	No
Illinois	Jersey County	8	No
Illinois	Kane County	9.2	Yes
Illinois	McHenry County	8.9	Yes
Illinois	McLean County	8.9	No
Illinois	Macon County	9.2	No
Illinois	Madison County	10	Yes
Illinois	Randolph County	8.2	Yes
Illinois	Rock Island County	8.8	No
Illinois	St. Clair County	10	Yes
Illinois	Sangamon County	8.3	No
Illinois	Will County	9.7	Yes
Illinois	Winnebago County	9.1	No
Indiana	Bartholomew County	7	No
Indiana	Clark County	9.9	Yes
Indiana	Delaware County	8.1	No
Indiana	Dubois County	8.8	Yes
Indiana	Elkhart County	8.4	No
Indiana	Greene County	7.7	No
Indiana	Hamilton County	9.8	Yes
Indiana	Henry County	7.5	No
Indiana	Howard County	7.4	No
Indiana	Lake County	9.8	Yes
Indiana	LaPorte County	8.1	No
Indiana	Madison County	8.9	No
Indiana	Marion County	11.9	Yes
Indiana	Monroe County	7.7	No
Indiana	Porter County	8.3	Yes
Indiana	St. Joseph County	9.6	No
Indiana	Spencer County	8.2	Yes
Indiana	Tippecanoe County	8.4	No
Indiana	Vanderburgh County	9.2	Yes
Indiana	Vigo County	8.7	No
Indiana	Whitley County	7.6	No
Iowa	Black Hawk County	7.9	No
Iowa	Clinton County	8.6	No
Iowa	Johnson County	7.8	No
Iowa	Lee County	8.2	No

Iowa	Linn County	8.1	No
Iowa	Montgomery County	6.7	No
Iowa	Muscatine County	8.1	No
Iowa	Palo Alto County	7	No
Iowa	Polk County	7.6	No
Iowa	Pottawattamie County	8.2	No
Iowa	Scott County	8.4	No
Iowa	Van Buren County	7.1	No
Iowa	Woodbury County	7.9	No
Kansas	Johnson County	8.9	No
Kansas	Neosho County	9.6	No
Kansas	Sumner County	9.8	No
Kansas	Wyandotte County	10.8	No
Kentucky	Bell County	9.3	No
Kentucky	Boyd County	8	Yes
Kentucky	Campbell County	7.8	Yes
Kentucky	Carter County	6.2	No
Kentucky	Christian County	9.2	No
Kentucky	Daviess County	9	No
Kentucky	Fayette County	8.2	No
Kentucky	Hardin County	7.9	No
Kentucky	Jefferson County	10.2	Yes
Kentucky	Perry County	8	No
Kentucky	Pike County	7.2	No
Kentucky	Pulaski County	8	No
Kentucky	Warren County	8.1	No
Louisiana	Caddo Parish	9.6	No
Louisiana	Calcasieu Parish	7.4	No
Louisiana	East Baton Rouge Parish	8.5	No
Louisiana	Iberville Parish	7.7	No
Louisiana	Jefferson Parish	7.7	No
Louisiana	Lafayette Parish	7.9	No
Louisiana	Orleans Parish	7.8	No
Louisiana	Ouachita Parish	7.5	No
Louisiana	Rapides Parish	7.4	No
Louisiana	St. Bernard Parish	8	No
Louisiana	Tangipahoa Parish	7.5	No
Louisiana	Terrebonne Parish	7.2	No
Louisiana	West Baton Rouge Parish	8.8	No
Maine	Androscoggin County	5.3	No
Maine	Aroostook County	5.4	No
Maine	Cumberland County	6.5	No
Maine	Hancock County	3.2	No
Maine	Kennebec County	5.6	No
Maine	Penobscot County	4.5	No
Maryland	Baltimore County	7.7	Yes
Maryland	Cecil County	6.8	No
Maryland	Dorchester County	5.9	No
Maryland	Garrett County	5.2	No
Maryland	Harford County	6.7	Yes
Maryland	Howard County	6.9	Yes
Maryland	Kent County	5.5	No
Maryland	Montgomery County	6.8	Yes
Maryland	Prince George's County	5.9	Yes
Maryland	Washington County	6.8	Yes
Massachusetts	Berkshire County	7.5	No
Massachusetts	Bristol County	6.4	No
Massachusetts	Essex County	6.3	No
Massachusetts	Franklin County	7.8	No
Massachusetts	Hampden County	6.5	No

Massachusetts	Hampshire County	6.3	No
Massachusetts	Middlesex County	6.6	No
Massachusetts	Plymouth County	8.2	No
Massachusetts	Suffolk County	7.9	No
Massachusetts	Worcester County	8.6	No
Michigan	Allegan County	6.6	No
Michigan	Bay County	5.8	No
Michigan	Genesee County	7.2	No
Michigan	Ingham County	8.5	No
Michigan	Kalamazoo County	9.5	No
Michigan	Kent County	9.2	No
Michigan	Lenawee County	8.3	No
Michigan	Macomb County	8.2	Yes
Michigan	Missaukee County	8.6	No
Michigan	Oakland County	7.5	Yes
Michigan	Ottawa County	8.8	No
Michigan	St. Clair County	8.2	Yes
Michigan	Washtenaw County	8.7	Yes
Michigan	Wayne County	11.7	Yes
Minnesota	Anoka County	6.6	No
Minnesota	Becker County	7.2	No
Minnesota	Beltrami County	6.2	No
Minnesota	Carlton County	2.2	No
Minnesota	Cass County	7.8	No
Minnesota	Cook County	2.3	No
Minnesota	Crow Wing County	5.5	No
Minnesota	Dakota County	7.4	No
Minnesota	Hennepin County	8	No
Minnesota	Lake County	4.7	No
Minnesota	Lyon County	6.4	No
Minnesota	Olmsted County	6	No
Minnesota	Ramsey County	7.2	No
Minnesota	St. Louis County	5.1	No
Minnesota	Scott County	6.4	No
Minnesota	Wright County	7	No
Mississippi	Bolivar County	8.5	No
Mississippi	DeSoto County	8.7	No
Mississippi	Forrest County	9.9	No
Mississippi	Hancock County	8.5	No
Mississippi	Harrison County	9.1	No
Mississippi	Hinds County	10.1	No
Mississippi	Jackson County	8.2	No
Missouri	Buchanan County	8.1	No
Missouri	Cass County	6.3	No
Missouri	Cedar County	6.7	No
Missouri	Clay County	6	No
Missouri	Jackson County	7.9	No
Missouri	Jefferson County	8	Yes
Missouri	St. Louis County	7	Yes
Missouri	St. Louis city	8.9	Yes
Montana	Fergus County	5.2	No
Montana	Flathead County	7.7	No
Montana	Gallatin County	3.9	No
Montana	Lewis and Clark County	8.4	No
Montana	Lincoln County	13.4	Yes
Montana	Missoula County	10.1	No
Montana	Phillips County	5.6	No
Montana	Powder River County	7.7	No
Montana	Ravalli County	7.8	No
Montana	Richland County	5.2	No

Montana	Silver Bow County	7.8	No
Montana	Yellowstone County	7.9	No
Nebraska	Douglas County	7.5	No
Nebraska	Hall County	6.2	No
Nebraska	Lancaster County	6.4	No
Nebraska	Sarpy County	7.8	No
Nebraska	Washington County	6.2	No
Nevada	Clark County	10.8	No
Nevada	Douglas County	9.6	No
Nevada	Washoe County	11	No
Nevada	Carson City	8.7	No
New Hampshire	Belknap County	4.5	No
New Hampshire	Cheshire County	6.6	No
New Hampshire	Grafton County	5.3	No
New Hampshire	Hillsborough County	3.9	No
New Hampshire	Rockingham County	6	No
New Jersey	Atlantic County	6.3	No
New Jersey	Camden County	9.1	Yes
New Jersey	Hunterdon County	7.4	No
New Jersey	Mercer County	7.9	Yes
New Jersey	Middlesex County	7.7	Yes
New Jersey	Ocean County	6.6	No
New Jersey	Union County	9	Yes
New Jersey	Warren County	7.8	No
New Mexico	Bernalillo County	9.6	No
New Mexico	Doña Ana County	8.9	No
New Mexico	Lea County	6.3	No
New Mexico	Santa Fe County	4.3	No
New Mexico	Taos County	5.5	No
New York	Albany County	7.3	No
New York	Bronx County	8.1	Yes
New York	Chautauqua County	5.8	No
New York	Erie County	7.1	No
New York	Essex County	3.5	No
New York	Monroe County	6.5	No
New York	Onondaga County	6.1	No
New York	Queens County	7.4	Yes
New York	Steuben County	5.7	No
North Carolina	Buncombe County	5.8	No
North Carolina	Catawba County	8.2	Yes
North Carolina	Cumberland County	7.6	No
North Carolina	Davidson County	8.8	Yes
North Carolina	Durham County	7.3	No
North Carolina	Forsyth County	8.4	No
North Carolina	Guilford County	7.4	Yes
North Carolina	Johnston County	7.2	No
North Carolina	Mecklenburg County	8.7	No
North Carolina	Mitchell County	5.8	No
North Carolina	Montgomery County	7.6	No
North Carolina	New Hanover County	4.4	No
North Carolina	Northampton County	6.7	No
North Carolina	Pitt County	6.1	No
North Carolina	Rowan County	7.7	No
North Carolina	Swain County	6	No
North Carolina	Wake County	6.9	No
North Dakota	Billings County	4.9	No
North Dakota	Burke County	6.4	No
North Dakota	Burleigh County	7.7	No
North Dakota	Cass County	8.3	No
North Dakota	Dunn County	5.8	No

North Dakota	McKenzie County	5.4	No
North Dakota	Mercer County	6	No
North Dakota	Oliver County	7.2	No
North Dakota	Ward County	6.3	No
Ohio	Allen County	6.4	No
Ohio	Athens County	5.9	No
Ohio	Clark County	8.4	Yes
Ohio	Cuyahoga County	9.3	Yes
Ohio	Franklin County	8.8	Yes
Ohio	Hamilton County	10.5	Yes
Ohio	Lake County	6.4	Yes
Ohio	Lawrence County	8.1	Yes
Ohio	Medina County	6.6	Yes
Ohio	Montgomery County	9.4	Yes
Ohio	Preble County	8.1	No
Ohio	Stark County	9.2	Yes
Ohio	Summit County	8.4	Yes
Ohio	Trumbull County	7.4	No
Oklahoma	Carter County	8.7	No
Oklahoma	Cleveland County	10.3	No
Oklahoma	Comanche County	8	No
Oklahoma	Dewey County	7.7	No
Oklahoma	Kay County	9.9	No
Oklahoma	Oklahoma County	10.1	No
Oklahoma	Pittsburg County	8.9	No
Oklahoma	Sequoyah County	7.7	No
Oklahoma	Tulsa County	9.2	No
Oregon	Crook County	10	No
Oregon	Harney County	10.8	No
Oregon	Jackson County	13.5	No
Oregon	Klamath County	15.6	Yes
Oregon	Lane County	14.7	Yes
Oregon	Multnomah County	8.1	No
Oregon	Washington County	8.1	No
Pennsylvania	Allegheny County	10.9	Yes
Pennsylvania	Armstrong County	8.9	Yes
Pennsylvania	Beaver County	8.6	Yes
Pennsylvania	Berks County	8.1	Yes
Pennsylvania	Blair County	8.3	No
Pennsylvania	Cambria County	9.6	Yes
Pennsylvania	Centre County	7.8	No
Pennsylvania	Chester County	8.5	Yes
Pennsylvania	Cumberland County	7.6	Yes
Pennsylvania	Dauphin County	9.9	Yes
Pennsylvania	Delaware County	9.1	Yes
Pennsylvania	Lackawanna County	7.5	No
Pennsylvania	Lancaster County	9.2	Yes
Pennsylvania	Lehigh County	8.7	Yes
Pennsylvania	Montgomery County	8.2	Yes
Pennsylvania	Northampton County	8.1	Yes
Pennsylvania	Philadelphia County	9.1	Yes
Pennsylvania	Washington County	8.5	Yes
Pennsylvania	York County	9.6	Yes
Rhode Island	Kent County	4.5	No
Rhode Island	Providence County	7.9	No
Rhode Island	Washington County	4.3	No
South Carolina	Charleston County	7.2	No
South Carolina	Chesterfield County	6.7	No
South Carolina	Edgefield County	7.6	No
South Carolina	Florence County	7.5	No

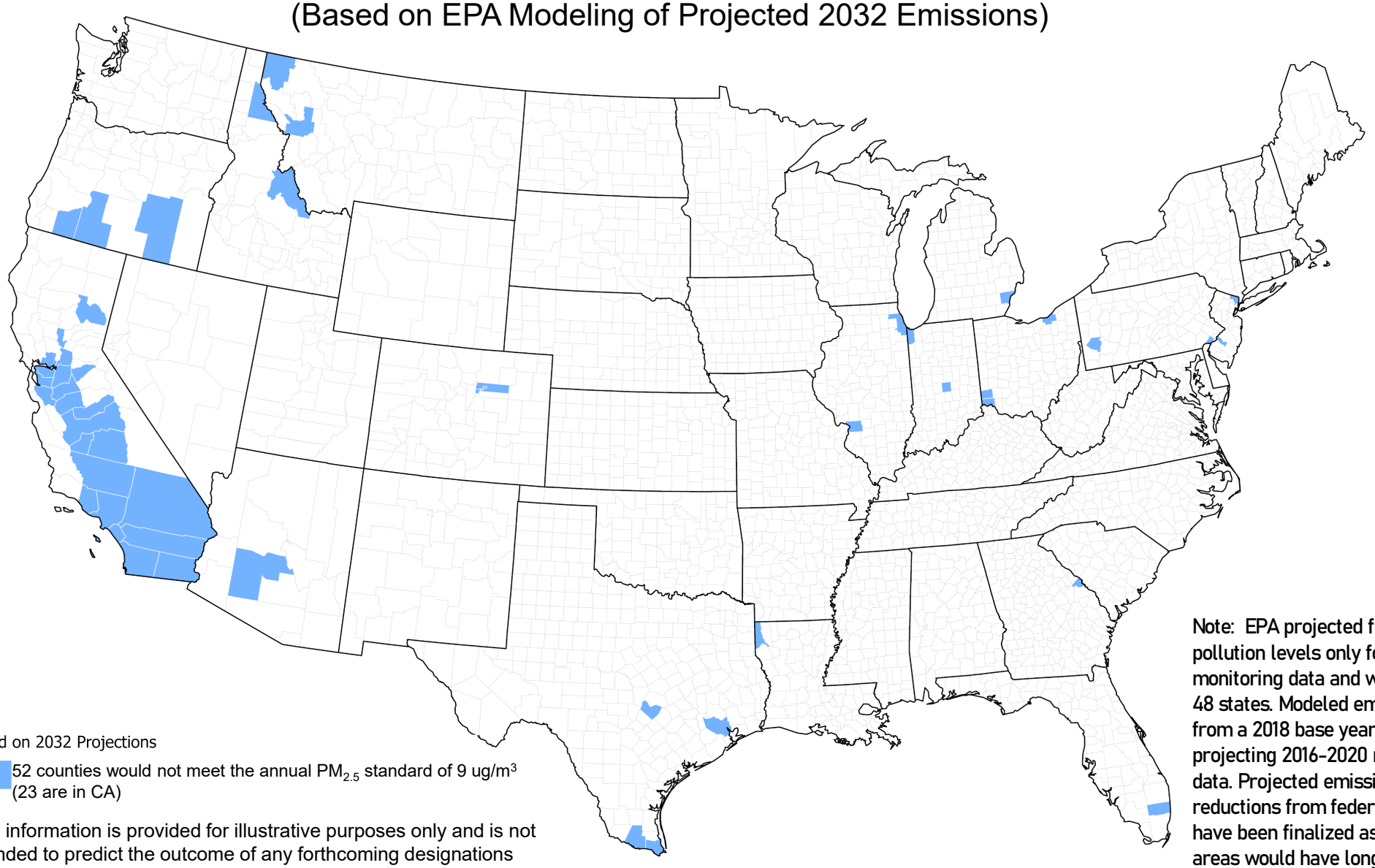
South Carolina	Greenville County	8.2	No
South Carolina	Lexington County	7.9	No
South Carolina	Richland County	7	No
South Carolina	Spartanburg County	8.1	No
South Carolina	York County	6.9	No
South Dakota	Brookings County	4.9	No
South Dakota	Brown County	5.5	No
South Dakota	Codington County	7.6	No
South Dakota	Custer County	4.1	No
South Dakota	Hughes County	3.3	No
South Dakota	Jackson County	4.5	No
South Dakota	Pennington County	7.3	No
Tennessee	Blount County	7	Yes
Tennessee	Davidson County	9.1	No
Tennessee	Dyer County	7.2	No
Tennessee	Hamilton County	7.7	Yes
Tennessee	Knox County	9.4	Yes
Tennessee	Lawrence County	5.8	No
Tennessee	Loudon County	6.6	Yes
Tennessee	McMinn County	7.4	No
Tennessee	Madison County	7.4	No
Tennessee	Maury County	6.6	No
Tennessee	Montgomery County	7	No
Tennessee	Putnam County	6.6	No
Tennessee	Roane County	7.1	Yes
Tennessee	Shelby County	8.5	No
Tennessee	Sullivan County	6.3	No
Tennessee	Sumner County	7.4	No
Texas	Bell County	7.4	No
Texas	Bexar County	8.6	No
Texas	Bowie County	10	No
Texas	Brewster County	5.5	No
Texas	Cameron County	9.1	No
Texas	Dallas County	9.4	No
Texas	Denton County	7.5	No
Texas	Ector County	7.4	No
Texas	El Paso County	9.2	No
Texas	Galveston County	7.9	No
Texas	Harris County	11.4	No
Texas	Hidalgo County	10.1	No
Texas	Jefferson County	8.3	No
Texas	Kleberg County	10.3	No
Texas	Lubbock County	5.8	No
Texas	Maverick County	7.9	No
Texas	Nueces County	8.7	No
Texas	Orange County	8.2	No
Texas	Potter County	5.9	No
Texas	Tarrant County	9.1	No
Texas	Travis County	9.3	No
Texas	Webb County	10.1	No
Utah	Cache County	8.1	Yes
Utah	Davis County	7.4	Yes
Utah	Duchesne County	6.9	No
Utah	Iron County	5.8	No
Utah	Salt Lake County	9.9	Yes
Utah	Tooele County	6.9	Yes
Utah	Uintah County	6.3	No
Utah	Utah County	7.5	Yes
Utah	Washington County	5.6	No
Utah	Weber County	7	Yes

Vermont	Bennington County	5.7	No
Vermont	Chittenden County	6.9	No
Vermont	Rutland County	7.5	No
Virginia	Albemarle County	7.3	No
Virginia	Arlington County	7.1	Yes
Virginia	Charles City County	6.1	No
Virginia	Chesterfield County	6.1	No
Virginia	Fairfax County	8.3	Yes
Virginia	Frederick County	7.7	No
Virginia	Henrico County	7.6	No
Virginia	Loudoun County	6.6	Yes
Virginia	Roanoke County	7.5	No
Virginia	Rockingham County	6.7	No
Virginia	Bristol city	6.5	No
Virginia	Hampton city	6.5	No
Virginia	Lynchburg city	5.9	No
Virginia	Norfolk city	6.5	No
Virginia	Richmond city	7.7	No
Virginia	Salem city	6.5	No
Virginia	Virginia Beach city	6.7	No
Washington	Clark County	9.1	No
Washington	King County	8.5	No
Washington	Kitsap County	6.4	No
Washington	Kittitas County	7.5	No
Washington	Okanogan County	13.4	No
Washington	Pierce County	8.1	Yes
Washington	Snohomish County	8.9	No
Washington	Stevens County	11.6	No
Washington	Yakima County	11.8	No
West Virginia	Berkeley County	8.2	Yes
West Virginia	Brooke County	8.5	Yes
West Virginia	Cabell County	7.1	Yes
West Virginia	Hancock County	7.8	Yes
West Virginia	Harrison County	6.9	No
West Virginia	Kanawha County	7.5	Yes
West Virginia	Marshall County	8.4	Yes
West Virginia	Monongalia County	7	No
West Virginia	Ohio County	7.5	Yes
West Virginia	Wood County	7.5	Yes
Wisconsin	Ashland County	5.6	No
Wisconsin	Brown County	7.8	No
Wisconsin	Dane County	8.8	No
Wisconsin	Dodge County	7.9	No
Wisconsin	Eau Claire County	8.1	No
Wisconsin	Forest County	5.9	No
Wisconsin	Grant County	8.7	No
Wisconsin	Kenosha County	7.9	No
Wisconsin	La Crosse County	7.9	No
Wisconsin	Milwaukee County	9.4	Yes
Wisconsin	Outagamie County	8	No
Wisconsin	Sauk County	7.7	No
Wisconsin	Taylor County	6.7	No
Wisconsin	Vilas County	5.3	No
Wisconsin	Waukesha County	9.2	Yes
Wyoming	Fremont County	2	No
Wyoming	Laramie County	4.9	No
Wyoming	Natrona County	3.8	No
Wyoming	Park County	4.9	No
Wyoming	Sublette County	3.6	No
Wyoming	Teton County	4.5	No

EPA Projects More than 99% of Counties would Meet the Revised Fine Particle Pollution Standard

Projection of Counties with Monitors that would not Meet in 2032

(Based on EPA Modeling of Projected 2032 Emissions)



Based on 2032 Projections

52 counties would not meet the annual $PM_{2.5}$ standard of 9 ug/m^3 (23 are in CA)

This information is provided for illustrative purposes only and is not intended to predict the outcome of any forthcoming designations process.

Note: EPA projected future fine particle pollution levels only for counties with monitoring data and within the contiguous 48 states. Modeled emissions are developed from a 2018 base year and used in projecting 2016-2020 monitoring data. Projected emissions reflect expected reductions from federal regulations that have been finalized as of March 2023. Some areas would have longer than 2032 to attain the revised $PM_{2.5}$ standard.

ENVIRONMENT

California's pursuit of clean air just got much harder: New soot standards set

BY ALEJANDRO LAZO
FEBRUARY 7, 2024

Downtown Los Angeles is shrouded in early morning fog and air pollution. (AP Photo/Richard Vogel, File)

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IN SUMMARY

The federal standard will likely throw new California counties out of compliance — and put even more pressure on the LA basin and San Joaquin Valley to clean the air.

The Biden administration today set a new, more rigorous standard for a dangerous air pollutant that has plagued vast swaths of California for decades: Fine particles, commonly called soot.

The U.S. Environmental Protection Agency's new annual soot standard could throw seven new California counties out of compliance, totaling 29 counties, according to EPA information released today based on 2020 through 2022 data.

San Diego and the rural counties of Mendocino, Mono, Shasta, Siskiyou, Tehama and Colusa could be added to the long list of California counties already breathing unhealthy levels of soot.

And the Los Angeles basin and the San Joaquin Valley, which are blanketed with the nation's worst smog and soot, now face an even tougher challenge after spending decades trying to clean the air.

California is so far off from achieving clean air that the local San Joaquin Valley Air District **wrote to the EPA** last year to warn: "There is no clear path forward on how the Valley or other regions of California can attain the proposed standard."

Spewed by an array of sources — from fireplaces to diesel trucks — fine particles known as PM2.5 can lodge in lungs, aggravate respiratory disease and trigger heart attacks. Hospitalizations and deaths from heart and lung ailments surge when soot concentrations rise, research shows.

The new standard is extremely controversial — and widely expected to be challenged in court by industries and some states.

The EPA predicts that strengthening it will save 4,500 lives and eliminate 290,000 lost workdays nationwide in 2032.

The soot standard was last strengthened in 2012. Although the Clean Air Act requires an EPA evaluation every five years, President Donald Trump's administration declined to tighten it despite **mounting evidence** of the threat to public health.

Under the new standard, annual average concentrations of fine particles cannot exceed 9 micrograms per cubic meter of air, down 25% from the current 12.

For years, the Visalia and Bakersfield areas have had the nation's worst fine particle pollution, with average levels nearly twice as high as the new standard allows, based on the EPA's 2020 through 2022 data. Mono County, in the Eastern Sierra, also has soot levels more than double the new limit, according to that EPA data.

Although 29 counties have soot exceeding the new standard based on 2020-22 data, the EPA projects that it could drop to 23 counties by 2032.

Nationwide soot in 119 counties exceeds the new standard, based on the 2020-22 data. Of those, 59 already violated the old standard. By 2032, the EPA says it could drop to 52 counties in 16 states that violate the new limit.

Business groups say efforts to attain it will cause widespread economic problems and job losses. Brady Van Engelen, a lobbyist for the California Chamber of Commerce, said the more stringent standards could "effectively put all permitting into a gridlock" for new manufacturing activities and jobs.

> **"There is no clear path forward on how the Valley or other regions of California can attain the proposed standard."**
>
> — SAN JOAQUIN VALLEY AIR DISTRICT

Marty Durbin, senior vice president for policy for the U.S. Chamber of Commerce, said in an emailed statement that compliance is complicated by dust from roads and smoke from wildfires. He said the EPA should have kept the existing standard instead of "punishing counties and the private sector for situations largely out of their control."

However, the Clean Air Act requires the EPA to set its standards based strictly on the latest scientific evidence — not what is achievable or economical.

Achieving the new target will take wide-ranging new state and local regulations aimed at cutting emissions. Fine particles are spewed into the air from the burning of diesel fuel, gasoline and wood, including trucks, farm vehicles, fireplaces and restaurant charbroilers, but also from manufacturing plants and dust stirred up by farming, construction and roads. (Emissions from wildfires are exempt from the EPA's soot standards.)

Air pollution rules in California, particularly in the Los Angeles basin, are already the most stringent in the nation. So California officials say that they desperately need the help of the federal government, since states and local agencies cannot control some of the biggest remaining sources of soot — aircraft, trains and ships.

Remote, rural, mountain areas aren't immune: The Sierra Nevada counties of Mono and Plumas have high levels of soot, largely because of wood burning.

"The science is clear: soot pollution is one of the most dangerous forms of air pollution and it's linked to a range of serious and potentially deadly illnesses, including asthma and heart attacks," said EPA Administrator Michael S. Regan.

Dr. Doris Browne, a former president of the National Medical Association, which represents Black physicians, said the new standards are critical for addressing health disparities. Communities of color, along with older people and those with heart and lung conditions, are most in danger from "their close proximity to sources of this dangerous and deadly pollutant," she said.

The next step? The EPA will spend up to two years determining which counties are out of compliance. The agency warned that its projections released today are not formal designations, and the counties could change.

Then, local and state officials will launch years of planning to decide which additional pollution-fighting measures to undertake. California's local air quality districts must develop and approve elaborate plans detailing their promises to achieve emissions reductions.

The federal government can withhold highway dollars if a state fails to submit a plan, the plan is inadequate or the plans aren't followed. But those situations are rare, and the EPA considers withholding funds an "extraordinary measure," said Shayla Powell, an agency spokeswoman.

What is pm2.5 and why is it dangerous?

Fine particles of air pollution are 30 times smaller than a human hair, or 2.5 micrometers in diameter or less. Soot is sometimes hard to see, easy to inhale deep into the lungs and devastatingly common in California.

Fine particle pollution can be extremely harmful when inhaled. That's because the human body's defenses help keep larger, coarse particles from the deepest parts of lungs. But the fine particles can penetrate the air sacs of lungs and then pass into the bloodstream and travel to other organs, particularly the heart.

An EPA **analysis** concluded that "a substantial body of published scientific literature documents the association between PM2.5 concentrations and the risk of premature death."

A range of adverse health impacts can result; **increased risk of death** from **heart** disease is one of the most **well-documented**. **A 2019 study of Californians**, for instance, linked fine particles to elevated risks of death from coronary artery disease, and a 2020 **study** found that long-term exposure was associated with deaths from heart disease and strokes.

> **Fine particles can penetrate lungs and then pass into the bloodstream and travel to other organs, particularly the heart.**

Increased asthma attacks are another well-documented health impact. And in recent years, a growing body of research has shown it can harm the brain. A study by University of Southern California researchers published this year reported that exposure can **alter brain development patterns in adolescents**.

"It's a much larger, systemic story," said Edward Avol, professor emeritus at the University of Southern California's School of Medicine. "A sad part of the story is that it's not equal — we don't all get to breathe the same quality air."

"People who live closer to freeways, who live close to refineries or power plants, who, by virtue of their economic status, live in more polluted areas are more exposed."

What are the major sources in California?

While fine particle pollution is often referred to as soot, evoking an industrial Dickensian era, much of it comes from fumes from trucks, automobiles, power plants and other sources that mix in the air with other compounds.

While some fine particle pollution can come directly from a specific source, such as a diesel truck, construction site, fireplace or smokestack, most fine particle pollution (unrelated to wildfires) comes from these complex chemical reactions.

Sulfur dioxide is one compound that can mix with others to create particles. It's emitted when coal, petroleum oil or diesel is burned. Nitrogen oxides are other common urban precursors that come largely from traffic or industrial plants. Ammonia, which can come from large-scale agricultural operations, among other sources, is another important precursor.

What will the San Joaquin Valley have to do?

California's vast valley has a long way to go to make its air healthy, according to the San Joaquin Valley Air District, the agency responsible for regulating the region's polluters.

In an interview with CalMatters, Samir Sheikh, the district's executive director, said the region faces unique challenges given its geography. With the valley surrounded by mountains, pollution gets trapped.

Emissions from agriculture, energy production and goods transport are among the major sources. While some emissions are at an all-time low, according to the district, climate change worsens the problem.

"We do have a very unique situation here where it takes even more reduction — significantly more reduction — in our area than it does most of the rest of the country to achieve the same goals," Sheikh said. "We're surrounded by forests with wildfires, there's persistent droughts...There are challenges that are becoming even bigger over time."

Reductions will need to come from cars, trucks, heavy equipment and other so-called "mobile" sources that the local air district doesn't regulate — they are under the control of the state Air Resources Board.

California has already set the nation's toughest emission standards for cars, trucks and other vehicles, and its **recently enacted regulations for zero-emission cars** will help the San Joaquin Valley and Los Angeles basin comply with the new soot standard.

Clean air advocates in the Central Valley deploy the morbid emergency room acronym D.O.A., dead on arrival, as shorthand for what they see as the main causes of pollution in the valley: development, oil and agriculture.

In the San Joaquin Valley, which is one of the poorest regions in the nation, inequality and health injustice go hand-in-hand.

“It's hard to put a price tag on not being able to let your kid go outside and play safely,” said Catherine Garoupa, executive director of the Central Valley Air Quality Coalition. “For better or worse, the San Joaquin Valley is the canary in the coal mine. We're the extreme example.”

In the Sacramento region, soot isn’t a new problem. But its air has met the EPA’s previous annual standards for soot. In an interview with CalMatters before the EPA’s announcement, Mark Loutzenhiser, a manager with the **Sacramento Metropolitan Air Quality Management District**, said his agency will be closely watching the process with the anticipation that they could be out of compliance.

What will the Los Angeles region have to do?

The Los Angeles region also faces severe challenges meeting the current standard. The South Coast Air Quality Management District is responsible for regulating air pollution in Los Angeles, Orange, San Bernardino and Riverside counties, which has 17 million residents.

Based on the EPA’s analyses of air quality data from 2019 through 2021, The Los Angeles basin reached 14.2 per cubic meter of fine particulate matter in the air. It now has to get to 9 to meet the new one announced today.

Yet the South Coast hasn’t even approved a plan to meet the previous standard, set in 2012. It won’t do so until at least spring of 2024, said Bernard Parks, Jr., a spokesperson for the agency. That plan will now immediately be outdated.

Parks refused CalMatters' requests for an interview about how the region will cut emissions and would only answer questions by email.

> **"People who live closer to freeways, who live close to refineries or power plants, who, by virtue of their economic status, live in more polluted areas are more exposed."**
>
> — EDWARD AVOL, UNIVERSITY OF SOUTHERN CALIFORNIA'S SCHOOL OF MEDICINE

The air district said it has already set dozens of local regulations and that it needs the federal government's help to control sources that it can't regulate, such as ships and aircraft.

Local regulations already in place have cut emissions from oil refineries and other industrial plants, as well as an array of sources in homes and businesses, such as paints, solvents, charbroilers and fireplaces.

The district is seeking more reductions by targeting industrial boilers, heaters, furnaces and other units as well as internal combustion engines and turbines. The district also offers an array of incentives aimed at reducing emissions from trucks, school buses and other mobile sources regulated by the state.

Violating the previous fine particle standard caused an annual toll of an estimated 1,500 premature deaths, 8,700 hospitalizations and 163,000 days absent from school and work, the air district said in a **letter to the EPA**.

What about wildfires? Aren't they a major source?

Wildfire smoke is **toxic** and its proliferation this summer in many cities in other states helped underscore the reality of what a future with more extreme weather might look like. It is a considerable source of soot, and those particles are considered smoke's most hazardous ingredient.

Smoke may be diminishing some of California's **clean-air gains**, according to The New York Times. The Energy Policy Institute of Chicago released a **report** last year that showed some California counties were more polluted than they were in 1970. In 2020, more than half of California counties experienced their worst air pollution since 1998, according to the report.

But California's air quality agencies do not have to consider wildfire smoke when planning how to attain the EPA's new standard. Fires are considered "exceptional events" under the federal Clean Air Act. And the EPA

allows jurisdictions to apply for waivers for wildfire events, although critics say that is a complex and protracted process.

Some experts say that the EPA's exemptions for wildfires may have to be reconsidered as climate change triggers larger and more unpredictable wildfires — and more and more soot.

John Osborn D'Agostino, CalMatters' data and interactives editor, contributed to the reporting on this article.

MORE ON AIR QUALITY

Has California's landmark law cleaned communities' dirty air?

California's environmental justice law is supposed to clean the air for 15 hot spot communities, home to almost 4 million people. But after more than 4 years and $1 billion, it's still impossible to say whether it's worked.

by Rachel Becker JANUARY 31, 2022

No place is safe: New national report on climate change details sweeping effects

California ranks among the top states suffering economic damage from climate-related disasters. The report describes food shortages, floods, droughts, wildfires, pollution, disease — all linked to climate change.

by Alejandro Lazo NOVEMBER 14, 2023

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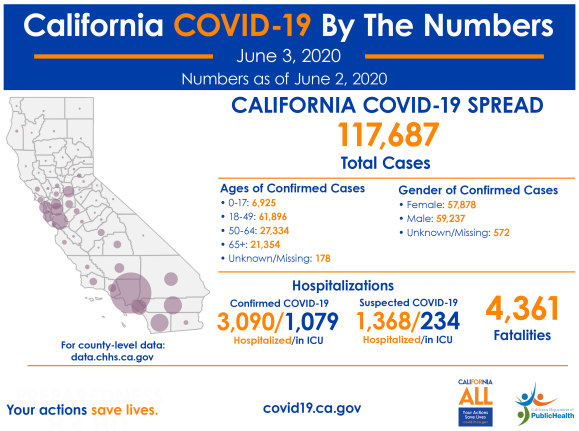
OFFICE OF PUBLIC AFFAIRS

State Officials Announce Latest COVID-19 Facts

Date: June 3, 2020
Number: NR20-111
Contact: CDPHpress@cdph.ca.gov

SACRAMENTO – The California Department of Public Health today announced the most recent statistics on COVID-19. California now has 117,687 confirmed cases and 4,361 deaths.



Testing in California

As testing capacity continues to increase across the state, the California Department of Public Health is working to expand access to COVID-19 testing. Testing should be used for medical evaluation of persons with symptoms of COVID-19 as well as for efforts by public health agencies and essential employers to prevent and control the spread of COVID-19. Individuals prioritized for testing include:

- Hospitalized patients
- Symptomatic and asymptomatic healthcare workers, first responders, and other social service employees

- Symptomatic individuals age 65 and older or symptomatic individuals of any age with chronic medical conditions that increase the risk of severe COVID-19 illness
- Individuals who are tested as part of disease control efforts in high-risk settings
- Asymptomatic residents and employees of congregate living facilities when needed to prevent disease transmission
- Symptomatic and asymptomatic individuals in essential occupations such as grocery store and food supply workers, utility workers and public employees
- Other individuals with symptoms consistent with COVID-19

As of June 2, there have been 2,131,294 tests conducted in California and reported to the California Department of Public Health. This represents an increase of 59,703 tests over the prior 24-hour reporting period. These numbers include data from commercial, private and academic labs, including Quest, LabCorp, Kaiser, University of California and Stanford, and the 25 state and county health labs currently testing. The Department is now reporting all tests reported in California, rather than the total number of individuals tested.

Data Portal

The state has launched a user-friendly data portal at COVID-19 Statewide Update that tracks COVID-19 cases statewide and by county, gender, age and ethnicity. The portal also outlines statewide hospitalizations and testing efforts. The data presented on the portal is updated daily and will include additional information as it is available.

Racial Demographics – A More Complete Picture

The California Department of Public Health is committed to health equity and collecting more detailed racial and ethnic data that will provide additional understanding for determining future action. Health outcomes are affected by forces including structural racism, poverty and the disproportionate prevalence of underlying conditions such as asthma and heart disease among Latinos and

African American Californians. Only by looking at the full picture can we understand how to ensure the best outcomes for all Californians.

The differences in health outcomes related to COVID-19 are most stark in COVID-19 deaths. We have nearly complete data on race and ethnicity for COVID-19 deaths, and we are seeing the following trends. Overall, for adults 18 and older, Latinos, African Americans and Native Hawaiians and Pacific Islanders are dying at disproportionately higher levels. The proportion of COVID-19 deaths in African Americans is about double their population representation across all adult age categories. For Native Hawaiians and Pacific Islanders, overall numbers are low, but about three-fold difference between the proportion of COVID-19 deaths and their population representation. More males are dying from COVID-19 than females, in line with national trends. More information is available at COVID-19 Race and Ethnicity Data.

Health Care Worker Infection Rates

As of June 2, local health departments have reported 10,293 confirmed positive cases in health care workers and 63 deaths statewide.

Your Actions Save Lives

Every person has a role to play. Protecting yourself and your family comes down to common sense:

- Staying home except for essential needs/activities following local and state public health guidelines when patronizing approved businesses. To the extent that such sectors are re-opened, Californians may leave their homes to work at, patronize, or otherwise engage with those businesses, establishments or activities.
- Practicing social distancing.
- Wearing a cloth face mask when out in public.
- Washing hands with soap and water for a minimum of 20 seconds.
- Avoiding touching eyes, nose or mouth with unwashed hands.
- Covering a cough or sneeze with your sleeve, or disposable tissue. Wash your hands afterward.
- Avoiding close contact with people who are sick.
- Staying away from work, school or other people if you become sick with respiratory symptoms

like fever and cough.
- Following guidance from public health officials.

What to Do if You Think You're Sick

Call ahead: If you are experiencing symptoms of COVID-19 (fever, cough or shortness of breath), call your health care provider before seeking medical care so that appropriate precautions can be taken. More than 85 community testing sites also offer free, confidential testing: Find a COVID-19 Testing Site.

For more information about what Californians can do to prevent the spread of COVID-19, visit Coronavirus (COVID-19) in California.

California continues to issue guidance on preparing and protecting California from COVID-19. Consolidated guidance is available on the California Department of Public Health's Guidance web page.

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Title: The disproportionate rise in COVID-19 cases among Hispanic/Latinx in disadvantaged communities of Orange County, California: A socioeconomic case-series

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Abstract

Background: Recent epidemiological evidence has demonstrated a higher rate of COVID-19 hospitalizations and deaths among minorities. This pattern of race-ethnic disparities emerging throughout the United States raises the question of what social factors may influence spread of a highly transmissible novel coronavirus. The purpose of this study is to describe race-ethnic and socioeconomic disparities associated with COVID-19 in patients in our community in Orange County, California and understand the role of individual-level factors, neighborhood-level factors, and access to care on outcomes.

Methods: This is a case-series of COVID-19 patients from the University of California, Irvine (UCI) across six-weeks between 3/12/2020 and 4/22/2020. Note, California's shelter-in-place order began on 3/19/2020. Individual-level factors included race-ethnicity status were recorded. Neighborhood-level factors from census tracts included median household income, mean household size, proportion without a college degree, proportion working from home, and proportion without health insurance were also recorded.

Results: A total of 210-patients tested were COVID-19 positive, of which 73.3% (154/210) resided in Orange County. Hispanic/Latinx patients residing in census tracts below the median income demonstrated exponential growth (rate = 55.9%, $R2 = 0.9742$) during the study period. In addition, there was a significant difference for both race-ethnic ($p < 0.001$) and income bracket ($p = 0.001$) distributions prior to and after California's shelter-in-place. In addition, the percentage of individuals residing in neighborhoods with denser households ($p = 0.046$), lower levels of college graduation ($p < 0.001$), health insurance coverage ($p = 0.01$), and ability to work from home ($p < 0.001$) significantly increased over the same timeframe.

Conclusions and Relevance: Our study examines the race-ethnic disparities in Orange County, CA, and highlights vulnerable populations that are at increased risk for contracting COVID-19. Our descriptive case series illustrates that we also need to consider socioeconomic factors, which ultimately set the stage for biological and social disparities.

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Introduction

By April 28, 2020, the COVID-19 pandemic has infected over 1 million individuals in the United States, with nearly 60,000 associated deaths[1]. Furthermore, COVID-19 has produced disproportionately worse outcomes among underserved minority populations. For example, recent epidemiological evidence has demonstrated a higher rate of hospital admissions and deaths among Hispanic/Latinx and African American communities[2,3]. In New York City, Hispanic/Latinx and African American patients represent 34% and 28% of fatalities despite only representing 29% and 22% of the population, respectively[4]. Understanding the critical pattern of race-ethnic disparities related to COVID-19 necessitates exploration of biological, social, and environmental factors as well as the interaction of these factors.

It is widely accepted that social determinants of health, "conditions in which people are born, grow, work, live, age, and the wider set of forces and systems,"[5] play a critical role in the creation of disparities related to morbidity, mortality, and quality of life for most chronic, noncommunicable diseases (NCD's) including cardiovascular disease, stroke, diabetes, asthma, and certain cancers[6]. These social determinants include poverty, wealth, educational quality, neighborhood conditions, childhood experience, social support, access, etc. Social determinants linked to NCD's are thought to adversely impact disease outcomes via chronic exposures throughout the life course[6,7]. Unfortunately, the relatively short duration of acute infectious disease has limited investigations into the impact of social determinants, as most of this research has been conducted in chronic infections including HIV and TB[8]. However, more recent research on influenza suggested individual-level factors, neighborhood level factors, access to care, and social policies were associated with disparities in both respiratory infections and vaccine uptake[9-11]. For example, Chandrasekhar et al. observed that these factors could partially explain the

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variability in influenza hospitalizations with census tract data[9]. However, little is known about the social determinants of COVID-19 outcomes.

The pattern of race-ethnic disparities in COVID-19 outcomes emerging throughout the United States begs the question of what social factors may influence a highly transmissible, rapidly spreading novel coronavirus. Understanding the mechanisms associated with disparities in severe illness and death will inform the design of equitable public health strategies and preparedness plans for emerging and reemerging infectious diseases. The purpose of this study is to describe race-ethnic and socioeconomic disparities associated with COVID-19 in patients in our community in Orange County, California. Specifically, we sought to understand the role of individual-level factors, neighborhood-level factors, and access to care on COVID-19 outcomes. Further, we sought to understand the role of social distancing as an equitable public health policy that may not be available to those who cannot work from home.

Methodology

Patient selection

This descriptive case series included patients with confirmed COVID-19 infections who presented to the University of California Irvine Medical Center (UCI), the only academic teaching hospital (411 beds) located in Orange County, California, from March 12, 2020, to April 22, 2020. Study Day 1 was March 12, 2020, which corresponds to the date of presentation of the first confirmed COVID-19 case at UCI. COVID-19 status was diagnosed by nucleic acid detection assays for all patients. Retrospective collection of patient data was approved by UCI's Institutional Review Board.

Individual-level factors

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We obtained demographic and socioeconomic information through manual retrospective chart review of all COVID-19 cases. Race-ethnicity data is commonly collected at UCI through patient/proxy self-report. Additional individual-level factors included the patient's marital status, address, and occupation status. Patient home addresses were used to determine the census tract and whether the patients lived in a house or apartment.

Neighborhood-level factors

We obtained ecological-level information through address linkage at the level of the census tract (the smallest census geographic unit in the United States) to the 2019 Federal Financial Institutions Examination Council (FFIEC) census reports, which contains 583 census tracts in Orange County[12,13]. Census tracts are uniquely numbered geographic areas that average 4,000 inhabitants from 1,600 housing units and represent relatively homogenous population characteristics[14]. As UCI is a tertiary referral center, patients geocoded to a census tract other than Orange County were excluded.

Census variables included: (1) median household income, (2) average household size, (3) percent of inhabitants 25-years and over with a college degree, (4) percent of working inhabitants 16-years and over that work from home, and (5) percent of inhabitants without health insurance. We ecologically classified individuals living in areas where the household income fell between 80% and 120% of the Orange County Median Family Income ($89,398 for 2019) as *middle-income* status[12]. We ecologically classified individuals living in areas where the household income fell below 80% of Median Family Income as *lower-income* and individuals living in areas where the household income was above 120% of Median Family income as

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upper-income. We ecologically classified the proportion of inhabitants who work from home as the ability to shelter in place.

Statistical Analysis

Descriptive statistics were generated for demographic variables of all patients, including age, gender, and race-ethnic status. Growth patterns between weeks 1 and 6 for income brackets (*Lower, Middle, and Upper*) and race-ethnic groups (*White, Asian, and Hispanic/Latinx*) were studied by using least-squares regression analysis. We fully acknowledge that both Latinx and Black populations have been disproportionately affected by COVID-19; however, Black individuals account for 2.1% of the Orange County population[12] and we do not have a large enough representation for statistical analysis of this group. Three models were tested to fit each time series: linear, exponential, and logistic growth curves. The slope-intercept equation, $y = mx + b$, where y is the number of new COVID-19 cases, m is the slope, and b is the y-intercept, was used for linear regression. The standard exponential growth equation, $a = Ne^{rt}$, where a is the number of new COVID-19 cases, N is a constant, r is the growth rate, and t is time after the start of our collection period was used for exponential regression. A standard logistic growth equation, $a = a_{max}/(1 + Be^{-rt})$, where a_{max} is the asymptotic maximum number of articles, and B and r are constants that affect the contour of the growth curve, was used for logistic regression. A P value of less than or equal to 0.05 was considered to indicate significance. The Akaike information criterion was used as a measure of the goodness of fit of the three models, with the best fit determined by lowest value[15].

To assess difference between income and race-ethnic status with respect to California's statewide stay-at-home order (which began on 3/19/2020), proportions of cases from 2 week

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blocks from the pre-shelter period (Weeks 1-2, 3/12/2020 – 3/25/2020) and post-shelter period (Weeks 4-5, 4/2/2020 – 4/15/2020), were compared using Pearson's chi-square.

Pearson's chi-square was also used to test for significant differences in race-ethnic breakdown between county demographics, all positive COVID-19 patients, and critical COVID-19 patients, defined as need for ICU-level care or mechanical ventilation or death. Number of cases of COVID-19 per 100,000 population and proportion with critical disease were computed for each race-ethnic group with corresponding 95% confidence intervals. A *p*-value of 0.05 was considered significant for all analyses.

Results

Subjects

A total of 1,940 COVID-19 nucleic acid detection tests were conducted over the study period, of which 10.8% (210/1,940) were positive. Of positive cases, 73.3% (154/210) had an identifiable medical record and met inclusion criteria. This included 80 males and 74 females with an average age of 44.7 years (range, 13-88 years) (**eTable 1**).

Individual-level Factors

The race-ethnic distribution of our patients was 40.3% (62/154) Hispanic/Latinx, 24.0% (37/154) White, 21.4% (33/154) Asian, 2.6% (4/154) Black, and 11.7% (18/154) Other/Unknown, and changes in race-ethnic distribution were monitored over the six-week study period (**Figure 1A**). During this period, the number of Hispanic/Latinx COVID-19 cases grew linearly ($R^2 = 0.997$) starting after the first case in Week 2 with 5.9 new patients per week ($p < 0.001$). No significant growth pattern was observed for either White or Asian persons ($p = 0.53$ and $p = 0.43$,

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respectively). There was a significant difference observed in race-ethnic distribution relative to the time of shelter (Weeks 1-2 vs. Weeks 4-5) with $p < 0.001$ (**Figure 1B**).

Neighborhood-level factors

The median household income for recorded census tracts was $80,190 (range $25,705 to $214,323), which included 45.3% (68/150) Lower, 29.3% (44/150) Middle, and 25.3% (38/150) Upper income brackets over the six-week study period (**Figure 2A**). Across the study period, patients residing in low income tracts demonstrated an exponential growth rate (r = 64.2%, R^2 = 0.958) ($p = 0.001$). Patients residing in middle-income tracts demonstrated a linear growth rate (1.9 patients per weak, $p = 0.02$). No significant growth rate was observed for patients residing in high-income tracts ($p = 0.40$). There was a significant difference observed in the income bracket distribution of census tracts relative to the time of shelter (Weeks 1-2 vs. Weeks 4-5) with p = 0.04 (**Figure 2B**).

We divided patients into groups residing in tracts above and below the median income and examined the race-ethnic distribution of COVID-19 cases over the study period. Only Hispanic/Latinx COVID-19 cases residing in tracts below the median income demonstrated exponential growth (r = 55.9%, R^2 = 0.9742) (**Figure 3**). We observed no significant growth rate in new COVID-19 cases amongst Hispanic/Latinx patients who lived in tracts above the Orange County median income (>$85,398) or amongst White or Asian patients in either income group.

Over the study period, the mean household size assigned by census tracts rose linearly from 2.52 to 4.01 (0.28 increase per week, R^2 = 0.903, $p = 0.046$) (**Figure 4A**). With regards to education, the mean percentage of census tract inhabitants without a college degree rose linearly from 45.2% to 80.0% (7.2% increase per week, R^2 = 0.939, $p < 0.001$) (**Figure 4B**). The mean proportion of inhabitants working from home in the representative census tracts declined linearly

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from 6.3% to 3.3% (-0.6% increase per week, $R^2 = 0.989$, $p < 0.001$) (**Figure 4C**). Lastly, the mean distribution of inhabitants who have no health insurance in the representative census tracts rose grew exponentially from 7.0% to 13.8% (r = 12.2%, $R^2 = 0.867$) ($p = 0.01$) (**Figure 4D**).

County Disparity

We observed significant disparities in race-ethnic distribution among COVID-19 cases with non-critical and critical disease when compared to county demographics (**Figure 5**). Compared to Orange Country's race-ethnic distribution (40.1% White, 21.4% Asian, and 34.2% Hispanic/Latinx)[12], the non-critical cases were comprised of 24.4% White, 20.7% Asian, and 39.3% Hispanic/Latinx and the critical cases were comprised of 21.1% White, 26.3% Asian, and 47.4% Hispanic/Latinx. In addition, the COVID-19 cases per 100,000 people were also disparate among race-ethnic groups, with 2.9 (95% CI: 0.71 to 6.8) White cases, 3.0 (95% CI: 1.4 to 6.1) Asian cases, and 9.4 (95% CI: 7.2 to 12.6) Hispanic/Latinx cases per 100,000 people of each group.

Discussion

While recent epidemiologic reports on COVID-19 have observed disparities in incidence, morbidity, and mortality among underserved and minority populations, including the Hispanic/Latinx community, there remains a poor understanding about which social determinants may contribute to these disparities. Included in this descriptive case series is information about the impact of individual and neighborhood-level determinants on COVID-19 incidence over time and severity. Our observation of exponential growth in Hispanic/Latinx

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COVID-19 cases who live in dense households and low-income communities highlights the importance of understanding community-level factors during a pandemic.

The extensive research on the relationship between social determinants and race-ethnic disparities in noncommunicable diseases, including heart disease and stroke, has largely been characterized by long-term exposures leading to differences in disease ourcomes[16,17]. However, the social determinants of infectious disease are less well-characterized. Our finding that COVID-19 cases in Orange County increased linearly in neighborhoods with higher housing density, lower educational attainment, and lower health coverage further underscore the importance of understanding contextual factors surrounding infectious disease outbreaks.

It has been suggested that individuals living in disadvantaged communities may be at greater risk of infectious diseases[10]. For example, a significant association between severity and lower educational attainment (individual and community) was observed in a study examining factors associated with poorer outcomes during the H1N1 pandemic of 2009[18]. Other studies suggest that neighborhoods defined as disadvantaged were associated with higher influenza-related deaths, hospitalizations, and poorer vaccination coverage[9-11,19]. Similarly, for COVID-19 the interaction of social determinants at multiple levels may lead to a "perfect storm" that disproportionately affects underserved populations by negatively impacting both rates of infection and outcomes.

This study generates several hypotheses to explain the impact of social determinants of health on the observed disparities in COVID-19 incidence and severity over time. We hypothesize that underserved populations living in lower-income census tracts are experiencing a spike in COVID-19 transmission due to increased housing density, employment in "essential/frontline" job sectors, lower educational attainment, and limited health care access. For

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health care workers, this trend has been seen across the U.S. and has been attributed to their "frontline" status with exposure to COVID-19 patients[20]. We hypothesize that the lower income and minority populations that demonstrate a similar increase over time may also be experiencing this "frontline" spike due to barriers to social distancing."

Social policies at the local, county, state, and national level, including universal face masking, self and family case isolation, social distancing, school cancellation, and voluntary or mandated shelter in place, may underlie the connection between social determinants and COVID-19 disparities[21]. For example, while social distancing has been demonstrated to be a strong and effective preventive measure against COVID-19 transmission rates[22,23], our data suggest that those living in communities where work at home is infrequent had higher COVID-19 case growth. Adherence to social policies is likely difficult for populations that do not have and cannot afford remote work options. For example, approximately 75% of New York frontline and essential workers, including healthcare, grocery & convenience stores, public transit, cleaning services, and delivery operations, are people of color[24]. We suggest that social policies incorporate a framework around social determinants that would promote strategies to achieve equity for all communities.

In addition, pre-existing disparities in co-morbidities associated with disproportionately worse COVID-19 outcomes may be partially responsible for the race-ethnic disparities observed in this study. Data from the National Health and Nutrition Examination Survey (NHANES) suggests that more than a third of all US adults met the definition of metabolic syndrome with greater prevalence among Black and Latinx populations and in low socioeconomic populations[25]. The significantly greater presence of metabolic syndrome in underserved populations[11] may

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provide some insight into the racial-ethnic disparities in COVID-19 incidence, particularly for critical disease

Limitations of this study include the small sample of patients from a single-center, so conclusions may not be broadly generalizable. However, the strengths of this study include the collection of comprehensive data, including race-ethnic and census-tract derived community determinants from all patients presenting with COVID-19 over the study period. Future studies should evaluate the complex interactions of the social determinants of income and ethnicity with other demographic, clinical, and laboratory factors.

In summary, our study examines the unveiling of race-ethnic disparities over the first six weeks of COVID-19 in Orange County, CA, and highlights vulnerable populations that are at increased risk for contracting COVID-19 and experiencing disproportionately severe outcomes. While our findings that Hispanic/Latinx populations are at increased risk corroborates reports elsewhere in the United States[2], this study demonstrates the increase was most dramatic in minority groups living in disadvantaged communities. When we think of race-ethnic disparities, we often investigate immediate causes of disease, including risk factors. Our descriptive case series illustrates that for COVID-19 disparities, we also need to consider the "causes of those causes," which ultimately set the stage for biological and social disparities.

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Demographic information	No. (%)
Total No.	154
Age, Mean [range], y	44.7 [13-18]
Sex	
Female	74 (48.1)
Male	80 (51.9)
Race-Ethnicity	
Hispanic/Latinx	62 (40.3)
White	37 (24.0)
Asian	33 (21.4)
Black	4 (2.6)
Other / Unknown	18 (11.7)
Household income of census tracts	
No.	150
Median [range], $	80,190 [25,705 – 214,323]
Upper income	68 (45.3)
Middle income	38 (25.3)
Lower income	44 (29.3

eTable 1. **Study population demographic information**.

Median household income of corresponding census tracts was available for 150 patients. Individuals living in areas where the household income fell between 80% and 120% of the Orange County Median Family Income ($89,398 for 2019) as *middle-income* status[12]. Individuals living in areas where the household income fell below 80% of Median Family Income as *lower-income* and individuals living in areas where the household income was above 120% of Median Family income as *upper-income*.

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Figure 1. **COVID-19 race-ethnic trends.**

Bar charts demonstrating trends for White, Asian, and Hispanic/Latinx patients from Week 1 (3/12/2020 – 3/17/2020) through Week 6 (4/16/2020-4/22/2020) demonstrating a linear increase in Hispanic/Latinx patients with other race-ethnic groups demonstrating no significant growth trend (**A**). This likely accounts for a significant difference in race-ethnic distributions relative to the time of shelter (Weeks 1-2 vs. Weeks 4-5) (**B**).

Figure 2. **COVID-19 census tract trends.**

Bar charts demonstrating trends for Upper, Middle, and Lower income neighborhoods of patients from Week 1 (3/12/2020 – 3/17/2020) through Week 6 (4/16/2020-4/22/2020) demonstrating an exponential increase for lower income groups, linear increase for middle income groups, and no significant trend for upper income groups (**A**). This likely accounts for a significant difference in income bracket distributions relative to the time of shelter (Weeks 1-2 vs. Weeks 4-5) (**B**).

Figure 3. COVID-19 race-ethnic trends by census tracts.

White (**A**), Asian (**B**), and Hispanic/Latinx (**C**) growth trends residing in tracts above and below the median income between Week 1 (3/12/2020 – 3/17/2020) through Week 6 (4/16/2020-4/22/2020). The only group to demonstrate a significant growth pattern was Hispanic/Latinx patients living in census tracts below the median income.

Figure 4. **COVID-19 socioeconomic trends**.

Scatterplots demonstrate a linear increase in average household size (**A**), linear increase in proportion of inhabitants without a college degree (**B**), linear decrease in proportion of

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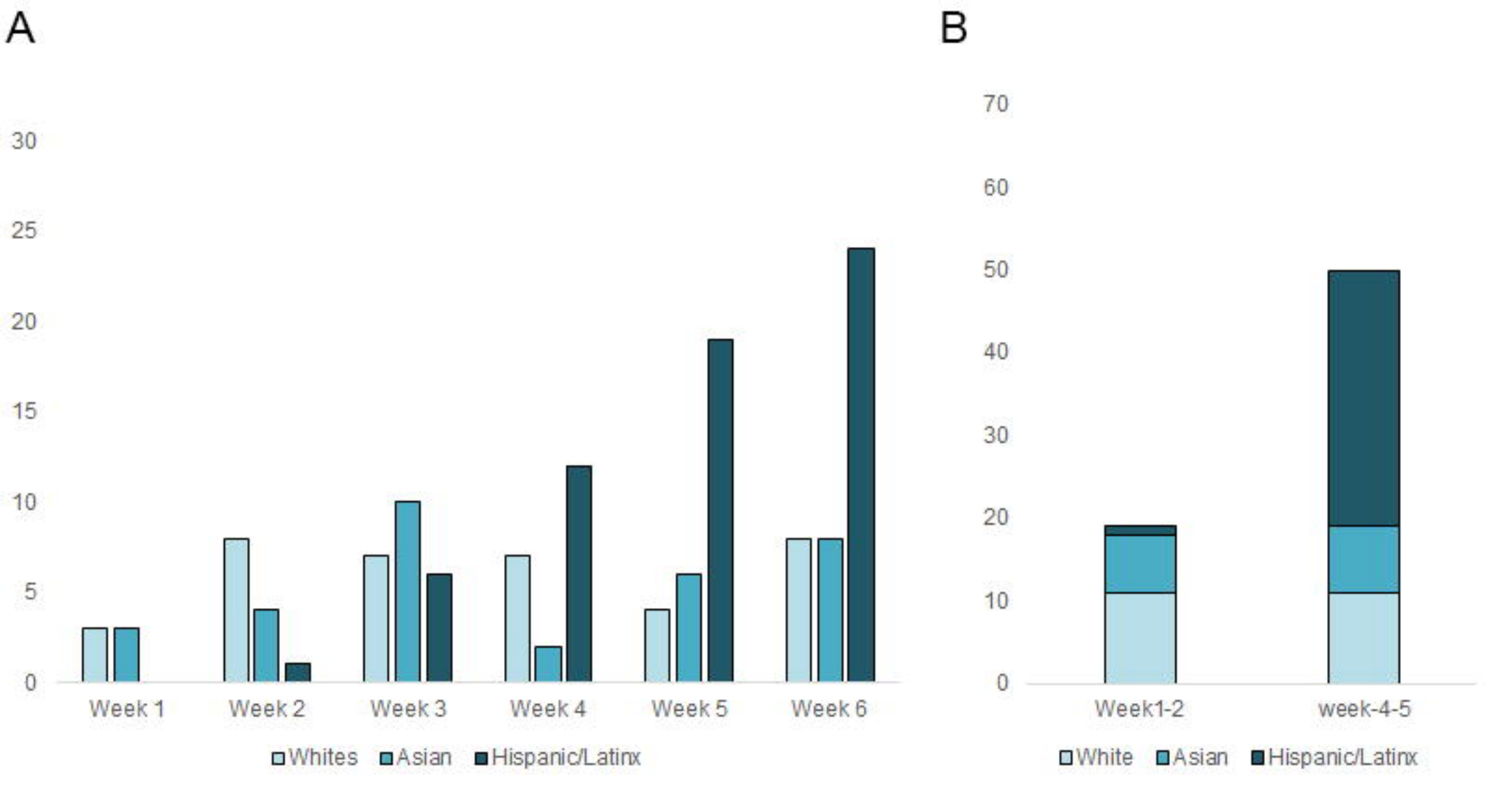
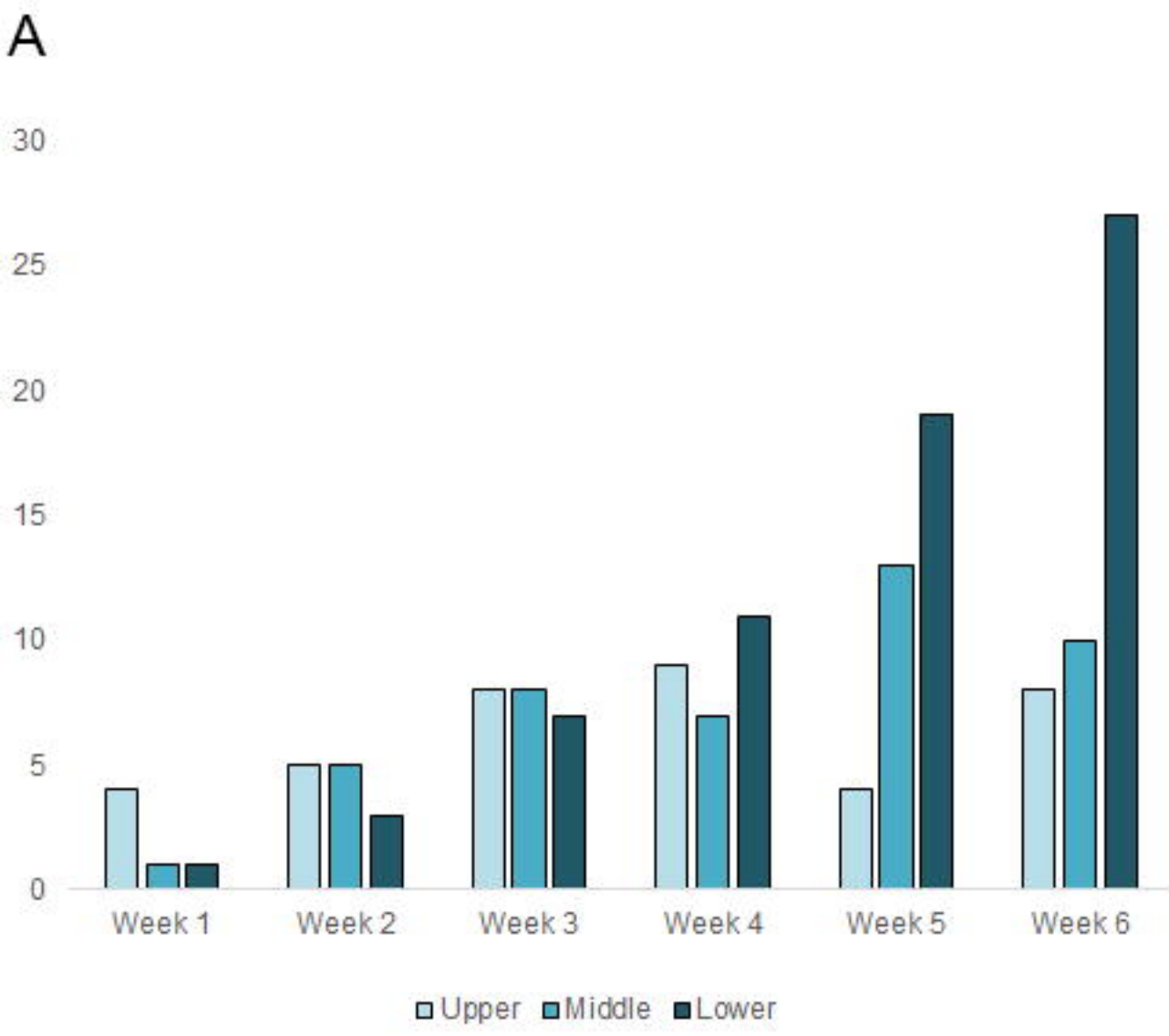
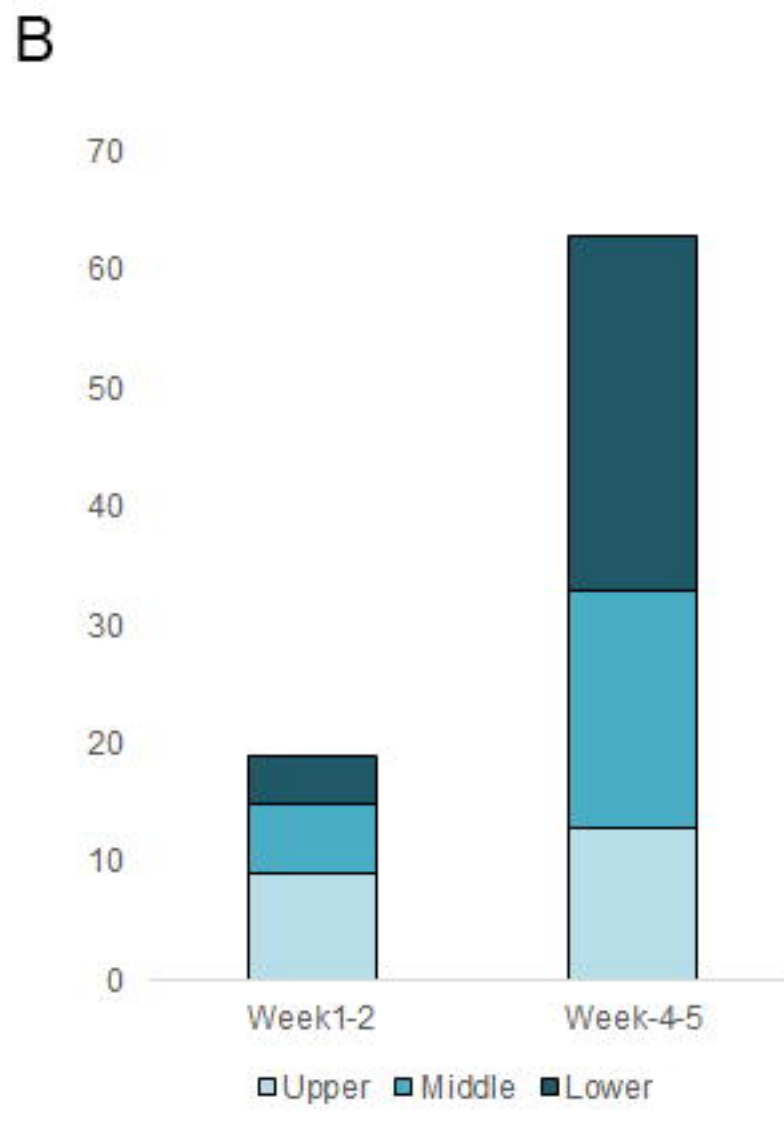
inhabitants working from home (**C**), and exponential increase proportion of inhabitants without health insurance (**D**).

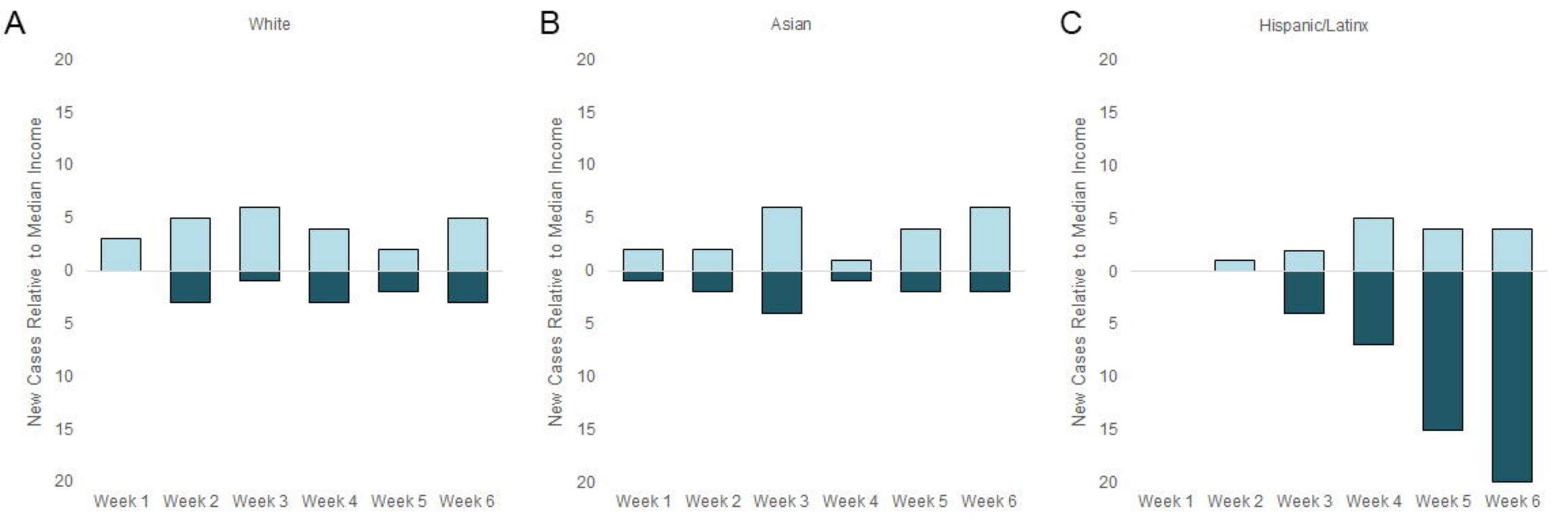
Figure 5. Race-ethnic disparities of COVID-19 patients.

Bar charts demonstrating disparities between the Orange County racial profile and the distribution of Non-Critical COVID patients as well as Critical COVID patients at our institution. Specifically, while Hispanic/Latinx patients account for 34.2% of the county population, they represent 47.4% of our institution's critical cases. Conversely, while White patients account for 40.1% of the county population, they represent 21.1% of our institution's critical cases.

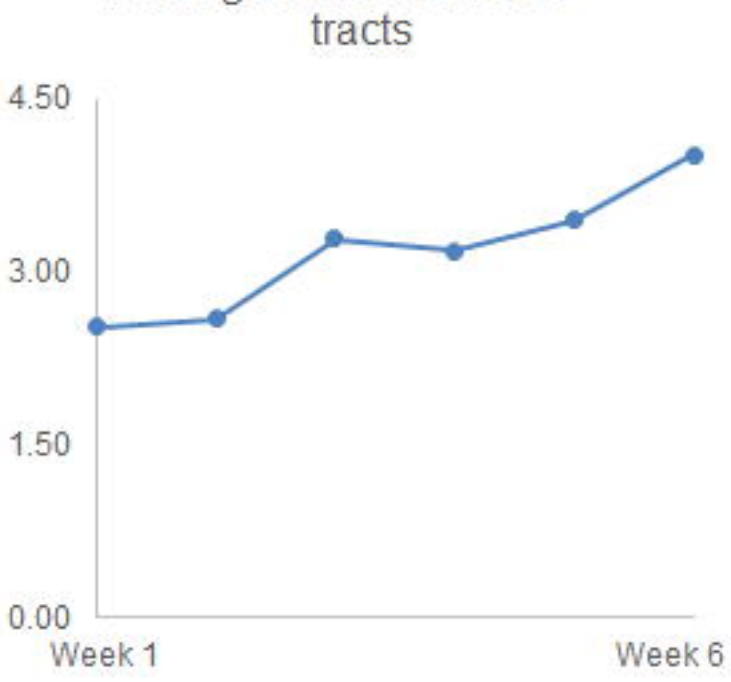

A
30
25
20
15
10
5
0
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Whites
Asian
Hispanic/Latinx
B
70
60
50
40
30
20
10
0
Week1-2
week-4-5
White
Asian
Hispanic/Latinx


A
30
25
20
15
10
5
0
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Upper
Middle
Lower

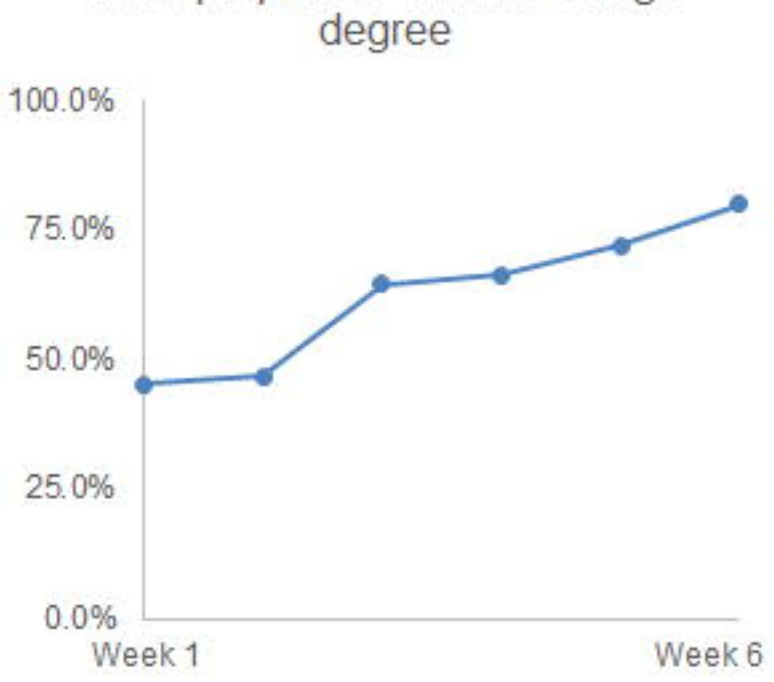

B
70
60
50
40
30
20
10
0
Week1-2
Week-4-5
Upper
Middle
Lower


A
White
B
Asian
C
Hispanic/Latinx
New Cases Relative to Median Income
20
15
10
5
0
5
10
15
20
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6

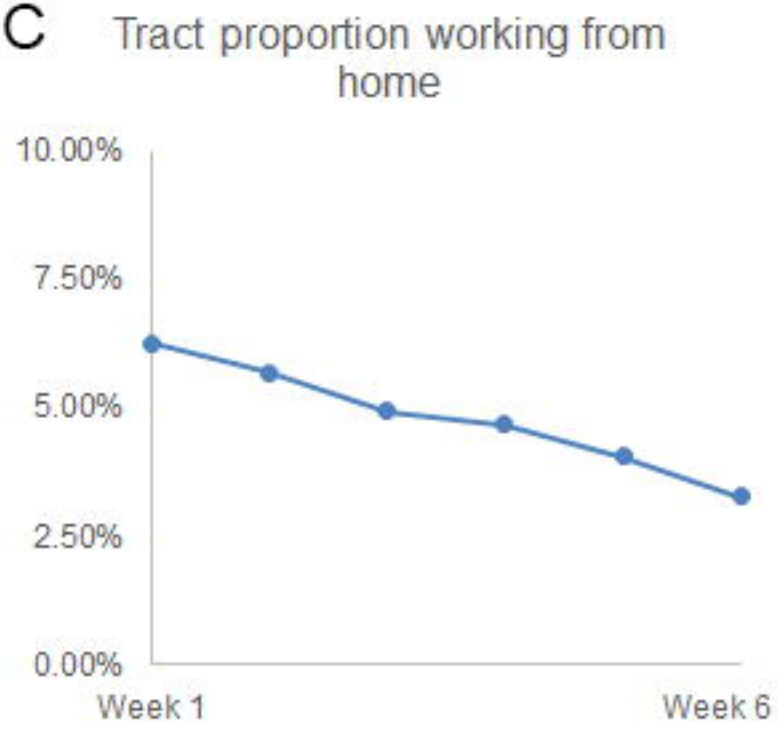
A


Average household size tracts
4.50
3.00
1.50
0.00
Week 1
Week 6

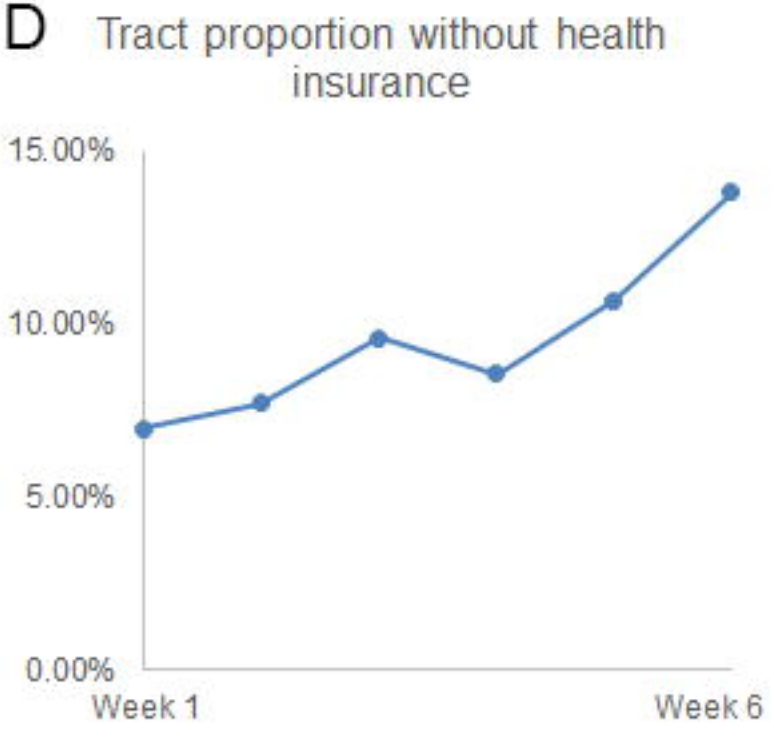
B

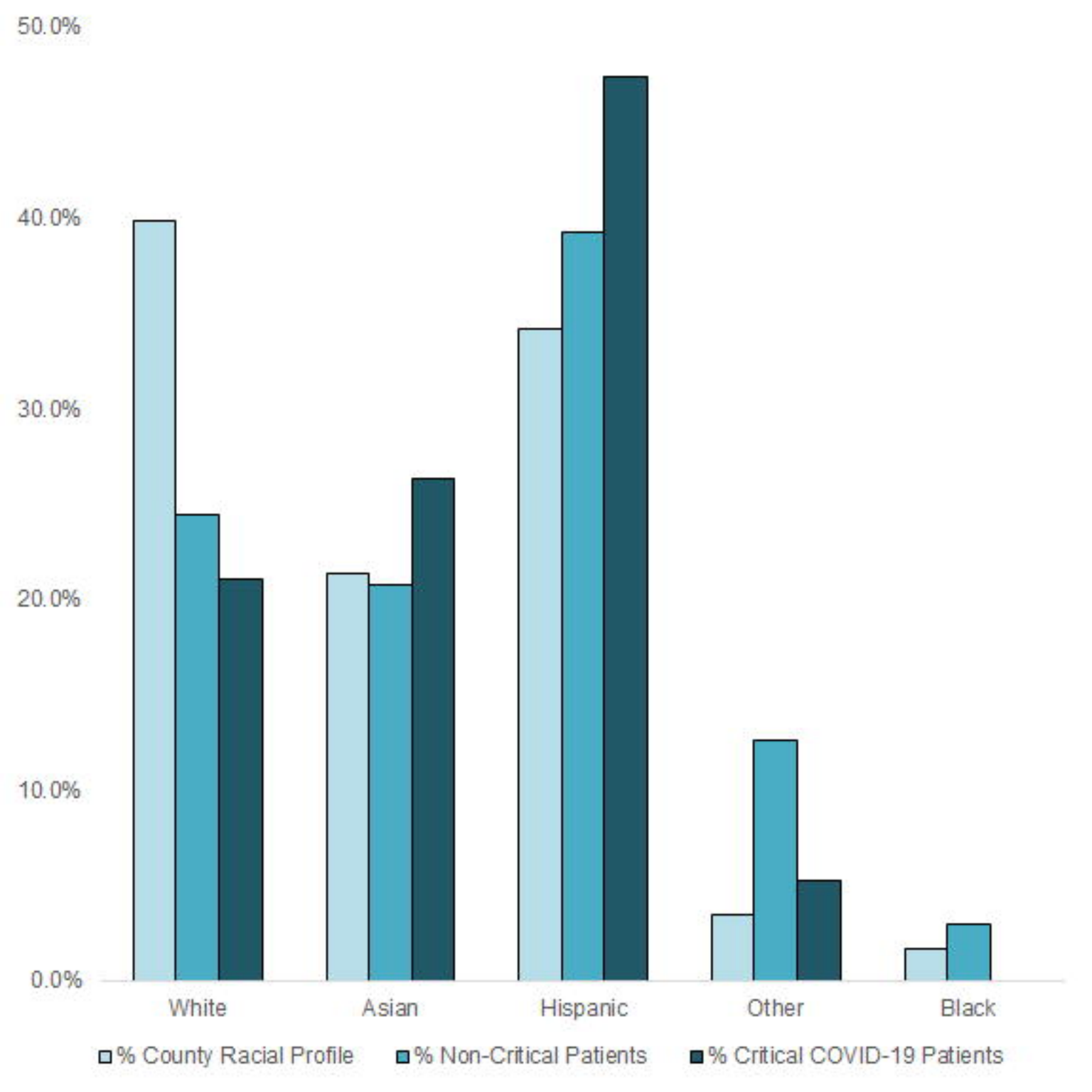

Tract proportion without college degree
100.0%
75.0%
50.0%
25.0%
0.0%
Week 1
Week 6

C


Tract proportion working from home
10.00%
7.50%
5.00%
2.50%
0.00%
Week 1
Week 6

D


Tract proportion without health insurance
15.00%
10.00%
5.00%
0.00%
Week 1
Week 6


50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
White
Asian
Hispanic
Other
Black
% County Racial Profile
% Non-Critical Patients
% Critical COVID-19 Patients

Prepublication Release

PEDIATRICS

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children

Monika K. Goyal, MD, MSCE, Joelle N. Simpson, MD, MPH, Meleah D. Boyle, MPH, Gia M. Badolato, MPH, Meghan Delaney, DO, MPH, Robert McCarter, ScD, Denice Cora-Bramble, MD, MBA

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Prepublication Release

Racial/Ethnic and Socioeconomic Disparities of SARS-CoV-2 Infection Among Children

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Abbreviations:
Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
Non-Hispanic (NH)
Median family income (MFI)
Odds ratio (OR)
Confidence interval (CI)

What's Known on This Subject: Racial/ethnic and socioeconomic disparities in SARS-CoV-2 infection have been reported among adults, but are understudied in relation to infection risk in children.

What this Study Adds: In this cross-sectional study of a large cohort of children tested in the United States for SARS-CoV-2 through an exclusively pediatric drive-through/walk-up testing site, rates of SARS-CoV-2 infection were disproportionately higher among minority and socioeconomically disadvantaged youth.

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Contributors' Statement Page:

Dr. Goyal conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript.

Dr. Simpson conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, and reviewed and revised the manuscript.

Ms. Boyle and Ms. Badolato collected data, carried out the initial analyses, and reviewed and revised the manuscript.

Dr. Delaney coordinated and supervised data collection, and reviewed and revised the manuscript.

Dr. McCarter supervised and conducted the analyses, and reviewed and revised the manuscript.

Dr. Cora-Bramble conceptualized and designed the study, and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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ABSTRACT

Objective: To evaluate racial/ethnic and socioeconomic differences in rates of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection among children.

Methods: We performed a cross-sectional study of children tested for SARS-CoV-2 at an exclusively pediatric drive-through/walk-up SARS-CoV-2 testing site from March 21-April 28, 2020. We performed bivariable and multivariable logistic regression to measure the association between patient race/ethnicity and estimated median family income (MFI) based on census block group estimates with: 1) SARS-CoV-2 infection and 2) reported exposure to SARS-CoV-2.

Results: Of 1000 children tested for SARS-CoV-2 infection, 20.7% tested positive. In comparison to non-Hispanic (NH)-whites (7.3%), minority children had higher rates of infection (NH-black: (30.0%; adjusted OR 2.3 [95% CI 1.2, 4.4]; Hispanic: 46.4%; adjusted OR 6.3 [95% CI 3.3, 11.9]). In comparison to children in the highest MFI quartile (8.7%), infection rates were higher among children in quartile 3 (23.7%; adjusted OR 2.6 [95% CI 1.4, 4.9]; quartile 2 (27.1%; adjusted OR 2.3 [95% CI 1.2, 4.3], and quartile 1 (37.7%; adjusted OR 2.4 [95% CI 1.3, 4.6]). Rates of reported exposure to SARS-CoV-2 also differed by race/ethnicity and socioeconomic status.

Conclusions: In this large cohort of children tested for SARS-CoV-2 through a community-based testing site, racial/ethnic minorities and socioeconomically disadvantaged children carry the highest burden of infection. Understanding and addressing the causes of these differences are needed to mitigate disparities and limit the spread of infection.

INTRODUCTION

Racial/ethnic and socioeconomic-related disparities in health outcomes have been reported for years, across multiple clinical conditions.[1] The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has served to shine a spotlight on and amplify such disparities, as reports indicate that racial/ethnic minorities and socioeconomically disadvantaged populations are the most severely impacted.

More than 1.5 million cases of SARS-CoV-2 infection have been diagnosed in the United States, and children are estimated to comprise approximately 50,000 of those cases.[2] Recent data highlight the disproportionate burden of SARS-CoV-2-related illness and death on racial/ethnic

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minorities among adults.[3-5] Additional data further suggest that low socioeconomic status may further exacerbate health outcomes for racial and ethnic minorities.[4]

Data regarding disparities in SARS-CoV-2 infection and outcomes have been, thus far, mostly limited to adults. It is unknown whether such disparities extend to children as well. The primary objective of this study was to investigate the presence of racial/ethnic and socioeconomic disparities in rates of SARS-CoV-2 infection in a large sample of non-acutely ill children who were tested at an exclusively pediatric drive-through/walk-up SARS-CoV-2 testing site.

METHODS

Study Design

This was a planned cross-sectional analysis of a registry of children tested for SARS-CoV-2 at an exclusively pediatric drive-through/walk-up urban SARS-CoV-2 testing site from March 21, 2020 through April 28, 2020. This SARS-CoV-2 specimen collection site is affiliated with a tertiary care urban children's hospital. This service was funded through philanthropic support; therefore, patients seeking this service did not incur any out of pocket charges. To broaden access to those without motor vehicles, the testing site also allowed for walk-up testing. Targeted outreach to non-English speaking communities was also conducted in order to advertise this service to all communities. Furthermore, interpreters proficient in Spanish and Ahmaric were present at the testing site daily to assist non-English speaking families, and translated information material was made available to all. The institutional review board approved this study and provided a waiver of informed consent as this was a post hoc analysis of previously collected data.

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Study Population

Children between the ages of 0-22 years with mild symptoms not requiring acute medical care were eligible to be tested at this site with a physician referral. Age criteria for access to the testing site were consistent with the policies of the affiliated children's hospital and primary care practices. Physicians could refer patients through the use of an electronic portal available on the hospital website if they met age criteria, reported mild symptoms, and had at least one of following: known exposure, high risk status, family member with high risk status, required testing for work. The online referral form included patient demographics (name, age, sex, race/ethnicity, and address), reported symptoms, and reason for referral.

The testing site, located within one mile of the hospital at an outdoor enclosed parking lot of a local university, offered testing two to three times per week, including weekends, between the hours of 10am and 2pm. Because the testing site was not equipped to provide any medical management, patients who appeared ill were immediately rerouted to the hospital prior to receipt of SARS-CoV-2 testing.

Outcomes and Exposures

The primary outcome was rate of SARS-CoV-2 positivity. Trained staff collected nasopharyngeal or throat swabs which were refrigerated and sent to an offsite commercial laboratory (Quest Diagnostics, Inc) for PCR testing. Quest Diagnostics publishes that they use four different United States Food and Drug Administration granted Emergency Use Authorization molecular tests including a laboratory-developed test (LDT), COBAS Roche Diagnostics test, Hologic Panther Fusion test, and Hologic Panther Covid-19 molecular assay. The published limits of detection of these tests are the following: Quest LDT 136 copies/mL; Roche 0.009 TCID50/mL (TCID50 is defined as median tissue culture infectious dose) and both

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Hologic tests are 0.01 TCID50/mL. The secondary outcome included patient/family reported SARS-CoV-2 exposure status based on data from the standardized online referral form.

Exposure variables were race/ethnicity and socioeconomic status. Consistent with other studies, race/ethnicity was categorized as non-Hispanic (NH) black, NH-white, Hispanic, and other.[6-8] We used median family income (MFI) by census block group from the American Communities Survey 2014-2018 as a proxy for socioeconomic status. The American Communities Survey uses 5-year estimates derived from home address to estimate median family income.[9] MFI was then categorized into quartiles. Potential confounding variables included age and sex.

Statistical Analysis

We used means and frequency analyses to describe the study population and calculate unadjusted SARS-CoV-2 positivity rates. Home addresses were geocoded using ArcGIS Pro (Version 2.5.1) to create a point layer for all patients. The point layer was spatially joined with a census block group polygon layer and then merged with ACS population level data by census block group to derive median family income.

Bivariable and multivariable logistic regression analyses were developed to estimate unadjusted and adjusted odds ratios (OR) to assess the strength of association of race/ethnicity and socioeconomic status with the outcome measures. We tested for an interaction between race/ethnicity and SES but only retained interactions that were statistically significant, and thus the interaction was excluded from the final models. Linear regression analysis was used to assess trends in rates of SARS-CoV-2 infection over the study period among each racial/ethnic group. Estimates derived from the multivariable models included adjusted odds ratios with 95%

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confidence intervals (CI) and adjusted probabilities. All analyses were conducted using Stata 16.0 (College Station, TX).

RESULTS

Characteristics of Study Population:

During the study period, 1000 children were tested for SARS-CoV-2 at the drive-through/walk-up specimen collection site. The median age was 8.0 (IQR 2.0, 14.0) years and 52.3% were male.

Of the children tested, approximately one-third were of NH-black and one-quarter were of Hispanic race/ethnicity. Median family income ranged from $11,667 to more than $250,000. Approximately one-third (29.1%) had a median family income below the national median family income of $78,500. (**Table 1, Figure 1a**). Median family income differed by race/ethnicity, with significantly lower median family income for minority youth (MFI NH-white: $161,250; NH-black: $92,188, p<0.001; Hispanic: $75,114, p<0.001; other: $139,568, p=0.001).

Disparities in SARS-CoV-2 Positivity Rates

Of the 1000 children tested, 207 (20.7%) tested positive for SARS-CoV-2. The median age of those testing positive was 11.0 (IQR 5.0, 16.0) years and 47.8% were male.

Positivity rates for SARS-CoV-2 differed by race/ethnicity. In comparison to NH-white children (7.3%), NH-black (30.0%, OR 3.3 [95% CI 1.8, 5.9]), and Hispanic (46.4%, OR 9.1 [95% CI 5.1, 16.4]), children had higher rates of SARS-CoV-2 infection. (**Figure 2, Table 2**) After adjustment for age, sex, and MFI, minority children had a greater likelihood of SARS-CoV-2 infection compared to NH-white children (NH-black (aOR: 2.3 [95% CI: 1.2, 4.4]; Hispanic (aOR: 6.3 [95% CI: 3.3, 11.9]. (**Table 2**) Furthermore, positivity rates among Hispanic

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children increased over time (p-trend=0.002), but not among other racial/ethnic groups. (**Figure 3**)

Positivity rates for SARS-CoV-2 infection also differed by MFI (**Figure 1b**). Children residing in households of lower MFI had higher rates of positivity compared to those residing in households with the highest MFI. In comparison to children in the highest MFI quartile (8.7%), SARS-CoV-2 infection rates were higher among children in quartile 3 (23.7%, OR 3.2 [95% CI: 1.8, 5.6]); quartile 2 (27.1%; OR 3.8 [95% CI: 2.1, 6.6]), and quartile 1 (37.7%, OR 5.9 [95% CI: 3.4, 10.3]). (**Figure 2, Table 2**) In the fully-adjusted model, rates of SARS-CoV-2 positivity were higher among children within the lowest MFI quartiles compared to quartile 4 (Quartile 3: aOR: 2.6 [95% CI: 1.4, 4.9]; Quartile 2: aOR: 2.3 [95% CI: 1.2, 4.3]; Quartile 1: 2.4 [95% CI: 1.3, 4.6]). **(Table 2)**

Disparities in Exposure Status

Of the 1000 children tested, 106 (10.6%) reported exposure to SARS-CoV-2. Reports of exposure to SARS-CoV-2 infected people differed by race/ethnicity. In comparison to NH-white children (11.3%), NH-black children (34.9%; aOR 2.3 [95% CI 1.0, 5.1]) and children of other racial/ethnic groups (19.8%; aOR 2.5 [95% CI 1.1, 5.8]) reported higher rates of a known exposure. Furthermore, patient/family reported exposure also differed by MFI, with higher rates of exposure in less socioeconomically advantaged households (quartile 4: 12.3%; quartile 2: 29.3%, aOR 2.4 [95% CI 1.1, 5.2]). (**Table 3**)

DISCUSSION

In this large cohort of children tested for SARS-CoV-2 virus through community-based testing, we found evidence of both racial/ethnic- and socioeconomic-related disparities in SARS-

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CoV-2 infection. Specifically, minority and socioeconomically disadvantaged children had a higher likelihood of SARS-CoV-2 infection. Furthermore, these observed racial/ethnic disparities in infection rates only slightly attenuated after adjustment for socioeconomic status.

Our findings of disproportionately higher rates of SARS-CoV-2 infection among minority youth mirror that found in recent adult literature. For instance, Millet and colleagues found that US counties with higher populations of black residents had disproportionately higher rates of SARS-CoV-2 related infection and deaths, beyond adjustment for sociodemographics, comorbidities, and socioeconomic determinants.[3] Similarly, through an analysis using health system data in California, Azar and colleagues found higher rates of SARS-CoV-2 infection among black adults compared to white patients after adjustment for median household income.[5]

Although it was beyond the scope of this study to understand the causes for these differential rates of infection, the causes may be multifactorial, and include, but are not limited to structural factors, poorer access to health care, limited resources, as well as bias and discrimination. For instance, structural factors may prevent minorities from practicing social distancing, and thus, limiting exposure. Minorities are disproportionately over-represented in 'essential' service industries that require travel and face-to-face interactions.[10, 11] When working in the food service industry, health care, and transportation, teleworking and 'sheltering in place' may not be feasible. Additionally, minorities have higher reliance on public transportation and are more likely to live in crowded settings, such as public housing, compared to NH-whites.[12, 13] Furthermore, minorities have higher rates of living in multigenerational households, thus, increasing opportunities for exposure to older adults who may be more vulnerable to infection.[14] In fact, our data indicate that minority youth had higher likelihood of reporting exposure to SARS-CoV-2 compared to NH-white youth. Another explanation for the disproportionately

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higher rates of SARS-CoV-2 infection among minority youth may be due to prior experiences of bias and discrimination, which can lead to distrust of the healthcare system and delays in seeking care,[15] and thus, spread of infection to household members.

Rates of SARS-CoV-2 infection were higher among Hispanic than NH-black or NH-white children. This finding is similar to that recently reported by Martinez and colleagues.[16] A study on differences in measures of exposure to H1N1 by race/ethnicity demonstrated that when compared to NH-whites and NH-blacks, Hispanics had the highest rates of living in metropolitan areas, in apartment buildings, and with a larger household size. Hispanics also reported the highest rates of difficulty in avoiding public transportation, lowest rates in ability to telework, and the highest rates of difficulty obtaining childcare that was not with a group of children.[17] Along with the aforementioned reasons for these disparities, Hispanic children may have experienced the most pronounced burden of infection due to compounding additional factors such as immigration status and language barriers. Furthermore, symptomatic adults may avoid testing due to fears of deportation.[17, 18] Future work to ensure equitable allocation of testing and culturally appropriate prevention education may help improve early identification, quarantine, and distribution of resources to reduce community spread of disease.

The findings of this study should be considered in the context of several potential limitations. Race and ethnicity data were provided by the clinician at time of referral, not self-reported, and thus may be subject to misclassification bias. We used MFI from the American Communities Survey as a proxy for SES status, which may be another source of misclassification bias. However, to provide greater precision, estimates on MFI were based on census block group rather than zip code. Recent adult data demonstrate higher rates of morbidity and mortality among racial/ethnic minorities and socioeconomically disadvantaged groups. As

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our study was conducted outside a clinical care setting, we could not assess disparities in morbidity and mortality. Access to the testing site required physician referral. Therefore, our findings of racial/ethnic and socioeconomic disparities in positivity rates may be an underestimate, as racial/ethnic and socioeconomically disadvantaged groups have less access to primary care physicians.[19-21] In addition, referral to the testing site by clinicians may have been differentially provided, and advertisement of the testing site may not have been uniformly distributed among all potential referring clinicians. Furthermore, the testing site was available a few days per week and during the hours of 10am and 2pm which may not have been convenient for all. The testing site was located in a relatively low income neighborhood with a large proportion of minority residents. However, our data illustrate children of various socioeconomic backgrounds travelled across state lines to access the testing site. In addition, four different diagnostic tests were used for SARS-CoV-2 testing which was standard laboratory approach to keep up with test demand during this pandemic. It is unlikely that these polymerase chain reaction amplification-based tests were differentially distributed by patient race/ethnicity and/or MFI. Furthermore, we were unable to adjust for unmeasured confounding variables, including, but not limited to housing conditions or occupancy. Finally, as this was a single center study, these results may not be generalizable to other geographic locations with different racial/ethnic and socioeconomic compositions of their communities.

In conclusion, we found higher rates of SARS-CoV-2 infection among minority and socioeconomically disadvantaged children. Future research should confirm and extend this work by focusing on the modifiable reasons for these observed disparities as well as their differential impact in terms of SARS-CoV-2-related morbidity and mortality outcomes to mitigate the spread of infection and its health effects.

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Table 1. Demographics of Study Population

Demographic Characteristic	SARS-CoV-2 Tested n=1000 (%)
Age	
<1 year	89 (8.9)
1-4 years	282 (28.2)
5-11 years	279 (27.9)
12-17 years	222 (22.2)
≥18 years	128 (12.8)
Sex	
Male	523 (52.3)
Female	477 (47.7)
Race/Ethnicity	
NH-white	203 (20.3)
NH-black	304 (30.4)
Hispanic	229 (22.9)
Other	171 (17.1)
Unknown	93 (9.3)
Median Family Income (quartiles)	
Q4 [$157,679->$250,000]	236 (23.6)
Q3 [$107,321-$157,308]	237 (23.7)
Q2 [$70,341-$107,292]	236 (23.6)
Q1 [$11,667-$70,300]	237 (23.7)
Unknown	54 (5.4)

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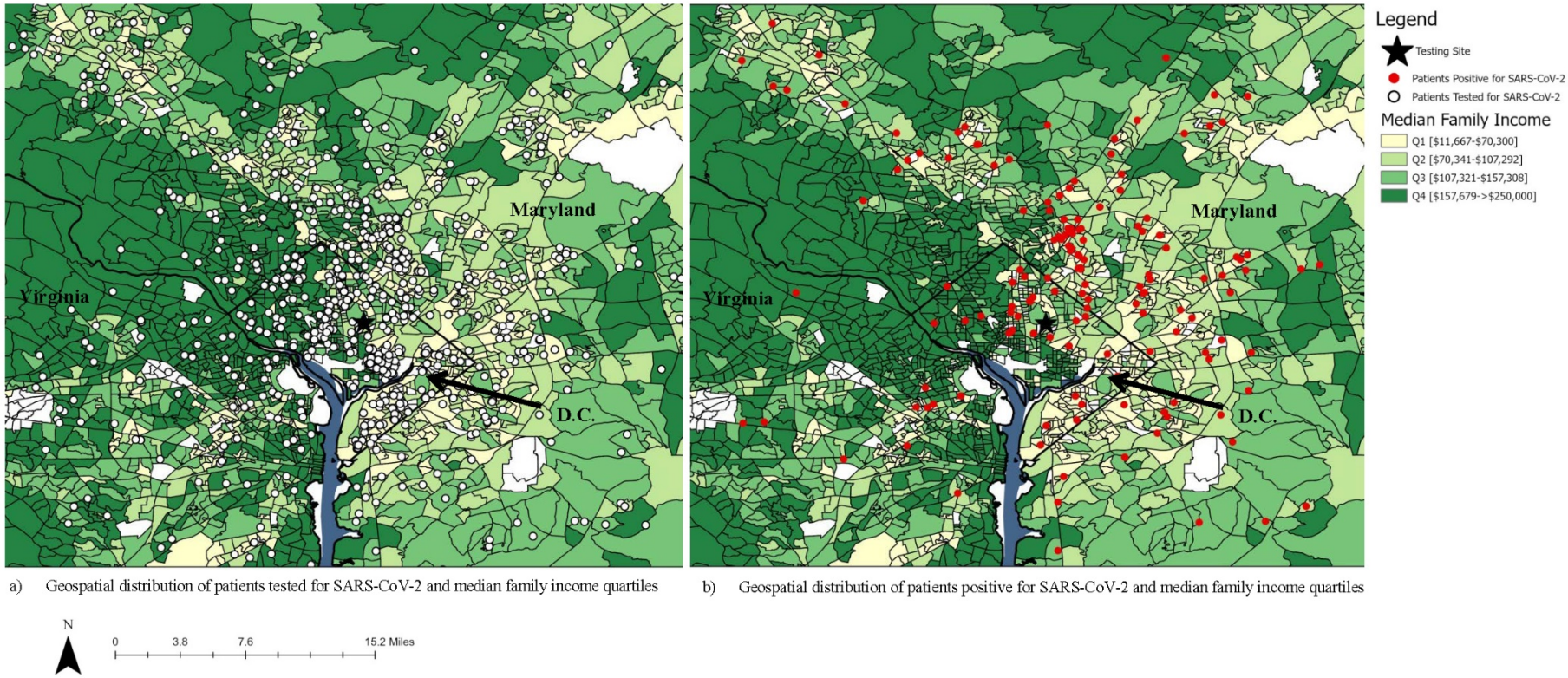
Figure 1. SARS-CoV-2 Testing and Positivity by Median Family Income



a) Geospatial distribution of patients tested for SARS-CoV-2 and median family income quartiles

b) Geospatial distribution of patients positive for SARS-CoV-2 and median family income quartiles

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Figure 2. Rates of SARS-CoV-2 Infection by Race/Ethnicity and Socioeconomic Status

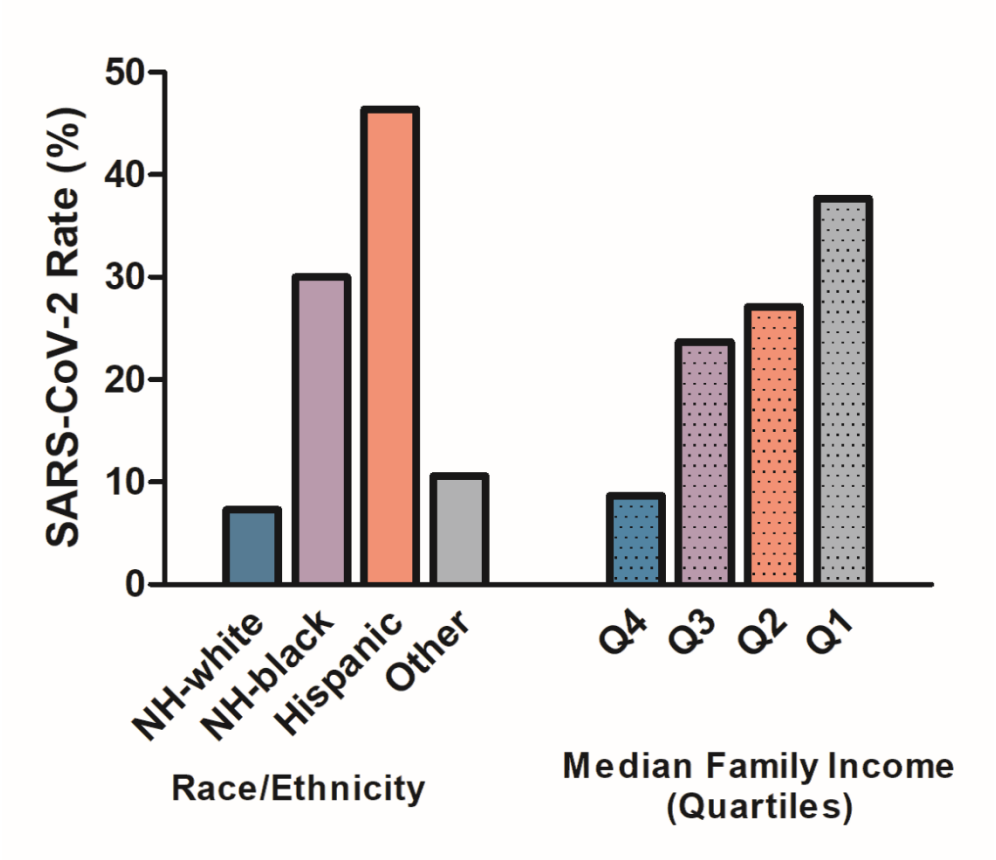

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Table 2: **Racial/Ethnic and Socioeconomic Factors Associated with SARS-CoV-2 Virus Positivity**

Demographic Characteristic	OR (95% CI)	aOR (95% CI)[a]
Race/Ethnicity		
NH-white	Reference	Reference
NH-black	3.3 (1.8, 5.9)	2.3 (1.2, 4.4)
Hispanic	9.1 (5.1, 16.4)	6.3 (3.3, 11.9)
Other	1.9 (0.9, 3.8)	1.8 (0.9, 3.7)
Median Family Income (quartiles)		
Q4: $157,679->$250,000	Reference	Reference
Q3: $107,321-$157,308	3.2 (1.8, 5.6)	2.6 (1.4, 4.9)
Q2: $70,341-$107,292	3.8 (2.1, 6.6)	2.3 (1.2, 4.3)
Q1: $11,667-$70,300	5.9 (3.4, 10.3)	2.4 (1.3, 4.6)

[a] Adjusted for age, sex, race/ethnicity, and median family income.

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Figure 3. Trends in Rates of SARS-CoV-2 Positivity over Study Period, by Race/Ethnicity

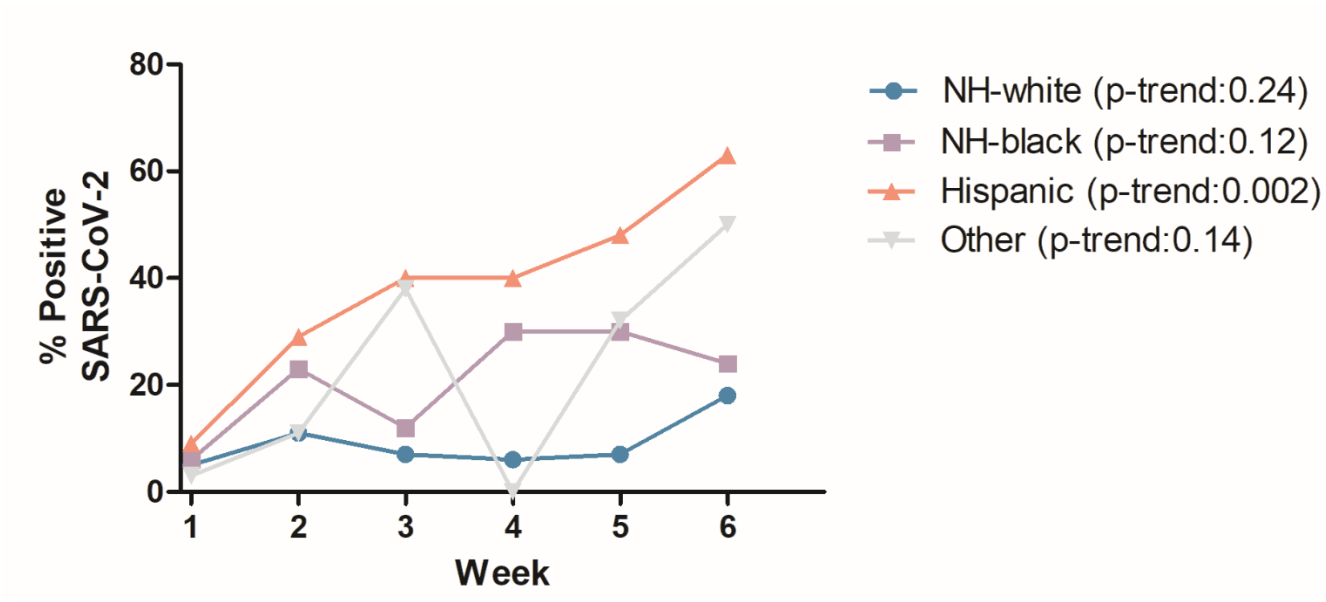

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Table 3. Racial/Ethnic and Socioeconomic Factors Associated with Reported SARS-CoV-2 Virus Exposure

Demographic Characteristic	OR (95% CI)	aOR (95% CI)[a]
Race/Ethnicity		
NH-white	Reference	Reference
NH-black	2.2 (1.1, 4.4)	2.3 (1.0, 5.1)
Hispanic	2.2 (1.1, 4.5)	1.9 (0.8, 4.4)
Other	2.0 (1.0, 4.5)	2.5 (1.1, 5.8)
Median Family Income (quartiles)		
Q4 [$157,679->$250,000]	Reference	Reference
Q3 [$107,321-$157,308]	2.0 (1.0, 4.1)	1.9 (0.9, 4.1)
Q2 [$70,341-$107,292]	2.6 (1.3, 5.1)	2.4 (1.1, 5.2)
Q1 [$11,667-$70,300]	2.5 (1.3, 4.9)	2.1 (0.9, 4.6)

[a] Models adjusted for age, sex, race/ethnicity, and median family income.

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Hazardous air pollutant exposure as a contributing factor to COVID-19 mortality in the United States

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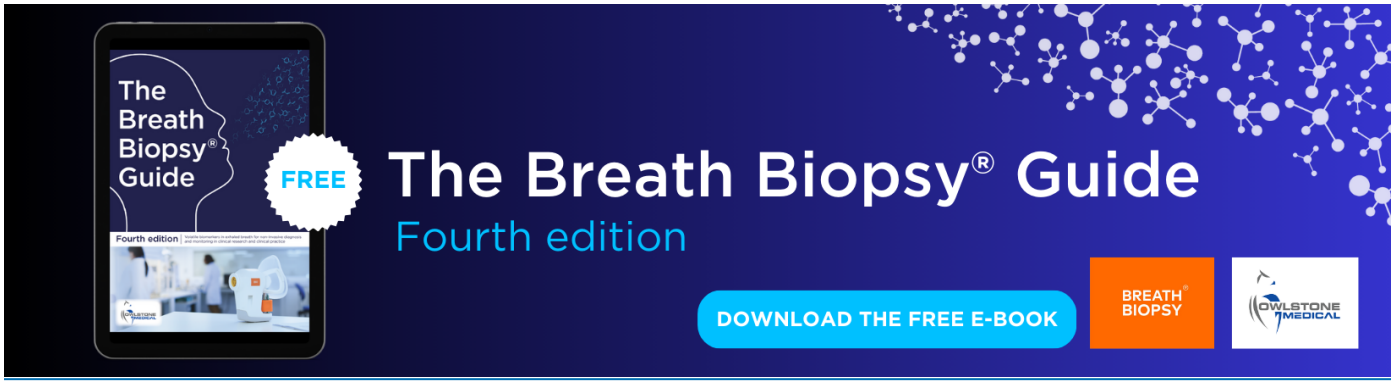

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LETTER

Hazardous air pollutant exposure as a contributing factor to COVID-19 mortality in the United States

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Abstract

To date, COVID-19 has claimed more than 100 000 American lives. Early inquiry suggests preexisting conditions are key risk factors contributing to COVID-19 mortality and air pollution exposure could exacerbate this relationship. Building on prior research linking deaths from respiratory viruses to air pollution exposures, we investigate how 2014 National Air Toxics Assessment hazardous air pollutants (HAPs) respiratory hazard quotient and respiratory hazard index are related to COVID-19 mortality. Our focus on HAPs builds upon the knowledge base linking poor air quality to COVID-19 mortality, since most (if not all) earlier studies only include criteria pollutants. Herein, we examine the relationship between HAP exposure and US-based COVID-19 mortality, while controlling for socioeconomic status, population health indicators, and exposure to PM2.5 and ozone. We fit county-level negative binomial mixed models, predicting COVID-19 mortality as a function of HAP respiratory toxicity levels and relevant covariates. We include models for combined exposure to HAPs, as well as for specific pollutants. We find that an increase in the respiratory hazard index is associated with a 9% increase in COVID-19 mortality. Although differing in magnitude, this association holds for individual HAPs acetaldehyde, and diesel PM. These findings help us to understand variation in US-based COVID-19 mortality rates, reinforce existing research linking air pollution to mortality, and emphasize the importance of regulatory efforts to limit air pollution exposure risk.

1. Introduction

In December of 2019, a novel coronavirus disease (COVID-19) appeared in Wuhan, China (Martelletti and Martelletti 2020). Since then, COVID-19 has become a global pandemic, and as of July 18, 2020, the World Health Organization has estimated that there are over 13 million COVID-19 cases worldwide and almost 600 000 deaths attributed to this disease. Public health professionals are urgently tasked with understanding and combating this disease, as well as assessing which populations might be more at-risk in contracting and succumbing to it.

While data are still emergent, early evidence suggests that long-term exposure to air pollution might constitute a major risk factor increasing the likelihood of severe outcomes from COVID-19 (Comunian *et al* 2020, Conticini *et al* 2020 ; Fattorini and Regoli 2020, Hendryx and Luo 2020, Ogen 2020, Wu *et al* 2020, Zhu *et al* 2020). These researchers build upon a study demonstrating a positive association between air pollution concentrations and mortality rate caused by severe acute respiratory syndrome (SARS), a closely related coronavirus, during a 2000 outbreak in China (Cui *et al* 2003). Research suggests that air pollutants may influence COVID-19 severity directly, by

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damaging the cilia and thus impacting the capacity of the lungs to expel pathogens (Brandt *et al* 2020, Conticini *et al* 2020), as well as indirectly, by aggravating pre-existing cardiovascular and respiratory conditions (Brandt *et al* 2020, Comunian *et al* 2020, Conticini *et al* 2020, Fattorini and Regoli 2020).

While prior work has focused mainly on measuring associations between COVID-19 mortality and population-based exposures to nitrogen dioxide (Conticini *et al* 2020, Fattorini and Regoli 2020, Ogen 2020, Zhu *et al* 2020), ozone (Fattorini and Regoli 2020, Zhu *et al* 2020), and particulate matter (Cole *et al* 2020, Comunian *et al* 2020; Hendryx and Luo 2020, Wu *et al* 2020), limited and preliminary work (Devara *et al* 2020, Pansini 2020) has been done to assess whether long-term exposures to hazardous air pollutants (HAPs) are also associated with increased risk of mortality from COVID-19. HAPs, also known as air toxics, include both volatile organic compounds and metals (EPA 2020b), and this unique group of pollutants have also been linked to an increased risk of respiratory and immune conditions (EPA 2020; Suh 2000). Therefore, our main study objective is to understand the relationship between exposure to elevated HAPs and COVID-19 mortality in the US. Unlike criteria air pollutants, which have been the focus of high-profile recent studies, HAPs are a less studied group of pollutants, but include a wide array of known toxics such as volatile organic chemicals, metals, pesticides, etc. We hypothesize that HAPs exposure could contribute to COVID-19 vulnerability because they are linked to chronic respiratory stress. Finally, the basis for HAP regulatory decision making relies on documented potential human health effects, so inquiry into COVID-19 mortality relationships are relevant. We fit multiple hierarchical statistical models, relating cumulative HAP exposure to COVID-19 mortality, while controlling for individual pollutants and other known risk factors. Results from this study add to emerging literature on links between air quality and increased risk of COVID-19 mortality.

2. Methods

For this study, we use a socio-environmental synthesis approach, publicly available data, and regression modeling (supplementary table 1 available online at stacks.iop.org/ERL/15/0940a9/mmedia). Our outcome variable is county-level COVID-19 mortality, obtained from The New York Times. These data are based on reports from state and local health agencies as of May 13, 2020 (NYT 2020).

HAP respiratory hazard index (HI) and respiratory hazard quotient (HQ) values were obtained from EPA National Air Toxics Assessment (NATA) for the year 2014 (EPA 2018). NATA is a HAP emissions population risk screening tool which estimates ambient concentrations of 187 HAPs released from point, nonpoint, and natural sources, as well as HAPs arising from secondary formation in the atmosphere. The HQ (for single pollutants) and HI (for multiple pollutants) represent the ratio of modeled yearly average ambient concentration to the concentration (known as the respiratory reference concentration or RfC) at which a negative respiratory health outcome is expected to be observed (See table 1). The respiratory HQ values for specific pollutants are summed to create the HAP respiratory HI. For example, in Onondaga County, New York, the 2014 NATA Respiratory HI metric (0.22) component chemicals include the summation of respiratory HQs for acetaldehyde (0.08), acrolein (0.03), formaldehyde (0.08), diesel PM (0.02), bromomethane (0.006), naphthalene (0.005), and all others (0.008). In 2014, US county-based average HI values ranged from 1.16 in Marshall County, Kentucky to 0.06 in Denali County, Alaska with a mean value for all US Counties of 0.44. Cumulative risk assessment approaches, such as NATA, help assess potential health effects of chemical mixtures. When applied to HAPs, such cumulative approaches provide stronger evidence linking exposures and adverse health effects (Jacquez and Greiling 2003, Stingone *et al* 2017, Sheth *et al* 2019).

In our study, we use both the combined HI and individual pollutant respiratory HQ for five specific HAPs: formaldehyde, acetaldehyde, acrolein, naphthalene, and diesel PM. We chose these HAPs because they are, on average, the top five pollutants that contribute to respiratory HQs, and collectively they account for over 50% of the total US respiratory HI in 2014 (table 1) (EPA 2018). Emissions levels tend to decrease over time, and the NATA respiratory HQ in 2014 is likely a good substitute for the average level between the years 2010 and 2019 (Ard 2015, EPA 2020).

We also include average county PM2.5 and ozone concentrations. Data for modeled average daily PM2.5 for 2000–2014 were sourced from the CDC Wonder Environmental data via the County Health Rankings and Roadmaps website (2020) and averaged. We obtained 2016 summer average 8 h maximum ozone concentrations from EPA's Environmental Justice Screening and Mapping Tool (EJSCREEN) (EPA 2020c). EJSCREEN reports using the EPA downscaler model to derive block group-level ozone estimates from monitored concentrations (EPA 2020c).

We include several covariates in our model. We use the R package 'tidycensus' to get American Community Survey (ACS) data from the US Census (Walker 2020) and averaged ACS variables for years 2012 to 2018. For county urban population percentage, we utilize 2010 US Census estimates. ACS variables included are median income, total population, a race variable for percentage of individuals self-identifying as Black, an ethnicity variable

Table 1. Top five hazardous air pollutants by average US respiratory hazard quotient (HQ).

Hazardous air pollutant	Health effects	Reference concentration (RfC) (μg m^{-3})	US County average modelled annual concentration (μg m^{-3}) (County range)	US County average HQ (County range)
Acrolein	Potent respiratory and ocular irritant (Bein and Leikauf 2011). Has been associated with cardiovascular/respiratory diseases and risk factors. (Henning *et al* 2017; Perez *et al* 2015)	0.035	0 (0, 0.01)	0.06 (0, 0.35)
Acetaldehyde	Eye and respiratory tract irritant. At higher concentrations, can cause damage to respiratory and cardiovascular systems in humans (Delikhoon *et al* 2018; Morris 1997).	9	1.07 (0.2, 2.62)	0.12 (0.02, 0.29)
Formaldehyde	Linked to eye irritation, dry and/or sore throats, inflammation, bronchial asthma-like symptoms, childhood asthma, and upper respiratory tract infections (Delikhoon *et al* 2018)	9.8	1.25 (0.11, 2.64)	0.13 (0.01, 0.27)
Diesel Particulate Matter	Consistently linked with respiratory and cardiovascular health effects (Mirowsky *et al* 2015; Steerenberg *et al* 1998; Tang *et al* 2012; Totlandsdal *et al* 2010)	5	0.11 (0, 1.12)	0.02 (0, 0.22)
Naphthalene	A possible carcinogen that is linked to inflammation of the lungs, damage to the nasal passages, and damage to lung tissue (Jia and Batterman 2010).	3	0.02 (0, 0.11)	0.01 (0, 0.04)

for percentage of individuals self-identifying as Hispanic, percentage of individuals below the poverty threshold, median house value, percentage of individuals achieving less than a high school degree, and percentage of individuals over 64.

Additional county-level covariates came from various sources (supplementary table 1). These include rates of adult obesity, preventable hospital stays, physical inactivity, and smoking from County Health Rankings, which derives data from the Behavioral Risk Factor Surveillance System (BRFSS) and Medicare claims data (Remington *et al* 2015, County Health Rankings & Roadmaps 2020). Hospital bed counts in 2019 were included from Homeland Infrastructure Foundation-Level Data (HIFLD) (HIFLD 2020). We also obtained dates when first cases were reported from each county as a way to account for infection spread in our model.

We fit negative binomial mixed models using county-level COVID-19 mortality as our dependent variable. Our statistical approach is like that of Wu and colleagues (2020). We include a state fixed effect and population offset to account for between-state variation and the fact that higher population counties will likely have both more cases and more deaths. All covariates were centered and scaled prior to analysis.

The negative binomial model statement is:

$$y_{ik} = e^{X_{ik}\beta_{ik} + loglog\,(\mu_{ik}) + \alpha_k}$$

where y_{ik} is the predicted death rate in each county, i, for each state, k; u_i is a population offset for each county; X_{ik} is the vector of predictors for county i in state k; β_{ik} is the vector of coefficients for county i for each state k; and α_k is the vector of intercepts for each state k.

We fit a combined regression model and single pollutant models for the five HAPs mentioned above (table 1).

We conducted additional sensitivity/robustness analyses to assess the potential of overcounting among the different pollutants. For example, PM2.5 may be counted individually as part of HAP particulates. We fit single pollutant models with only one pollutant included alongside our controls and in a subsequent multi-pollutant model containing each of the individual pollutants. We also tested for spatial autocorrelation using a Moran's I. While models did have signals of spatial autocorrelation prior to including the state fixed effect, after this was included no autocorrelation was detected.

All analyses were conducted in R version 3.6.3 (R Core Team 2020). The model was built and run using the 'glmmTMB' R package (Brooks *et al* 2017) . Sensitivity analyses for outliers, non-constant variance, and multicollinearity were done using the 'car' package (Fox and Weisberg 2011). The R code executing the data gathering, processing, and analysis are publicly available (https://github.com/lylla318/covid19-haps).

3. Results

As of July 11, 2020, there were 129 832 confirmed and probable deaths attributed to COVID-19 infection within 3223 US counties (1204 counties had no reported COVID-19 deaths). Figure 1 shows the spatial distribution of key predictors (NATA respiratory HI, PM2.5, and ozone) and COVID-19 mortality rates per county, which suggests higher mortality rates in populated areas as well as in rural southern counties; both areas also show higher respiratory HI levels.

In figure 2, we present the effect on mortality rate ratios (MRR) and 95% confidence intervals (CI) for both combined and single-pollutant models. For NATA respiratory HI, our indicator of all modeled HAP exposure with non-cancer respiratory health impacts, the effect on MRR per 0.1 increase is 1.09 (CI: 1.01, 1.17). As a point of reference, a 0.1 increase in NATA HI is equivalent to 10% of the combined RfC level. Our model results for other air pollution exposures are: a 1 μg m^{-3} increase in PM2.5 and 1 ppb increase in ozone concentration correlate with a 7% (CI: 1.02, 1.12) and 2% (CI: 1.01, 1.04) increase in COVID-19 MMR, respectively.

Results show that an increase of 0.9 μg m^{-3} in modeled average annual ambient acetaldehyde concentration is associated with a 24% increase in COVID-19 mortality rate (MRR of 1.24 (CI: 1.01, 1.52)). For the single-pollutant model that includes diesel PM, NATA's indicator of diesel exhaust concentrations, the effect on MRR per 0.5 μg m^{-3} increase is 2.82 (1.70, 4.68), equating to a 182% increase in the mortality rate. Single pollutant models also estimate an increase in 0.3 μg m^{-3} of naphthalene concentrations resulting in a 791% increase in the mortality rate (MRR of 8.91 (CI: 1.96, 40.52)). No statistically significant associations were found for formaldehyde and acrolein.

Our secondary analysis fit one multi-pollutant model, which includes criteria pollutants and individual HAPs (table 2). This was performed as a sensitivity/robustness test for the single pollutant models due to possible interaction between pollutants and potential over-counting. In comparison to the models described earlier, the effect of controlling for multiple pollutants attenuates the impact of every individual pollutant on COVID-19 mortality except for acetaldehyde and diesel PM. For example, the single pollutant model for naphthalene estimates the effect on MRR of 39.02 (CI: 5.57, 273.22) per increase of 0.3 μg m^{-3} of ambient average concentration, and this effect is substantially reduced, and not statistically significant, when controlling for the effect of other pollutants (MRR of 17.17 (CI: 0.82, 357.47)) In the multi-pollutant model, only two pollutant effects on MRR are statistically significant at the 95% confidence level. These include acetaldehyde HQ (MRR of 3.34 (CI: 1.69, 6.63)), and PM2.5 (μg m^{-3}) (MRR of 1.09 (CI: 1.01, 1.18)).

Table 2 shows multi-pollutant model parameter estimates. While our main focus is related to key air pollution explanatory variables, some non-pollutant predictors are statistically significant, including, among others, the percentage of individuals identifying as Black (MRR of 1.28 (CI: 1.17, 1.39)), the percentage of individuals with less than a high school education (MRR of 1.68 (CI: 1.51, 1.88)), the percent of households under the federal poverty line (MRR of 1.21 (CI: 1.08, 1.36)), and the percentage of individuals over the age of 64 (MRR of 1.25 (CI: 1.16, 1.35)).

4. Discussion

Our analysis builds upon studies identifying air pollution as a factor contributing to increased risk of COVID-19 mortality (Comunian *et al* 2020, Conticini *et al* 2020, Hendryx and Lou 2020, Martelletti and Martelletti 2020, Ogen 2020, Wu *et al* 2020, Zhu *et al* 2020). Our models suggest increased chronic multi-air pollutant exposure, even at levels below expected impact thresholds, are associated with higher COVID-19 mortality rates when controlling for known socioeconomic and behavioral health influences. We contribute to the ongoing investigation of COVID-19 mortality by confirming related PM2.5 findings and helping to provide one possible explanation to why some rural counties, such as those in Georgia and Louisiana (figure 2), have experienced higher mortality rates than urban areas.

First, our findings highlight that enforcing pollutant release limits is indeed related to health betterment in society. Further, continuing to make pollution load information publicly available at the state and federal level is critical for inquiry. The potential link between pollution exposure and COVID-19 mortality should be expanded upon because such efforts can contribute to evaluating the efficacy of current pollution prevention measures. For example, our findings suggest that the decision to relax enforcement of the Clean Air Act may inadvertently exacerbate air quality issues in areas most vulnerable to increased COVID-19 mortality due to long term air pollution exposures.

Second, our analysis indicates chronic, cumulative exposure to HAPs at levels below reference concentration (RfC), an estimate of daily inhalation exposure likely to be without an appreciable risk of deleterious effects during a lifetime (EPA 2020d), may heighten population vulnerability to COVID-19 mortality. The RfC assumes health impact thresholds exist for certain toxic effects. Aligning with prior studies (Hendryx and Luo 2020), we identify signals of increased COVID-19 mortality rates occurring with small changes in low levels of diesel PM

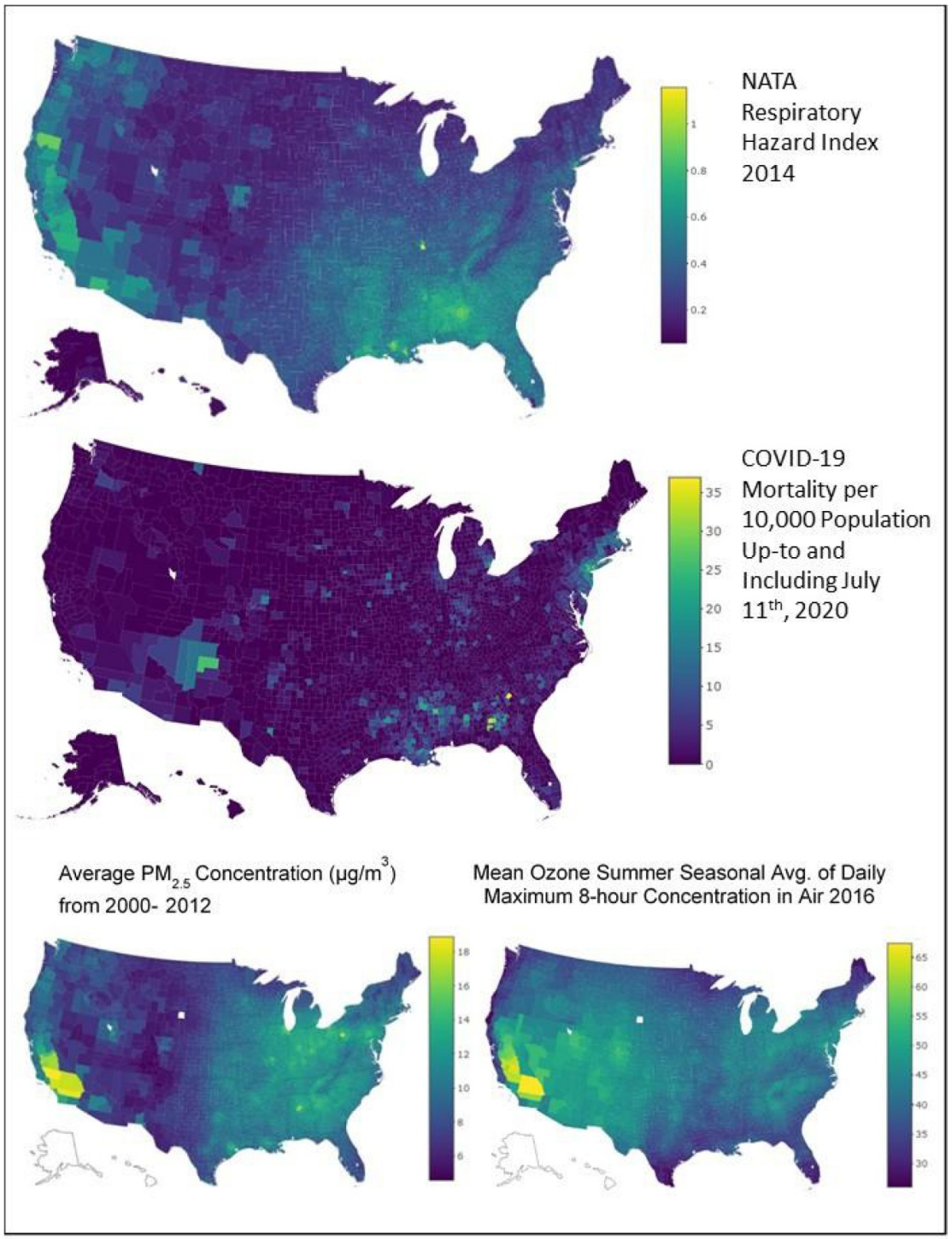

Figure 1. Spatial distribution of COVID-19 mortality, NATA respiratory quotient (HQ), PM2.5 mass concentration (μg m^{-3}) and ozone (ppb) for all US counties.

concentrations. For the first time, we also identify this pattern with acetaldehyde. Possibly, chronic exposure to these pollutants at very low levels, while not causing observable respiratory system damages, do reduce the body's ability to recover from COVID-19 in some way. Further scrutiny may reveal why these associations have appeared.

Third, we also find signals of cumulative exposure impacting COVID-19 mortality. These results are most striking in the context of cumulative exposure metrics and especially relevant to a holistic understanding of the socio-environmental system in which we live. Further, we reproduce findings showing that not all groups face the same level of vulnerability. For example, cumulative exposures are especially relevant in minority communities (Collins *et al* 2015) and among very young children (Grineski 2020). While cumulative approaches are beneficial to all, they are

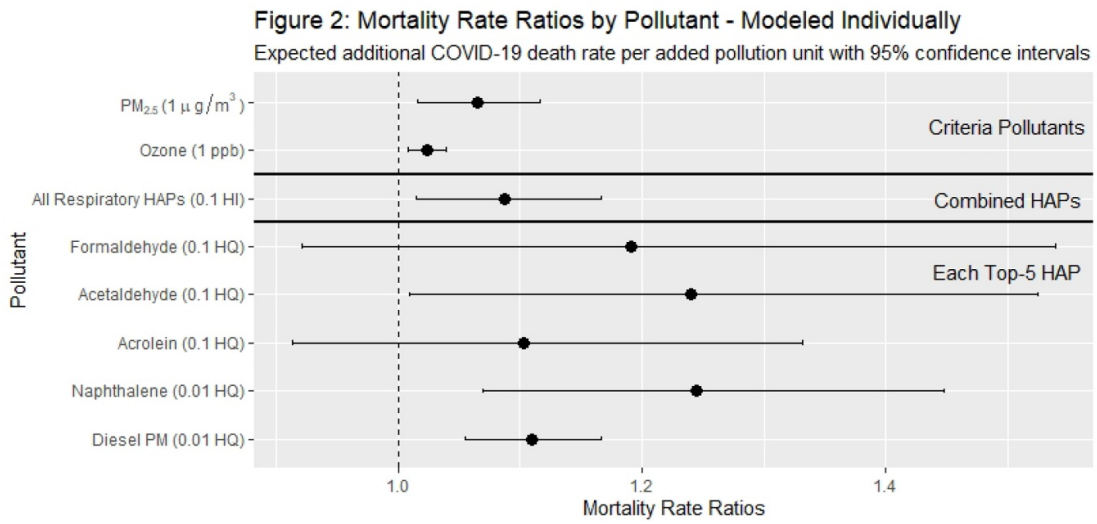

Figure 2. Change in mortality rate ratios (MRR) for criteria pollutants, combined HAPs, and top five HAPs, including exponentiated coefficients and 95% confidence intervals. Results from the models include all covariates.

Table 2. Single- and multi-pollutant models of COVID-19 mortality using air pollutant predictors.

	Single-pollutant[a] Exponentiated coefficient (95% CI)	Multi-pollutant Exponentiated coefficient (95% CI)
Air pollutants		
All respiratory HAPs	1.09 (1.01 to 1.17)	–
All Other HAPS (0.1 HI)—except top 5 (0.1 HI)	–	1.02 (1.01 to 1.04)
PM2.5 (μg m^{-3})	1.07 (1.02 to 1.12)	1.03 (0.87 to 1.21)
Ozone (1 ppb)	1.02 (1.01 to 1.04)	1.04 (0.91 to 1.10)
Formaldehyde (0.1 HQ)	1.19 (0.92 to 1.54)	0.34 (0.18 to 0.67)
Acetaldehyde (0.1 HQ)	1.24 (1.01 to 1.52))	2.47 (1.51 to 4.05)
Acrolein (0.1 HQ)	1.10 (0.91 to 1.33)	0.92 (0.70 to 1.21)
Naphthalene (0.1 HQ)	8.91 (1.96 to 40.52)	5.66 (0.58 to 55.56)
Diesel PM (0.1 HQ)	2.82 (1.70 to 4.68)	2.19 (1.21 to 3.96)
Covariates[b]		
Median home value ($)	–	1.05 (0.93, 1.18)
Less than high school education (%)	–	1.68 (1.51, 1.88)
Below poverty line (%)	–	1.21 (1.08, 1.36)
Days since first reported COVID-19 case (days from July 11th, 2020)	–	1.74 (1.56, 1.93)
Black (%)	–	1.28 (1.17, 1.39)
Hispanic (%)	–	0.98 (0.89, 1.08)
Over 64 years old (%)	–	1.25 (1.16, 1.35)
Median household income ($)	–	1.40 (1.21, 1.62)
Population Living in Urban Areas (%)	–	1.12 (1.04, 1.20)
Smoking rate (%)	–	0.92 (0.85, 1.01)
Hospital beds (n)	–	0.97 (0.92, 1.01)
Minimum temperature (° C)	–	0.90 (0.79, 1.02)
Maximum temperature (° C)	–	1.15 (1.02, 1.30)
BMI >30 (%)	–	1.06 (0.94, 1.20)
No physical activity (%)	–	1.02 (0.88, 1.17)
Preventable hospital stays (%)	–	1.06 (0.98, 1.13)

aSingle-pollutant models are individual model runs, including one pollutant and all covariates.
bMean scaled valuesBMI = body mass index; CI = confidence interval; HAPs = hazardous air pollutants; HI = hazard index; HQ = hazard quotient; PM = particulate matter

critical in the context of protecting vulnerable groups. NATA approaches HAP risk screening in a summative manner, accounting for the additional health burden of multi-pollutant exposure as a means by which EPA can identify areas for further regulatory action. By combining NATA results with public epidemiological

and sociodemographic datasets, we provide useful information for future rulemaking. Currently, several risk and technologies reviews for HAP source groups are being finalized without accounting for cumulative exposure health risks (see https://epa.gov/stationary-sources-air-pollution/risk-and-technology-review-national-emissions-standards-hazardous) despite contrary recommendations from the EPA Science Advisory Board (Swackhamer and Milford 2010). Our results align with these recommendations and bolster emerging evidence linking air pollution exposures to increased COVID-19 mortality.

As with all ecologic studies, there are limitations. Our exposure variable, a one-year estimate from 2014, is an imperfect measure of chronic HAPs exposure, but this is the most recent and best data available. Additionally, HAP concentrations vary substantially within counties. When COVID-19 mortality data becomes available at the census tract level, finer grained analysis may be performed. These same limitations apply to fine particulate matter county average concentrations. These data are averaged and are inconsistent across available sources (Diao *et al* 2019) bringing further uncertainty to the results presented here. We necessarily assume that individuals who die because of COVID-19 infection have also been chronically exposed to HAPs over their lifetimes. Further, we assume that the most relevant pollutants are captured in NATA. Finally, we also assume COVID-19 exposure is widespread and randomly distributed throughout the United States. Inconsistencies in COVID-19 mortality reporting, as well as local changes in HAP concentrations over time, are also sources of possible uncertainty. As such, results are not appropriate for individual-level inferential statements. While these limitations do not allow for causal conclusions, we do come to several important and time sensitive conclusions about chemical risk management and public health policy. We present these findings with the goal of helping the US population maintain general pulmonary health resilience and safeguarding against future coronavirus pandemics.

While our study has limitations, it also has important implications. Further inquiry will benefit from including more detailed information about COVID-19 patients as well as state and county level social distancing policies. We emphasize the need for diligence in environmental and human health protection during this pandemic, but also call for further research relating air pollution to COVID-19 in the context of both mortality and the environment.

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Declaration of competing financial interests

The authors declare that they have no competing financial interests.

Data availability statement

No new data were created or analysed in this study.

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Risk of COVID-19 and long-term exposure to air pollution: evidence from the first wave in China

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Abstract

People with chronic obstructive pulmonary disease, cardiovascular disease or hypertension have a high risk of severe coronavirus disease 2019 (COVID-19). Long-term exposure to air pollution, especially $PM_{2.5}$, has also been associated with COVID-19 mortality. We collated individual-level data of confirmed COVID-19 cases during the first wave of the epidemic in mainland China. We fitted a generalized linear model using city-level COVID-19 cases and severe cases as the outcome, and long-term average levels of air pollutants as the exposure. Our analysis was adjusted using several variables, including a mobile phone dataset, covering human movement from Wuhan before the travel ban and movements within each city during the time of emergency response. Other variables included census, smoking prevalence, climate, and socio-economic data from 324 cities in China. We adjusted for human mobility and socio-economic factors, and found that an increase in long-term NO_2 or $PM_{2.5}$ may correspond to an increase in the number of COVID-19 cases and severe infections. However, the linkage might also be affected by the confounding factor of population size because of the predefined correlation between population size and air pollution. The results are derived from a large, newly compiled and geocoded repository of population and epidemiological data relevant to COVID-19. The findings of this paper (and other previous studies that have given ambiguous results) indicate that a more definitive analysis is needed of the link between COVID-19 and air pollution.

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Introduction

The novel coronavirus disease (COVID-19) has rapidly spread across the world [1-4]. As more countries have passed the (first) peak of the COVID-19 epidemic, country-based strategies have shifted from containment to delay and mitigation, aiming to prevent a second epidemic curve or lower its peak [5]. The virus (SARS-CoV-2) induces respiratory stress, so individuals with a compromised respiratory system are expected to be more vulnerable to infection [6], and people with pre-existing conditions are more vulnerable to severe infection. Meta-analysis has shown that chronic obstructive pulmonary disease (COPD), cardiovascular disease (CVD), and hypertension are associated with severe COVID-19 infection and admission to intensive care units (ICUs) [7].

Long-term exposure to air pollution affects lung function and is associated with increased prevalence of COPD, cardiovascular disease and hypertension [8-10]. However, it is not known whether vulnerability to lung diseases can affect COVID-19 risk [11]. We need to understand the impact of air pollution exposure on COVID-19 infection and disease severity. This could help to improve future modelling and disease burden calculations around the world.

During the first wave of COVID-19 in China, to prevent further dissemination of the illness, Wuhan prohibited all transport in and out of the city on 23 January 2020. In the following days, cities across mainland China activated the highest level of emergency response and contained outbreaks outside Wuhan up until 6 March 2020. These measures substantially reduced air pollution: a significant reduction in pollution level was observed across cities in China between January and March 2020 [12,13]. Data on cities (excluding Wuhan) are ideal to assess the relationship between long-term average exposure and COVID-19 risk (Figure 1) because the cities had widely distributed COVID-19 cases, highly variable historical air quality, and have been surveyed comprehensively under consistent criteria and data standards across the country. Air pollution has both acute and long-term health effects, so air pollution reduction serves as a natural experiment to offset the potential acute effects in particular.

Methods

Epidemiological, demographic and geographical data

We collected epidemiological data from the official reports of the health commissions of 324 cities, excluding Wuhan. These included daily reports from 31 December 2019 to 6 March 2020, but excluded newly-reported locally-acquired infections. Data on the percentage of severe COVID-19 cases were obtained from official reports of Provincial Health Committees. The age structure for each city was obtained from the Sixth National Population Census of the People's Republic of China. Socio-economic data, including the gross domestic product (GDP) per capita in 2016, were obtained from China City Statistical Yearbook.

Human mobility data

Human movements were tracked using mobile phone data from Baidu location-based services (LBS) and telecommunications operators. The number of recorded movements from Wuhan city to other cities across China was calculated from 11 to 23 January 2020. On 23 January, movement from Wuhan reached almost zero because of the travel ban. Travel movements within each city were recorded until 6 March.

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Data for air pollution

Original daily data for particulate matter concentrations, including $PM_{2.5}$, PM_{10}, SO_2, CO, NO_2, and O_3 for each city were obtained from air quality stations across China from January 2015 to March 2020. For each city, the average concentration for each pollutant before the COVID-19 outbreak (January 2020) was calculated across the whole period available.

Statistical methods

To quantify the effect of air pollution on COVID-19 risk, we used the historical data for air quality between 2015 and 2019 and COVID-19 case reports. Socio-demographic and behavioural confounders were identified through the literature search. The association between long-term exposure to air pollutants and COVID-19 risk was assessed by regression with a generalized linear model (GLM):

$$Y_i \sim \text{Poisson}\left(\mu_i, \theta\right) \tag{1}$$

$$\begin{aligned}\log\left(\mu_{it}\right) = {} & \alpha + \beta_1 Flow_i + \beta_2 Peak\ time\ of\ \ flow_i + \beta_3 Within\text{-}city\ movements_i + \beta_4 GDP_i + \\ & \beta_5 Smoking\ \ prevalence_i + \beta_5 Second\text{-}hand\ \ smoking\ \ prevalence\ in\ non\text{-}smokers_i + \\ & \beta_6 percent\ of\ \ the\ \ population\ older\ than\ 65 - year\ old_i + \\ & \beta_7 Population_i + \beta_8 Population\ density_i + \\ & \beta_9 Temperature_i + \beta_{10} Rainfall_i + \\ & \beta_{11} PM_{2.5,i} * + \beta_{12} PM_{10,i} * + \beta_{13} SO_{2,i} * + \beta_{14} CO_i * + \beta_{15} NO_{2,i} * + \beta_{16} O_{3,i} *\end{aligned} \tag{2}$$

where $Flow_i$ is the passenger volume from Wuhan to city *i* during the Spring Festival 2020, before the Wuhan travel ban, and *Peak time of flow* reflects the corresponding peak time. *Within-city movements*$_i$ shows the effect of social distancing, such as suspending intra-city public transport, closing entertainment venues and banning public gatherings, and was measured by daily human mobility within a city between the travel ban and 6 March 2020 of city *i*. These data were obtained from the Baidu location-based service. GDP is the gross domestic product per capita of city *i*. *Smoking prevalence* and *second-hand smoking prevalence in non-smokers* were obtained from the Chinese National Nutrition and Health Survey (NNHS) [14,15]. The proportion of residents older than 65, population and population density of city *i* were extracted from census data. Climate conditions were shown by *temperature* and *rainfall* in summer and winter. *Latitude* and *longitude* show the spatial distribution of city *i*. $PM_{2.5}$, PM_{10}, SO_2, *CO*, NO_2, and O_3 show daily average concentration data of air pollutants of city *i* between 1 January 2015 and 31 December 2019. Air pollution variables were included in the model separately because of the high multicollinearity among them. βs are regression coefficients. The analysis used the R software (R Foundation for Statistical Computing, version 3.6.3), MASS package.

Sensitivity analysis

We conducted additional sensitivity analyses to assess the robustness of our results. First, we fit

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models omitting adjusted variables, separately. We then treated NO_2 and $PM_{2.5}$ as a categorical variable (categorized at empirical quintiles), then used air pollutant concentrations in winter and non-winter to replace the annual average. Finally, cities were categorized by population size into three separate groups, small (0–2.68 million population, n = 98), medium-sized (2.68–4.67 million, n = 97), and large (4.67–30.75 million, n = 98).

Results

Analysis of COVID-19 in China

We used a well-tested research data platform that gathers nationwide human mobility, census, air pollution and socio-economic data, and data on smoking from a nationwide survey [16]. The records we used consisted of reported COVID-19 cases for 324 cities (except Wuhan city) in mainland China between 31 December 2019 and 6 March 2020 (excluding newly-reported locally-acquired infections), mobile data of recorded movements (data provided by Baidu location-based services and telecommunications operators in China), census data (population, population density, and percentage of the population over 65 years old), smoking prevalence and second-hand smoking prevalence in non-smokers, gross domestic product (GDP) per capita, climate condition (temperature and rainfall), and six major air pollutant concentrations ($PM_{2.5}$, PM_{10}, SO_2, CO, NO_2, and O_3). We analysed and quantified the relationship between long-term exposure to air pollution and COVID-19 risk.

Between 31 December 2019 and 6 March 2020, 81,132 cases of COVID-19 were reported across China. Of these, 62.6% (50783/81132) of cases were clustered in Wuhan city, and the remaining 37.4% (30349/81132) cases were distributed across 324 other cities. After 6 March 2020, there were very few locally-acquired infections outside Wuhan city in the first wave. There was sustained local transmission of COVID-19 in Wuhan city, so data from there were not included in the subsequent analysis.

COPD, CVD and hypertension are associated with high risk of COVID-19 severity. We therefore suspected that long-term exposure to air pollutants, which increases lung damage, would be associated with increased vulnerability to COVID-19. To test this hypothesis, socio-demographic and behavioural confounders were identified through a literature search. We first investigated the effect of travel movements from Wuhan city, the location where COVID-19 was first recorded, and from where it spread across China. In 2020, during travel for the Spring Festival holiday, approximately 4.3 million people travelled out of Wuhan to other cities in China [16]. This travel is strongly associated with the total number of cases reported from each city (rho = 0.81, $P < 0.01$), suggesting the outbreaks across China were mainly seeded from Wuhan city.

Air pollution reduction and travel restrictions

On 23 January 2020, in an attempt to contain the epidemic, non-essential travel was prohibited in and out of Wuhan city, a major transport hub and conurbation of 11 million people. Since then, the whole of China has implemented the highest level of emergency response to reinforce the containment of COVID-19. Interventions included the closure of entertainment venues, the suspension of within-city public transport, and prohibition of travel to and from other cities across China. Our results indicate that these measures have significantly reduced the movement within

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cities compared with 2019 (Figure 2). The average air quality also significantly improved, compared with the same period in 2019. The changes in average daily $PM_{2.5}$, PM_{10}, SO_2, CO, NO_2, and O_3 were −7.02%, −19.25%, −15.06%, −5.46%, −20.17% and 5.01% from 31 December to 6 March (Figure 2).

The effect of long-term exposure to NO_2 and $PM_{2.5}$ on COVID-19 cases and severe infections

We also collected data on a range of confounding variables such as gross domestic product per capita, smoking prevalence, climate, and age composition (age > 65), together with travel movements from Wuhan and within-city movements (as a measure of social distancing). These were used as control variables in the statistical analysis. The population size of each city was not included in the model because of high multicollinearity with travel movements from Wuhan (rho = 0.71, $P < 0.01$). The three billion Spring Festival holiday trips also induced uncoordinated changes in actual population size across cities [17]. As expected, the number of COVID-19 cases in each city increased with passenger flow from Wuhan. More infections were reported in cities that had more travellers from Wuhan. Overall, we observed positive and significant associations between both reported and severe cases of COVID-19 with historical air pollutant concentration (Figure 3). In 324 cities (except Wuhan) that had data on air quality, an increase of 10 $\mu g/m^3$ in NO_2 or $PM_{2.5}$ concentration was associated with 22.41% (95% CI: 7.28%–39.89%) or 15.35% (95% CI: 5.60%–25.98%) increase in COVID-19 cases. We also examined the relationship between the number of severe COVID-19 cases and air pollutants. An increase of 10 $\mu g/m^3$ in NO_2 or $PM_{2.5}$ concentration was associated with a 19.20% (95% CI: 4.03%–36.59%) or 9.61% (95% CI: 0.12%–20.01%) increase in severe COVID-19 cases. The results are statistically significant and robust to sensitivity analyses (Tables 1–3). The analysis was also carried out for separate datasets. Cities were categorized by population size into small, medium, and large. There was a positive but not significant association between the number of confirmed cases and NO_2 or $PM_{2.5}$ concentration in each group (Figure 3). The results might still be affected by population size, however, because air pollution is usually the result of population growth, so there is a predefined correlation between air pollutant concentration and population size.

Discussion

Several studies have evaluated the association between air pollution exposure and COVID-19 risk. Our finding is in line with studies based on large-scale nationwide data, including in the US [18], UK [19,20], Italy [21,22], The Netherlands [23], Spain, France and Germany [24], and provinces of China [25]. However, the size of the study and that the first wave has been contained in China, meant that we were able to investigate the impact of historical air pollution on COVID-19 risk and severity. Our results also highlighted the importance of air quality improvements to health in China.

Our findings are consistent with previous results that exposure to air pollutants is associated with poorer lung function, often measured by forced vital capacity and forced expiratory volume in 1 second [26-29]. Particulate matter (PM) is associated with increased risk of cardiopulmonary diseases [30], aggravated case fatality of severe acute respiratory syndrome (caused by another type of coronavirus) [31] and could impair the immune response [32]. Oxidant pollutants could also damage the immune function and affect the ability of the lungs to clear the virus [6]. Nitrogen oxides (NO_X) can cause inflammatory responses and have a direct effect on the risk of respiratory diseases [33,34]

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(also shown in Comparative Toxicogenomics Database, http://ctdbase.org). Nitrogen oxide is primarily produced by traffic and factories, and less influenced by climate condition, so there were reductions in both the concentration of nitrogen oxides and within-city movements during the COVID-19 outbreak in cities of China. Increased ozone or sulphur dioxide concentrations were associated with lower COVID-19 risk, which is also consistent with previous studies [19,25]. However, the mechanisms underlying the impact on COVID-19 risk remain unknown.

Several important caveats are worth mentioning. First, the data included here were all from mainland China. It is therefore not clear whether the findings can be generalized to other countries without data on historic air pollution exposure. Second, there are currently no high-quality records at city level of severe COVID-19 infections and ICU admissions, although we have attempted to fill the gap by using province-level reports. Finally, we do not know the exact number of cases because of the number of asymptomatic and mild-symptomatic cases that may not be recorded. These data will not be available until there has been a systematic survey of infection (e.g. by serological testing) across China. However, we have reported a national-level disease pattern covering 324 cities and its potential association with long-term exposure to air pollutants.

In conclusion, our results, combined with recent reports from elsewhere, suggest a potential association between air quality and population vulnerability to COVID-19. Interventions to contain the COVID-19 outbreak in China successfully reduced air pollution levels and potentially prevented acute respiratory disease. The findings of this paper (and other previous studies that have given ambiguous results) indicate that a more definitive analysis is needed of the link between COVID-19 and air pollution.

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347 **Table 1.** Impact of historic air pollution exposure on COVID-19 risk.

	Confirmed COVID-19 cases			**Severe COVID-19 cases**		
Covariates	Coefficient	std	P	Coefficient	std	P
Intercept	2.630	0.538	<0.001	0.769	0.509	0.132
Within-city movements	-1.065	0.139	<0.001	-0.778	0.137	<0.001
Percent of population older than 65	0.069	0032	0.030	-0.054	0.035	0.129
Inflow from Wuhan	0.012	0.001	<0.001	0.030	0.009	<0.01
Peak of inflow from Wuhan	0.108	0.020	<0.001	0.074	0.023	<0.01
Mean Temperature of Coldest Quarter	0.026	0.009	<0.01	0.027	0.007	<0.001
NO_2*	0.020	0.007	<0.01	0.018	0.007	<0.01
$PM_{2.5}$*	0.014	0.004	<0.01	0.009	0.004	0.034
PM_{10}*	0.002	0.003	0.365	0.001	0.002	0.733
SO_2*	-0.016	0.008	0.050	-0.006	0.006	0.344
CO*	-0.013	0.246	0.958	-0.049	0.212	0.817
O_3*	-0.006	0.005	0.249	-0.010	0.005	0.049

348 *variables were included in the model separately because of the high multicollinearity among air
349 pollutants.
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353 **Table 2**. NO_2-sensitivity analysis.

	Confirmed COVID-19 cases		Severe COVID-19 cases	
Covariates	Variation per 10μg/m^3 (95%CI)	P	Variation per 10μg/m^3 (95%CI)	P
Main analysis	22.41% (7.28%, 39.89%)	<0.01	19.20% (4.03%, 36.59%)	<0.01
Omit # Inflow	24.22% (3.69%, 49.29%)	0.020	20.22% (2.29%, 41.31%)	0.026
Omit # Minimum Within-city movements	55.63% (35.29%, 79.21%)	<0.001	45.43% (27.74%, 65.57%)	<0.001
Omit # Percent of population older than 65	25.59% (10.21%, 43.33%)	<0.001	16.50% (1.98%, 33.09%)	0.025
Omit # Peak of inflow from Wuhan	15.04% (0.28%, 32.18%)	0.048	16.51% (1.46%, 33.79%)	0.030
Omit # Mean Temperature of Coldest Quarte	20.45% (5.48%, 37.73%)	<0.01	17.31% (2.10%, 34.80%)	0.024
Categorize NO_2 into quintiles				
Q1 (<20μg/m^3)	-	-	-	-
Q2 (20-30μg/m^3)	117.22% (31.23%, 284.65%)	<0.01	52.60% (6.65%, 118.36%)	0.021
Q3 (30-40μg/m^3)	107.31% (24.36%, 269.36%)	<0.01	29.10% (-11.71%, 88.76%)	0.187
Q4 (40-50μg/m^3)	215.77% (83.47%, 476.86%	<0.001	109.41% (31.25%, 234.12%)	<0.01
Q5 (>50μg/m^3)	163.42% (8.93%, 504.61%)	0.026	180.93% (16.74%, 575.01%)	0.021
Use NO_2 in winter	14.45% (2.79%, 27.68%)	0.015	12.94% (1.50%, 25.66%)	0.026
Use NO_2 in non-winter	24.95% (8.79%, 43.66%)	<0.01	21.50% (4.94%, 40.68%)	<0.01

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358 **Table 3**. $PM_{2.5}$-sensitivity analysis.

	Confirmed COVID-19 cases		**Severe COVID-19 cases**	
Covariates	Variation per 10μg/m^3 (95%CI)	P	Variation per 10μg/m^3 (95%CI)	P
Main analysis	15.35% (5.60%, 25.98%)	<0.01	9.61% (0.12%, 20.01%)	0.034
Omit # Inflow	30.24% (15.91%, 46.70%)	<0.001	16.41% (4.73%, 29.39%)	<0.01
Omit # Minimum Within-city movements	21.67% (9.08%, 35.62%)	<0.001	19.94% (8.97%, 32.02%)	<0.001
Omit # Percent of population older than 65	17.25% (7.67%, 27.74%)	<0.001	7.85% (-1.24%, 17.78%)	0.092
Omit # Peak of inflow from Wuhan	16.24% (5.79%, 27.73%)	<0.01	10.09% (0.415, 20.72%)	0.041
Omit # Mean Temperature of Coldest Quarte	10.61% (1.66%, 20.21%)	0.019	7.01% (-2.38%, 17.31%)	0.147
Categorize $PM_{2.5}$ into quintiles				
Q1 (<25μg/m^3)	-	-	-	-
Q2 (25-35μg/m^3)	31.34% (-34.21%, 202.21%)	0.478	28.10% (-21.12%,108.02%)	0.316
Q3 (35-45μg/m^3)	137.68% (20.85%, 442.36%)	0.023	26.04% (-23.17%, 106.77%)	0.358
Q4 (45-55μg/m^3)	278.37% (91.85%, 766.05%)	<0.001	74.19% (2.47%, 196.13%)	0.040
Q5 (>55μg/m^3)	164.94% (32.41%, 508.69%)	0.012	51.79% (-9.90%, 155.72%)	0.116
Use $PM_{2.5}$ in winter	6.06% (1.32%, 11.00%)	0.012	4.17% (-0.84%, 9.43%)	0.103
Use $PM_{2.5}$ in non-winter	22.97% (9.32%, 38.30%)	<0.001	13.93% (1.20%, 28.27%)	0.031

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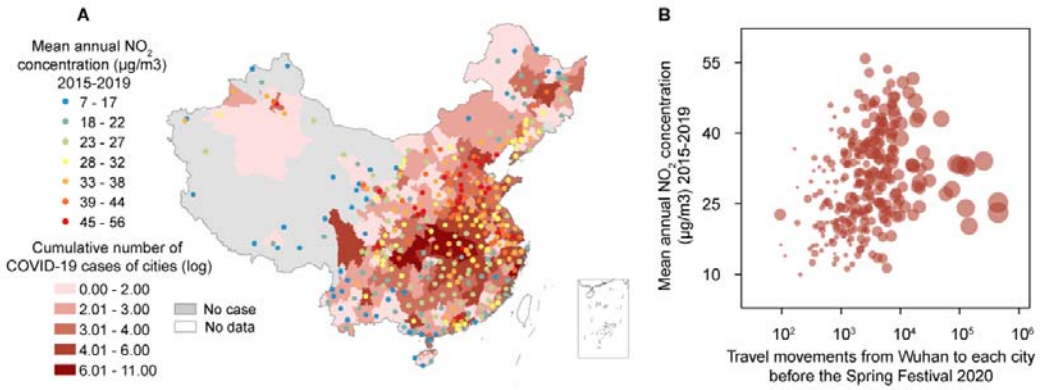

Figure 1. Air pollution exposure, COVID-19, and travel movements in 324 cities of China during Spring Festival 2020. (A) Distribution of cities with data on NO_2 and COVID-19. The shading from light red to dark red represents the cumulative number of confirmed COVID-19 cases in each city from low to high, from 31 December 2019 to 6 March 2020. Points coloured from blue to red represent the historic mean annual NO_2 concentration ($\mu g/m^3$) from low to high, during January 2015 and December 2019, before the COVID epidemic. (B) Association between the cumulative number of confirmed cases, the number of human movements from Wuhan to each city, and historic mean annual NO_2 concentration. The area of circles represents the cumulative number of cases reported by 6 March 2020.

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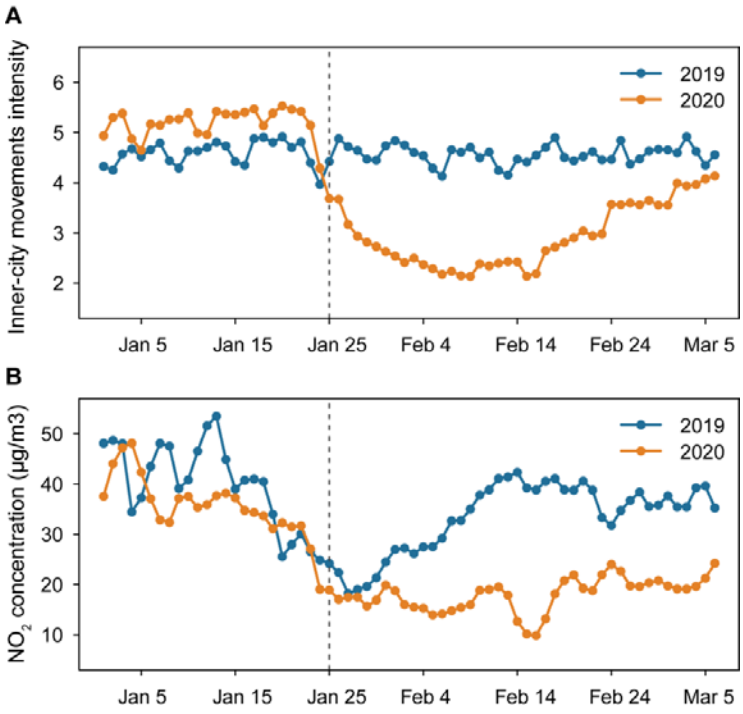

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376 **Figure 2.** (A) Average within-city movement intensity and (B) air pollutant concentration in 324
377 cities in China during the 2020 COVID-19 outbreak (orange line), compared with the same period
378 in 2019 (blue line).

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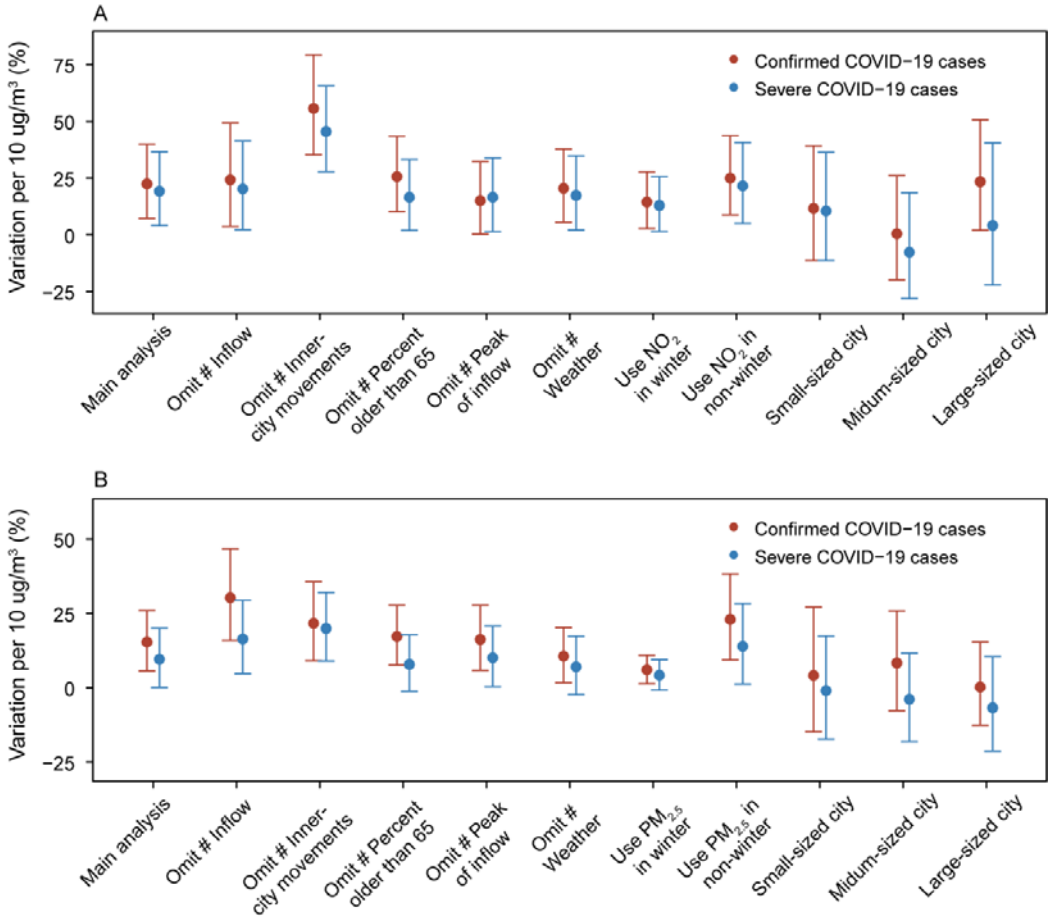

Figure 3. Variation per unit and 95% confidence intervals, (A) NO_2 and (B) $PM_{2.5}$. The variation per unit (VPU) = [exp(variable coefficient) – 1] ×100%. VPU can be interpreted as percentage increase in the number of COVID-19 cases associated with a 10 $\mu g/m^3$ increase in long-term average NO_2 and $PM_{2.5}$. The VPU from the main analysis was adjusted by confounding factors (inward movement from Wuhan city before travel ban and peak time of movement, within-city movements, GDP, smoking prevalence, second-hand smoking prevalence in non-smokers, percent of the population > 65 years old, population, population density, climate, and spatial distribution). In the sensitivity analyses, we omitted each confounding factor separately, and used seasonal air pollutant concentrations.

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Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study

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Abstract

Objectives: United States government scientists estimate that COVID-19 may kill tens of thousands of Americans. Many of the pre-existing conditions that increase the risk of death in those with COVID-19 are the same diseases that are affected by long-term exposure to air pollution. We investigated whether long-term average exposure to fine particulate matter ($PM_{2.5}$) is associated with an increased risk of COVID-19 death in the United States.

Design: A nationwide, cross-sectional study using county-level data.

Data sources: COVID-19 death counts were collected for more than 3,000 counties in the United States (representing 98% of the population) up to April 22, 2020 from Johns Hopkins University, Center for Systems Science and Engineering Coronavirus Resource Center.

Main outcome measures: We fit negative binomial mixed models using county-level COVID-19 deaths as the outcome and county-level long-term average of $PM_{2.5}$ as the exposure. In the main analysis, we adjusted by 20 potential confounding factors including population size, age distribution, population density, time since the beginning of the outbreak, time since state's issuance of stay-at-home order, hospital beds, number of individuals tested, weather, and socioeconomic and behavioral variables such as obesity and smoking. We included a random intercept by state to account for potential correlation in counties within the same state. We conducted more than 68 additional sensitivity analyses.

Results: We found that an increase of only 1 $\mu g/m_3$ in $PM_{2.5}$ is associated with an 8% increase in the COVID-19 death rate (95% confidence interval [CI]: 2%, 15%). The results were statistically significant and robust to secondary and sensitivity analyses.

Conclusions: A small increase in long-term exposure to $PM_{2.5}$ leads to a large increase in the COVID-19 death rate. Despite the inherent limitations of the ecological study design, our results

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underscore the importance of continuing to enforce existing air pollution regulations to protect human health both during and after the COVID-19 crisis. The data and code are publicly available so our analyses can be updated routinely.

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Summary Box

What is already known on this topic

1. Long-term exposure to $PM_{2.5}$ is linked to many of the comorbidities that have been associated with poor prognosis and death in COVID-19 patients, including cardiovascular and lung disease.
2. $PM_{2.5}$ exposure is associated with increased risk of severe outcomes in patients with certain infectious respiratory diseases, including influenza, pneumonia, and SARS.
3. Air pollution exposure is known to cause inflammation and cellular damage, and evidence suggests that it may suppress early immune response to infection.

What this study adds

1. This is the first nationwide study of the relationship between historical exposure to air pollution exposure and COVID-19 death rate, relying on data from more than 3,000 counties in the United States. The results suggest that long-term exposure to $PM_{2.5}$ is associated with higher COVID-19 mortality rates, after adjustment for a wide range of socioeconomic, demographic, weather, behavioral, epidemic stage, and healthcare-related confounders.
2. This study relies entirely on publicly available data and fully reproducible, public code to facilitate continued investigation of these relationships by the broader scientific community as the COVID-19 outbreak evolves and more data become available.

A small increase in long-term $PM_{2.5}$ exposure was associated with a substantial increase in the county's COVID-19 mortality rate up to April 22, 2020.

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Introduction

The scale of the COVID-19 public health emergency is unmatched in our lifetime and will have grave social and economic consequences. The suddenness and global scope of this pandemic has raised urgent questions that require coordinated investigation in order to slow the disease's devastation. A critically important public health objective is to identify key modifiable environmental factors that may contribute to the severity of the health outcomes (e.g., ICU hospitalization and death) among individuals with COVID-19. Data from China and Italy show that a majority of COVID-19 deaths occurred in adults aged ≥60 years[1] and in persons with serious underlying health conditions.[2-4] Early age-stratified COVID-19 death rates in the United States, reported by the Centers for Disease Control and Prevention (CDC),[5] also suggest that persons aged ≥65 are at highest risk. Additional factors associated with severe disease include male sex and the presence of comorbidities including hypertension, obesity, diabetes mellitus, cardiovascular disease, and chronic lung disease.[6 7] Severe COVID-19 infection is characterized by a high inflammatory burden, and it can cause viral pneumonia with additional extrapulmonary manifestations and complications including acute respiratory distress syndrome (ARDS),[8-13] which has a mortality rate ranging from 27% to 45%.[14] Studies have also documented high rates of heart damage,[11 15] cardiac arrhythmias,[12] and blood clots[16] in COVID-19 patients. Patients with severe disease can suffer respiratory failure and failure of other vital systems, leading to death.

Although the epidemiology of COVID-19 is evolving, there is a large overlap between causes of death in COVID-19 patients and the conditions caused and/or exacerbated by long-term exposure to fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ contains microscopic solids or liquid droplets small enough that they can be inhaled and cause serious health problems. The Global Burden of Disease

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Study identified air pollution as a risk factor for total and cardiovascular disease mortality, and it is believed to have contributed to nearly 5 million premature deaths worldwide in 2017 alone.[17] On Thursday, March 26, 2020 the US EPA announced a sweeping relaxation of environmental rules in response to the coronavirus pandemic, allowing power plants, factories and other facilities to determine for themselves if they are able to meet legal requirements on reporting air and water pollution. The association between $PM_{2.5}$ and health, including both infectious and chronic respiratory diseases, cardiovascular diseases, neurocognitive disease, and pregnancy outcomes in the United States and worldwide is well established.[18-24] A recent study by our group also documented a statistically significant association between long-term exposures to $PM_{2.5}$ and ozone and risk of ARDS among older adults in the United States.[25] Numerous scientific studies reviewed by the United States Environmental Protection Agency (US EPA) have linked $PM_{2.5}$ to a variety of health concerns including premature death in people with heart or lung disease, non-fatal heart attacks, irregular heartbeats, aggravated asthma, decreased lung function, and increased respiratory symptoms such as inflammation, airway irritations, coughing, or difficulty breathing.[26]

We hypothesize that because long-term exposure to $PM_{2.5}$ adversely affects the respiratory and cardiovascular systems and increases mortality risk,[27-29] it also exacerbates the severity of COVID-19 infection symptoms and worsens the prognosis of COVID-19 patients. In this study, we quantified the impact of long-term $PM_{2.5}$ exposure on COVID-19 mortality rates in United States counties. Our study includes 3,087 counties in the United States, covering 98% of the population. We leveraged our previous efforts that focused on estimating the long-term effects of $PM_{2.5}$ on mortality among 60 million United States' Medicare enrollees.[20 30 31] We used a well-tested research data platform that gathers, harmonizes, and links nationwide air pollution data, census

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data, and other potential confounding variables with health outcome data. We augmented this platform with newly collected COVID-19 data from authoritative data sources.[32] All data sources used in these analyses, along with fully reproducible code, are publicly available to facilitate continued investigation of these relationships as the COVID-19 outbreak evolves and more data become available.

Methods

Table 1 summarizes our data sources and their provenance, including links where the raw data can be extracted directly.

COVID-19 deaths

We obtained COVID-19 death counts for each county in the United States from Johns Hopkins University, Center for Systems Science and Engineering Coronavirus Resource Center.[32] This source provides the most comprehensive county-level COVID-19 data to date reported by the CDC and state health departments, including the number of new and cumulative deaths and confirmed cases reported in each county across the United States, updated daily. We collected the cumulative number of deaths for each county up to and including April 22, 2020. County-level COVID-19 mortality rates were defined for our analyses as the ratio of COVID-19 deaths to county level population size. While individual-level data would have allowed a more rigorous statistical analyses, individual-level data on COVID-19 death is currently not available.

Exposure to air pollution

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We calculated county-level long-term exposure to $PM_{2.5}$ (averaged from 2000 to 2016) from an established exposure prediction model.[33] The $PM_{2.5}$ exposure levels were estimated monthly at 0.01° × 0.01° grid resolution across the entire continental United States by combining satellite, modeled, and monitored $PM_{2.5}$ data in a geographically weighted regression. These estimates have been extensively cross-validated.[33] We aggregated these levels spatially by averaging the values for all grid points within a zip code and then averaging across zip codes within a county. We obtained temporally averaged $PM_{2.5}$ values (2000–2016) at the county level by averaging estimated $PM_{2.5}$ values within a given county. We computed the average 2016 $PM_{2.5}$ exposure analogously for each county to use in sensitivity analyses.

Potential confounders

In the main analysis, we considered the following 19 county-level variables and one state-level variable as potential confounders (see also Table 2): days since first COVID-19 case reported (a proxy for epidemic stage), population density, percent of population ≥65 years of age, percent of the population 45-64 years of age, percent of the population 15-44 years of age, percent living in poverty, median household income, percent black, percent Hispanic, percent of the adult population with less than a high school education, median house value, percent of owner-occupied housing, percent obese, percent current smokers, number of hospital beds per unit population, and average daily temperature and relative humidity for summer (June-September) and winter (December-February) for each county, and days since issuance of stay-at-home order for each state. Note that publicly available daily COVID-19 case counts at the county level were only available starting March 22, 2020, so that the measure of days since first COVID-19 case reported

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was truncated by this date. Additional detail on the creation of all variables used in the analysis is available in the Supplementary Materials.

Statistical methods

We fit a negative binomial mixed model[34-36] using COVID-19 deaths as the outcome and $PM_{2.5}$ as the exposure of interest to estimate the association between COVID-19 mortality rate and long-term $PM_{2.5}$ exposure, adjusted by covariates. The model included a population size offset and was adjusted for all the potential confounders listed above. We also included a random intercept by state to account for potential correlation in counties within the same state, due to similar socio-cultural, behavioral, and healthcare system features and similar COVID-19 response and testing policies. Additional modeling details are provided in the Supplementary Materials. We report mortality rate ratios (MRR), i.e., exponentiated parameter estimates from the negative binomial model, and 95% CI. The MRR for $PM_{2.5}$ can be interpreted as the relative increase in the COVID-19 mortality rate associated with a 1 $\mu g/m_3$ increase in long-term average $PM_{2.5}$ exposure. We carried out all analyses in R statistical software and performed model fitting using the lme4 package.[37 38]

Quantifying unmeasured confounding bias

Because this study is observational and the contributing factors to COVID-19 spread and severity remain largely unknown at this early stage of the pandemic, unmeasured confounding is a concern in our analyses. The E-value is a commonly used metric to evaluate the potential impact of unmeasured confounding on results from an observational study.[39] For a pre-specified exposure variable of interest (long-term exposure to $PM_{2.5}$), the E-value quantifies the minimum strength of

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association that an unmeasured confounder must have, with both the outcome (COVID-19 mortality rate) and exposure (long-term exposure to $PM_{2.5}$) conditional to all of the potential confounders included in the regression model, to explain away the estimated exposure-outcome relationship. We report the E-value for the MRR estimate for $PM_{2.5}$ under the main model with 20 potential confounders.

Secondary analyses

In addition to the main analysis, we conducted six secondary analyses to assess the robustness of our results to the confounder set used, outliers, and the model form specification.

First, because the New York metropolitan area has experienced the most severe COVID-19 outbreak in the United States to date, we anticipated that it would strongly influence our analysis. As a result, we repeated the analysis excluding the counties comprising the New York metropolitan area, as defined by the Census Bureau.

Second, although in our main analysis we adjusted for days since first COVID-19 case reported to capture the size of an outbreak in a given county, this measure is imprecise. To further investigate the potential for residual confounding bias (i.e., if counties with high $PM_{2.5}$ exposure also tend to have large outbreaks relative to the population size, then their death rates per unit population could appear differentially elevated, inducing a spurious correlation with $PM_{2.5}$), we also conducted analyses excluding counties with fewer than 10 confirmed COVID-19 cases.

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Third, we omitted an anticipated strong confounder, days since first COVID-19 case reported, from the model. Fourth, we additionally adjusted our models for the number of tests performed at the state level (see Table 1 for data source) to evaluate how state-level differences in testing policies might impact our results. Fifth, we additionally adjusted our models for county-level estimated percentage of people with COVID-19 symptoms (see Table 1 for data source) to evaluate how the size of the outbreak in each county might impacts our results. Sixth, we introduced $PM_{2.5}$ into our models as a categorical variable, categorized at the empirical quintiles, to assess the sensitivity of our results to the assumption of a linear effect of $PM_{2.5}$ on COVID-19 mortality rates.

Sensitivity analyses

We conducted 68 sensitivity analyses to assess the robustness of our results to data and modeling choices. First, we repeated all the analyses using alternative methods to estimate exposure to $PM_{2.5}$.[31] Second, we fit the models, modifying the adjustment for confounders, such as using a log transformation or categorized versions of some of the covariates. Third, because our study relies on observational data, our results could be sensitive to modeling choices (e.g., distributional assumptions or assumptions of linearity). We evaluated sensitivity to such choices by considering alternative model specifications and by fitting models stratified by county urban-rural status. Additional detail about the sensitivity analyses and the results are provided in the Supplementary Materials.

Results

Our study utilized data from 3,087 counties, of which 1,799 (58.3%) had reported zero COVID-19 deaths at the time of this analysis. Table 2 describes the data used in our analyses. All COVID-

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19 death counts (a total of 45,817 deaths) are cumulative up to April 22, 2020. Figure 1 illustrates the spatial variation of long-term average exposure to $PM_{2.5}$ and COVID-19 death rates (per 1 million population) by county. Visual inspection suggests higher COVID-19 death rates in the Mid-Atlantic, upper Midwest, and Gulf Coast regions. These spatial patterns in COVID-19 death rates generally mimic patterns in both high population density and high $PM_{2.5}$ exposure areas. In the Supplementary Materials, we provide additional data diagnostics that justify the use of the negative binomial model for our analyses.

In Table 3, we report the estimated regression coefficients for each of the covariates included in our main analysis, including $PM_{2.5}$. We found that the estimated MRR for $PM_{2.5}$ is 1.08 (1.02, 1.15). That is, we found that an increase of only 1 $\mu g/m_3$ in long-term average $PM_{2.5}$ is associated with a statistically significant 8% increase in the COVID-19 death rate. Importantly, we also found that population density, days since first COVID-19 case reported, rate of hospital beds, median household income, percent with less than a high school education, and percent Black are important predictors of COVID-19 death rate. Our results are consistent with previously reported findings that Black Americans are at higher risk of COVID-19 mortality than other groups,[40] we found a 45% (32%, 60%) increase in COVID-19 mortality rate associated with a 1-standard deviation (per 14.2%) increase in percent Black residents.

For our main analysis, the E-value for the estimated MRR for $PM_{2.5}$ was 1.37. That is, in order for an unmeasured confounder to fully account for the estimated effect of $PM_{2.5}$ on the COVID-19 mortality rate, it would have to be associated with both long-term $PM_{2.5}$ exposure and COVID-19 mortality by a risk ratio of at least 1.37-fold each, through pathways independent of all covariates

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already included in the model. If we were to include such a confounder in our models, along with all other confounders considered, the estimated MRR for $PM_{2.5}$ mortality would become 1 (the null value). To get a sense of the magnitude of the required confounding effect, we also computed the E-value for some of our key measured confounders for comparison. The E-values for days since first COVID-19 case reported (1.16), the weather variables (1.02), number of hospital beds (1.04) and the behavioral risk factors (1.02) were significantly smaller than the reported E-values for the required unmeasured confounder. This suggests that any unmeasured confounder would need to have a confounding effect substantially larger than any of our observed confounders in order to explain away the relationship between $PM_{2.5}$ and COVID-19 mortality rate.

In Figure 2, we report the MRR and 95% CI for $PM_{2.5}$ from all secondary analyses. In these analyses, we separately (a) omitted New York metropolitan area; (b) excluded counties with fewer than 10 confirmed COVID-19 cases; (c) omitted time since first reported COVID-19 case from the model; (d) additionally adjusted the model for number of tests performed; (e) additionally adjusted the model for estimated percentage of people with COVID-19 symptoms; and (f) treated $PM_{2.5}$ as a categorical variable. The results of these analyses were consistent with the main analysis. For the analysis of the $PM_{2.5}$ categorized into quintiles, the MRR for the k_{th} can be interpreted as the increase in COVID-19 mortality rate associated with a change from the first quintile to the k_{th} quintile in long-term $PM_{2.5}$ exposure. The MRR estimates from this model monotonically increased as $PM_{2.5}$ increased, supporting the assumption of a linear relationship between $PM_{2.5}$ and COVID-19 mortality rates. The results of all sensitivity analyses are provided in the Supplementary Materials.

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Discussion

This is the first nationwide study in the United States to estimate the relationship between long-term exposure to $PM_{2.5}$ and COVID-19 death rates. The results indicate that long-term exposure to air pollution increases vulnerability to the most severe COVID-19 outcomes. We found statistically significant evidence that an increase of 1 $\mu g/m^3$ in long-term $PM_{2.5}$ exposure is associated with an 8% increase in the COVID-19 mortality rate. Our results were adjusted for a large set of socioeconomic, demographic, weather, behavioral, epidemic stage, social isolation measures, and healthcare-related confounders and demonstrated robustness across a wide range of sensitivity analyses.

In our previous study[20] of 60 million Americans older than 65 years of age, we found that a 1 $\mu g/m^3$ in long-term $PM_{2.5}$ exposure is associated with a 0.73% increase in the rate of all-cause mortality. Therefore, the same small increase in long-term exposure to $PM_{2.5}$ led to an increase in the COVID-19 death rate of a magnitude 11 times that estimated for all-cause mortality.

Our results are consistent with previous findings that air pollution exposure increases severe outcomes during infectious disease outbreaks. Ciencewicki and Jaspers[19] provide a review of the epidemiologic and experimental literature linking air pollution to infectious disease. During the 2003 outbreak of Severe Acute Respiratory Syndrome (SARS), a type of coronavirus closely related to COVID-19, Cui et al[41] reported that locations in China with a moderate or high long-term air pollution index (API) had SARS case fatality rates 126% and 71% higher, respectively, than locations with low API. Long-term particulate matter exposure has been associated with hospitalizations for pneumonia in the well-controlled quasi-experimental conditions provided by

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the closing of the Utah Valley Steel Mill,[42] and a link between long-term $PM_{2.5}$ exposure and pneumonia and influenza deaths was reported in a well-validated cohort study.[28] Several studies have reported associations between short-term $PM_{2.5}$ exposure and poor infectious disease outcomes,[43 44] including higher hospitalization rates or increased medical encounters for influenza, pneumonia, and acute lower respiratory infections. In these studies and in the literature on the association between air pollution and chronic disease outcomes, relationships with long-term pollution exposure tend to be stronger than relationships with short-term exposure,[20 45 46] and the large effect estimate in our study is consistent with this trend.

Relationships have also been detected between pollution exposures and severe outcomes in the context of past pandemics. Studies found particulate matter exposure to be associated with the mortality during the H1N1 influenza pandemic in 2009.[47 48] Recent studies have even used historic data to show a relationship between air pollution from coal burning and mortality in the 1918 Spanish influenza pandemic.[49 50]

Although our study design cannot provide insight into the mechanisms underlying the relationship between $PM_{2.5}$ and COVID-19 mortality, prior studies have shed light on the potential biological mechanisms that may explain the relationship between air pollution and viral outcomes.[19] $PM_{2.5}$ exposure is known to be associated with many of the cardiovascular and respiratory comorbidities that dramatically increase the risk of death in COVID-19 patients. We hypothesize that the effects captured here are largely mediated by these comorbidities and pre-existing PM-related inflammation and cellular damage,[46 51] as suggested by a recent commentary.[52] Experimental studies[19 53-56] also suggest that exposure to pollution can suppress early immune responses to the

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infection, leading to later increases in inflammation and worse prognosis, which may also explain our findings. Some studies[57-59] have suggested that air pollution can also proliferate the transmission of infectious disease. If COVID-19 spread is indeed impacted by air pollution levels, which is not yet known, some of the effects detected in our study could be mediated by this factor as well.

This analysis provides a timely characterization of the relationship between historical exposure to air pollution and COVID-19 deaths in the United States. Research on how modifiable factors may exacerbate COVID-19 symptoms and increase mortality risk is essential to guide policies and behaviors to minimize fatality related to the outbreak. Our analysis relies on up-to-date population-level COVID-19 data and well-validated air pollution exposure measures.

Strengths of this analysis include adjusting for a wide range of potential confounders and a demonstrated robustness of results to different model choices. Moreover, the analyses rely exclusively on data and code that are publicly available. This provides a platform for the scientific community to continue updating and expanding these analyses as the pandemic evolves and data accumulate.

It is important to acknowledge that this study has limitations, mainly due to the fact that this is an ecological study with data available at the county level and that this is a cross-sectional study. High quality, nationwide individual-level COVID-19 outcome data are unavailable at this time and for the foreseeable future, thus necessitating the use of an ecologic study design for these analyses. Due to the potential for ecologic bias, our results should be interpreted in the context of

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this design and should not be used to make individual-level inferential statements. Also, unmeasured confounding bias is a threat to the validity of our conclusions. Unfortunately, in the midst of a pandemic it is not feasible to design a study and collect the data at the ideal level of spatial and temporal resolution to minimize all sources of bias. Yet, conditional on the data available, we have endeavored to adjust for confounding bias by all of the most important factors, including population density, time since the beginning of the outbreak, social isolation measures, behavior, weather, age structure, ethnicity, access to health care, and socio-economic factors. We also conducted 68 additional analyses to assess the robustness of the results to many modelling choices. Furthermore, we computed the E-value to demonstrate that the confounding effect of any unmeasured confounder would need to be much stronger than that of any of our observed confounders in order to explain away the relationship between $PM_{2.5}$ exposure and COVID-19 mortality rate. The calculation of the E-value provided reassurance that the presence of a strong unmeasured confounder is unlikely; however, this possibility cannot be ruled out completely.

The inability to accurately quantify the number of COVID-19 cases due to limited testing capacity presents another potential limitation. We instead used total population size as the denominator for our mortality rates, and we additionally adjusted our models for numerous anticipated proxies of outbreak size, including time since first reported COVID-19 case, time since stay-at-home order was issued, and population density.

To conduct the most rigorous possible studies of air pollution and health using ecologic data, it is critical to utilize areal units that minimize within-area exposure variability and maximize between-area exposure variability.[60] [61] We anticipated that our use of counties satisfies this criterion,

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because counties generally represent meaningful boundaries between urban, suburban, and rural areas. These population density-related delineations also often correspond to steep gradients in air pollution levels, thus maximizing across-unit exposure variability while minimizing within-unit variability. We also note that the use of long-term county-level exposure data in our study likely led to some degree of exposure misclassification. However, previous literature has found that using sub-county scale $PM_{2.5}$ exposure in studies of mortality tends to either have no impact or to increase the strength of the associations between $PM_{2.5}$ and mortality from various causes.[62]

Because of the many limitations, this study also provides justification for expanded follow-up investigations as more and higher-quality COVID-19 data become available. Such studies would include validation of our findings with other data sources and study types, as well as studies of biological mechanisms, impacts of $PM_{2.5}$ exposure timing, and relationships between $PM_{2.5}$ and other COVID-19 outcomes such as hospitalization. The results of this study also underscore the importance of continuing to enforce existing air pollution regulations. Based on our results, we anticipate a failure to do so could potentially increase the long-term COVID-19 death toll and hospitalizations, as well as further burden our healthcare system with other $PM_{2.5}$-related death and disease that would draw resources away from COVID-19 patients.

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Table 1: Publicly available data sources used in the analysis

	Source	Data
Outcome: COVID-19 Deaths	Johns Hopkins University the Center for Systems Science and Engineering (JHU-CSSE) Coronavirus Resource Center (https://coronavirus.jhu.edu/)	County-level COVID-19 death count up to and including April 22, 2020
Exposure: $PM_{2.5}$ concentrations	Atmospheric Composition Analysis Group (https://sites.wustl.edu/acag/)	0.01° × 0.01° grid resolution $PM_{2.5}$ prediction, averaged across the period 2000–2016 and averaged across grid cells in each county
Confounders for main analysis	US Census/American Community Survey (https://www.census.gov/programs-surveys/acs/data.html)	County-level socioeconomic and demographic variables for 2012–2016
	Robert Wood Johnson Foundation County Health Rankings (https://www.countyhealthrankings.org/)	County-level behavioral risk factor variables for 2020
	JHU-CSSE Coronavirus Resource Center	Time since first reported COVID-19 case
	Raifman et al, Boston University School of Public Health, COVID-19 United States state policy database (www.tinyurl.com/statepolicies)	Time since issuance of stay-at-home order
	Homeland Infrastructure Foundation-Level Data (HIFLD) (https://hifld-geoplatform.opendata.arcgis.com/datasets/hospitals)	County-level number of hospital beds in 2019
	Gridmet via Google Earth engine (https://developers.google.com/earth-engine/datasets/catalog/IDAHO_EPSCOR_GRIDMET)	4 km × 4 km temperature and relative humidity predictions, summer and winter averaged across the period 2000–2016 and averaged across grid cells in each county

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Additional confounders for secondary analyses	The COVID tracking project (https://covidtracking.com/)	State level number of COVID-19 tests performed up to and including April 22, 2020
	Carnegie Mellon University Delphi Research Center (https://covid-survey.dataforgood.fb.com/)	Estimated percentage of people with COVID-19 symptoms, based on survey data

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Table 2: Characteristics of the study cohort up to and including April 22, 2020, mean (standard deviation)

	Total 3,087 counties	$PM_{2.5}$ <8 $\mu g/m^3$ 1,217 counties	$PM_{2.5}$≥8 $\mu g/m^3$ 1,870 counties
COVID-19 death rate (per 100,000)	3.4 (10.6)	1.6 (5.7)	4.7 (12.7)
Average $PM_{2.5}$ ($\mu g/m^3$)	8.4 (2.5)	5.7 (1.4)	10.1 (1.2)
Rate of hospital beds (per 100,000)	242 (391.9)	300 (515.2)	204.2 (278)
Days since first case	23.6 (10.7)	19 (12.6)	26.5 (7.9)
Days since stay-at-home order	18.3 (12.4)	16.7 (13.6)	19.2 (11.4)
% Smokers	17.4 (3.5)	15.8 (3.1)	18.5 (3.4)
% Obese	32.9 (5.4)	31.2 (5.1)	34 (5.3)
% In poverty	10.5 (5.7)	9.7 (5.7)	11.1 (5.6)
% Less than high school education	21.2 (10.4)	16.5 (8.7)	24.2 (10.3)
% Owner-occupied housing	74.2 (8.8)	76 (7.7)	73.1 (9.3)
% Hispanic	7.6 (12.3)	9.7 (13.7)	6.3 (11.1)
% Black	8.2 (14.2)	1 (1.8)	12.9 (16.5)
% ≥65 years of age	16 (4.1)	17.4 (4.5)	15 (3.4)
% 45-64 years of age	26.4 (3)	26.9 (3.8)	26.1 (2.4)
% 15-44 years of age	37.6 (6.5)	35.2 (8.2)	39.2 (4.5)
Population density (person/sq. mi.)	406.7 (1732.6)	132.6 (430.7)	585.1 (2180.6)
Median household income ($1,000)	49 (13.1)	50.5 (10.9)	48 (14.3)
Median house value ($1,000)	136 (89.4)	140.4 (87.3)	133.1 (90.6)
Average summer temperature (°F)	86 (5.7)	83.7 (6.7)	87.4 (4.4)
Average winter temperature (°F)	45.1 (11.9)	39.4 (11.5)	48.7 (10.7)
Average summer relative humidity (%)	89 (9.6)	83.2 (11.5)	92.8 (5.5)
Average winter relative humidity (%)	87.5 (4.8)	87.9 (5.6)	87.2 (4.1)

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Table 3: Mortality rate ratios (MRR), 95% confidence intervals (CI), and P-values for all variables in the main analysis.

	MRR	95% CI	P-value
$PM_{2.5}$ ($\mu g/m_3$)	1.08	(1.02, 1.15)	0.01
Population density (Q2)	0.86	(0.60, 1.23)	0.40
Population density (Q3)	0.58	(0.40, 0.82)	0.00
Population density (Q4)	0.47	(0.33, 0.68)	0.00
Population density (Q5)	0.52	(0.35, 0.77)	0.00
% Poverty	1.02	(0.93, 1.13)	0.65
log(Median house value)	1.17	(0.99, 1.39)	0.06
log(Median household income)	1.28	(1.09, 1.51)	0.00
% Owner-occupied housing	1.12	(1.02, 1.23)	0.18
% Less than high school education	1.36	(1.21, 1.52)	0.00
% Black	1.45	(1.32, 1.60)	0.00
% Hispanic	1.00	(0.89, 1.12)	0.99
% ≥65 years of age	1.15	(0.99, 1.33)	0.07
% 15-44 years of age	0.93	(0.74, 1.17)	0.54
% 45-64 years of age	0.96	(0.83, 1.12)	0.62
Days since stay-at-home order	1.28	(0.97, 1.70)	0.08
Days since first case	2.96	(2.50, 3.51)	0.00
Rate of hospital beds	1.12	(1.02, 1.23)	0.01
% Obese	0.94	(0.86, 1.02)	0.14
% Smokers	1.08	(0.92, 1.26)	0.36
Average summer temperature (°F)	0.96	(0.79, 1.16)	0.68
Average winter temperature (°F)	1.18	(0.90, 1.53)	0.22
Average summer relative humidity (%)	0.84	(0.71, 1.01)	0.07
Average winter relative humidity (%)	1.00	(0.89, 1.13)	0.99

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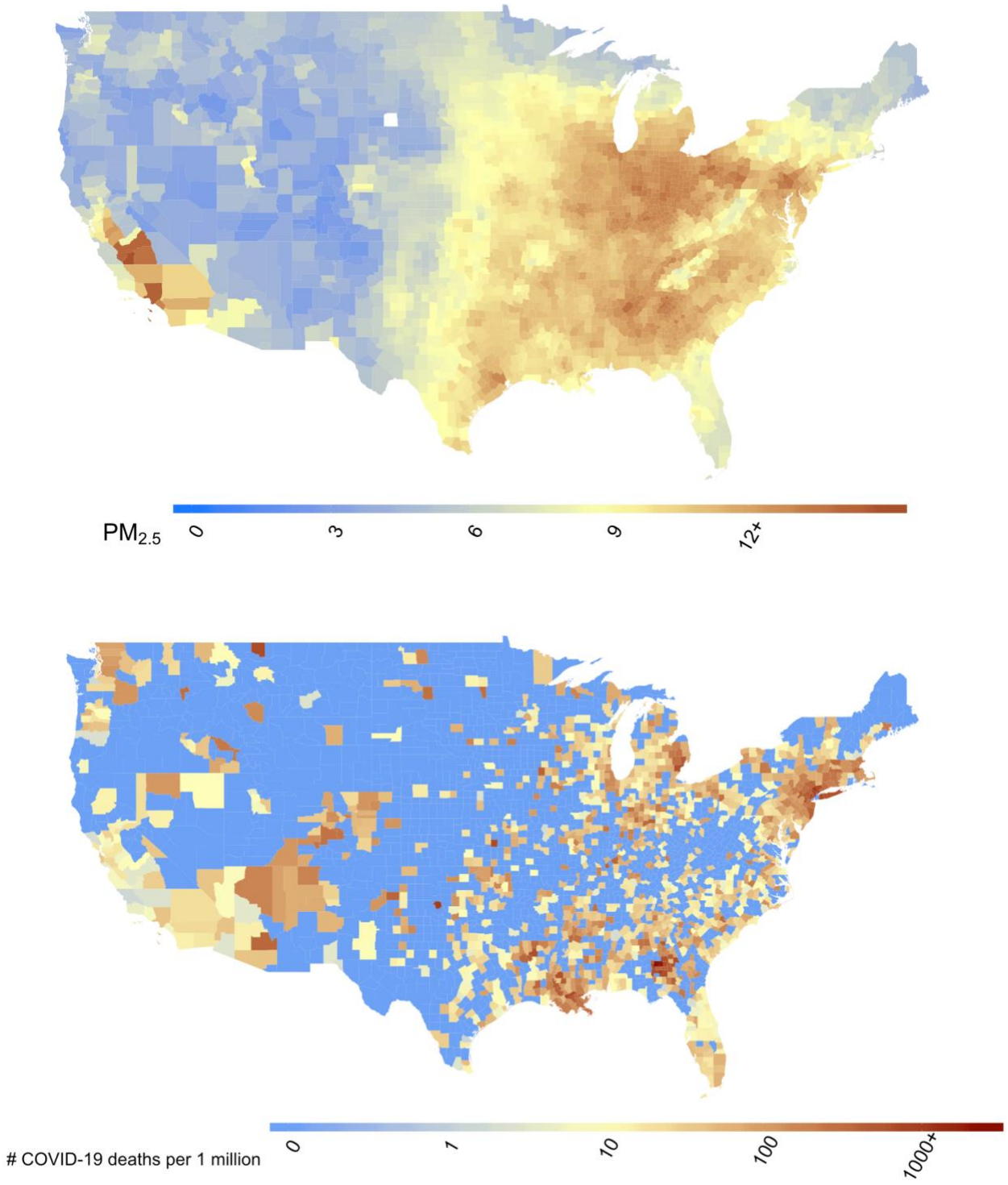

Fig 1: Maps show **(a)** county-level 17-year long-term average of $PM_{2.5}$ concentrations (2000–

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2016) in the United States in $\mu g/m_3$, and **(b)** county-level number of COVID-19 deaths per 1 million population in the United States up to and including April 22, 2020.

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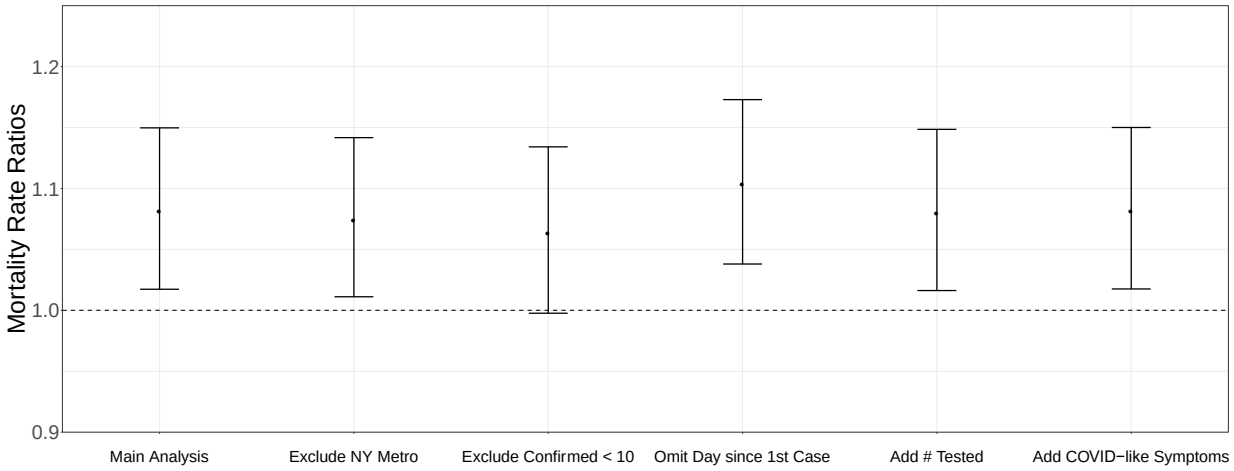

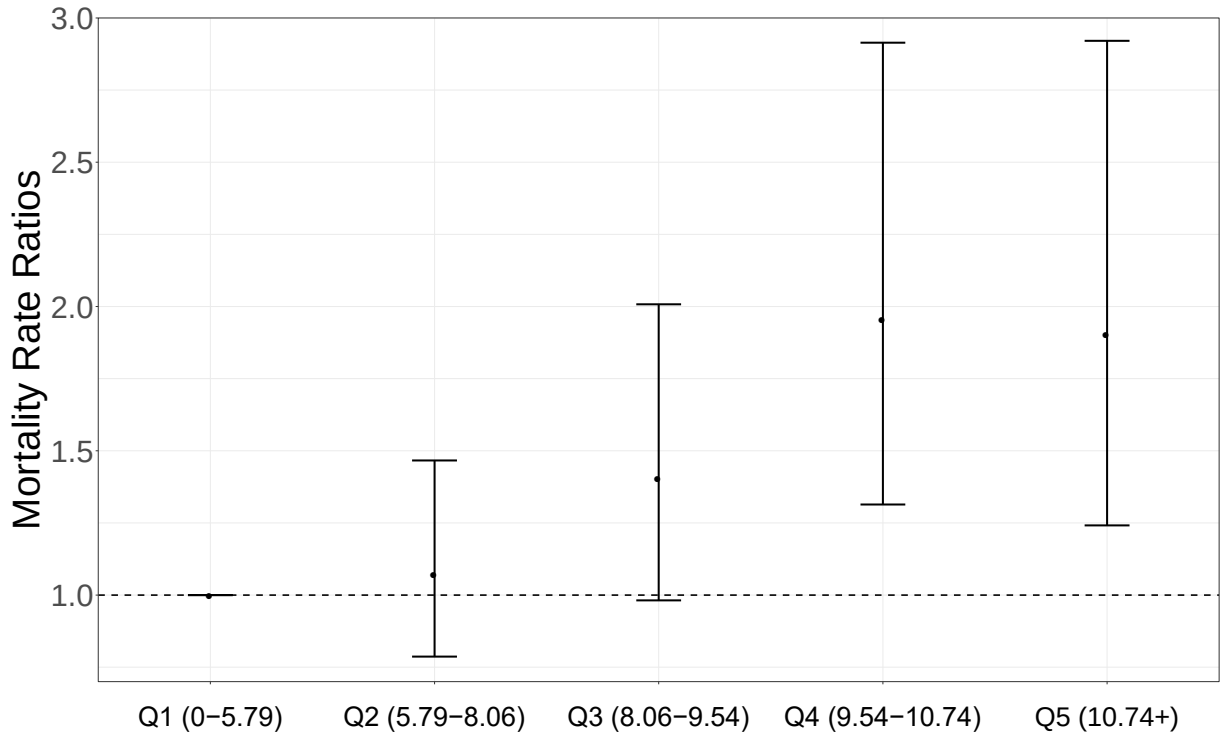

Fig 2: Mortality Risk Ratios (MRR) and 95% confidence intervals. **Upper panel**, MRR can be interpreted as percentage increase in the COVID-19 death rate associated with a 1 μg/m3 increase in long-term average $PM_{2.5}$ exposure. The MRR from the main analysis was adjusted for 20 potential confounders. In addition to the main analysis, results are shown for secondary analyses (a) excluding the counties in New York metropolitan area, (b) excluding counties with fewer than

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10 confirmed COVID-19 cases, (c) omitting time since first reported COVID-19 case from the model, (d) adding state-level number of tests performed to the model, (e) adding county-level estimated percentage of people with COVID-19 symptoms to the model, and (f) using $PM_{2.5}$ exposure categorized at quintiles. All COVID-19 death counts are cumulative counts up to and including April 22, 2020. **Lower panel**, MRR can be interpreted as the percentage increase in the COVID-19 death rate associated with each empirical quintile of long-term average $PM_{2.5}$ exposure compared to the baseline quintile (Q1).

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Association between short-term exposure to air pollution and COVID-19 infection: Evidence from China

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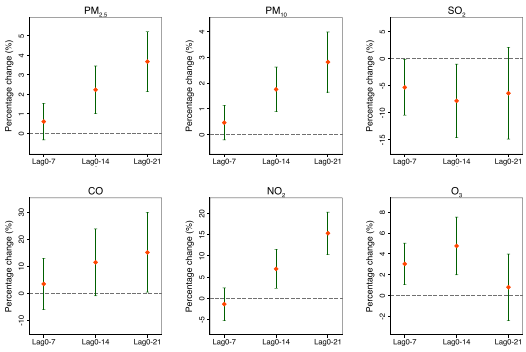
HIGHLIGHTS

- There was a significant relationship between air pollution and COVID-19 infection after controlling for confounding factors.
- Positive associations of $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3 with COVID-19 confirmed cases were observed.
- However, SO_2 was negatively associated with the number of daily COVID-19 confirmed cases.

GRAPHICAL ABSTRACT



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ABSTRACT

The novel coronavirus pneumonia, namely COVID-19, has become a global public health problem. Previous studies have found that air pollution is a risk factor for respiratory infection by carrying microorganisms and affecting body's immunity. This study aimed to explore the relationship between ambient air pollutants and the infection caused by the novel coronavirus. Daily confirmed cases, air pollution concentration and meteorological variables in 120 cities were obtained from January 23, 2020 to February 29, 2020 in China. We applied a generalized additive model to investigate the associations of six air pollutants ($PM_{2.5}$, PM_{10}, SO_2, CO, NO_2 and O_3) with COVID-19 confirmed cases. We observed significantly positive associations of $PM_{2.5}$, PM_{10}, NO_2 and O_3 in the last two weeks with newly COVID-19 confirmed cases. A 10-μg/m^3 increase (lag0–14) in $PM_{2.5}$, PM_{10}, NO_2, and O_3 was associated with a 2.24% (95% CI: 1.02 to 3.46), 1.76% (95% CI: 0.89 to 2.63), 6.94% (95% CI: 2.38 to 11.51), and 4.76% (95% CI: 1.99 to 7.52) increase in the daily counts of confirmed cases, respectively. However, a 10-μg/m^3 increase (lag0–14) in SO_2 was associated with a 7.79% decrease (95% CI: −14.57 to −1.01) in COVID-19 confirmed cases. Our results indicate that there is a significant relationship between air pollution and COVID-19 infection, which could partially explain the effect of national lockdown and provide implications for the control and prevention of this novel disease.

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1. Introduction

A novel coronavirus disease, namely COVID-19, was first detected in Wuhan city, China in December 2019 (Lu et al., 2020; Xu

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et al., 2020). In subsequent months, it spread rapidly to the rest of China, which has later become a global public health problem (Chen et al., 2020a; Gilbert et al., 2020; Sohrabi et al., 2020). COVID-19 is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Dong et al., 2020; Sohrabi et al., 2020; Zhou et al., 2020). Generally, most SARS-CoV-2 infected patients have mild symptoms including fever, dry cough, and sore throat (Huang et al., 2020; Sohrabi et al., 2020). However, some patients could have severe and even fatal complications such as Acute Respiratory Distress Syndrome (ARDS) (Chen et al., 2020b; Sohrabi et al., 2020).

To control the spread of COVID-19, various studies have been conducted to explore important factors affecting the transmission of SARS-CoV-2. Several early studies have demonstrated that human-to-human contact could increase the risk of COVID-19 infection (Chan et al., 2020; Li et al., 2020; Wang et al., 2020). Besides, population mobility has a significant effect on the COVID-19 epidemic (Kraemer et al., 2020). In addition, a recent study has shown an association of ambient temperature with the infection of COVID-19 (Xie and Zhu 2020). However, the impact of short-term exposure to air pollution lacks careful consideration.

Previous studies have suggested that ambient air pollutants are risk factors for respiratory infection by carrying microorganisms to make pathogens more invasive to humans and affecting body's immunity to make people more susceptible to pathogens (Becker and Soukup, 1999; Cai et al., 2007; Horne et al., 2018; Xie et al., 2019; Xu et al., 2016). Since COVID-19 is a respiratory disease and SARS-CoV-2 could remain viable in aerosols for hours (van Doremalen et al., 2020), it is interesting to investigate the effect of air pollution on COVID-19 infection. To provide useful implications for the control and prevention of this novel coronavirus disease, we aimed to explore the relationship between concentrations of six air pollutants and daily confirmed COVID-19 cases in 120 cities in China.

2. Materials and methods

2.1. Study area

This study included 120 cities (4 municipalities and 116 prefecture-level cities) in the geographic regions of 83.4° to 131.6° east longitude and 20.0° to 51.4° north latitude (Fig. 1). According to the National Health Commission, 79,968 COVID-19 confirmed cases have been identified in the whole of China as of February 29, 2020. Our studied cities covered 70% of confirmed cases. We focused our analysis on these 120 cities because of the limitation of the meteorological data and the air pollution data we have obtained.

2.2. Data collection

Daily confirmed new cases for each city between January 23, 2020 and February 29, 2020 were obtained from the reports released by local health commissions on the official websites. We set January 23, 2020 (i.e., the date of lockdown in Wuhan) as the starting point of our study period to minimize the potential inclusion of imported cases from Wuhan.

Air pollution data were collected from an online platform (https://www.aqistudy.cn) monitoring and analyzing the air quality. Daily concentrations of six air pollutants were measured, including particles with diameters ≤2.5 μm ($PM_{2.5}$), particles with diameters ≤10 μm (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and ozone (O_3).

Meteorological data on daily mean temperature, relative humidity, air pressure, and wind speed during the study period were obtained from the National Meteorological Information Center (http://data.cma.cn).

2.3. Statistical analysis

The generalized additive model (GAM) is a useful method to examine the effects of meteorological factors and air pollution on health

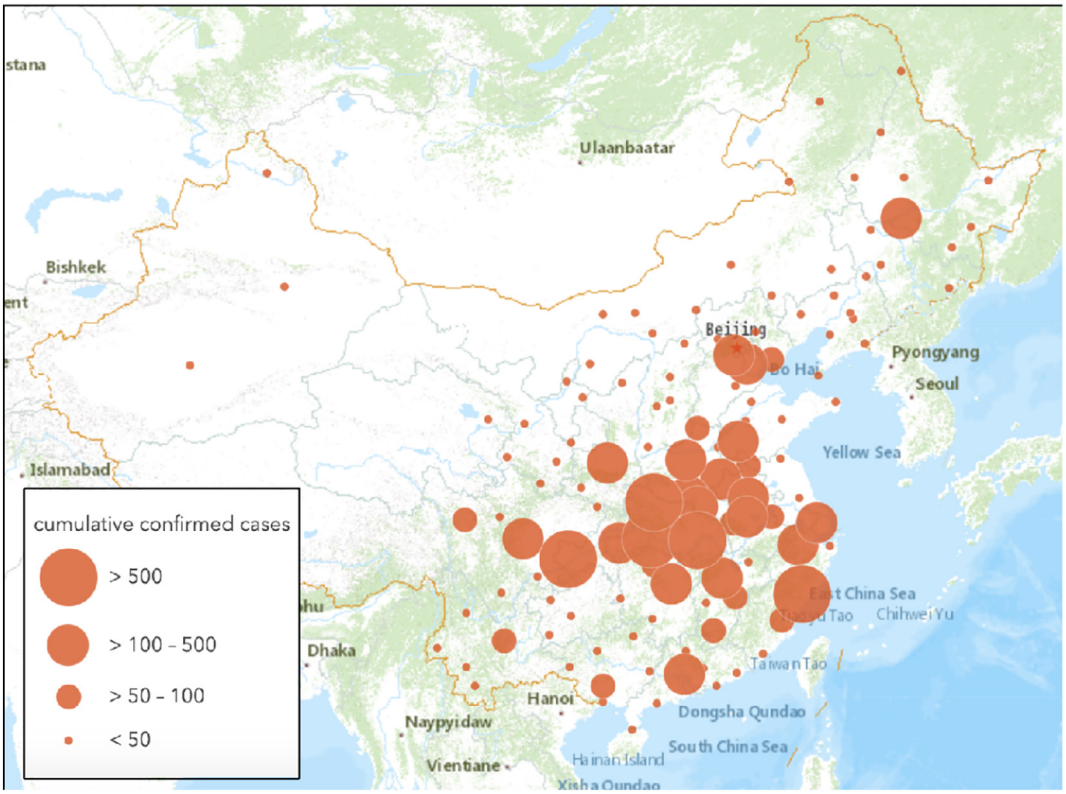

Fig. 1. Locations of 120 cities and cumulative COVID-19 confirmed cases in each city as of February 29, 2020.

Table 1
Descriptive statistics of daily confirmed new cases, concentration of air pollution, and meteorological variables across all cities and days.

	Mean (SD)	Min	Max
Daily confirmed cases	12.94 (228.96)	0	13,436
$PM_{2.5}$ (μg/m^3)	46.43 (38.55)	2	554
PM_{10} (μg/m^3)	62.97 (49.76)	4	632
SO_2 (μg/m^3)	12.23 (9.90)	2	87
CO (mg/m^3)	0.85 (0.47)	0.1	7.4
NO_2 (μg/m^3)	19.28 (11.87)	2	86
O_3 (μg/m^3)	78.22 (20.58)	11	152
Mean temperature (°C)	2.82 (10.11)	−33.8	26.5
Relative humidity (%)	67.25 (17.42)	17	100
Air pressure (hPa)	964.08 (76.15)	668.1	1039
Wind speed (m/s)	2.11 (1.19)	0	15.4

outcomes (Lin et al., 2018; Ma et al., 2020; Peng et al., 2006; Talmoudi et al., 2017; Yang et al., 2020). As demonstrated by previous studies, the effect of air pollution can last for several days (Lin et al., 2018; Myung et al., 2019; Xie et al., 2019; Yang et al., 2020). In addition, an incubation period of 1 to 14 days for COVID-19 was reported by the National Health Commission in China. So, it is a reasonable choice to apply a moving-average approach to capture the cumulative lag effect of ambient air pollution (Duan et al., 2019; Li et al., 2018; Yang et al., 2020). Thus, in this study, we used the GAM with a Gaussian distribution family to estimate the associations between the moving average concentrations of air pollutants (lag0–7, lag0–14, lag0–21) and daily COVID-19 confirmed cases (Hastie, 2017; Liu et al., 2020). Specifically, we examined the effects of six air pollutants in six separate models (i.e., single-pollutant models) to reduce the collinearity since some of these pollutants were highly correlated (Chen et al. 2018; Dastoorpoor et al., 2019; Phosri et al., 2019). The basic model was defined as follows:

$$\log(y_{it}) = a + Z_{il} + s(tem_{il}) + s(rhu_{il}) + s(prs_{il}) + s(win_{il}) + \log(y_{i,t-1}) + city_i + day_t + \varepsilon_{it}$$

Here, $log(y_{it})$ indicates the log-transformed COVID-19 counts reported on day t in city i (added 1 to avoid taking the logarithm of 0) (Liu et al., 2020; Xie and Zhu, 2020). a is the intercept. Z_{il} denotes the linear term of $(l + 1)$-day moving average concentration of air pollutant (lag0-l) in city i (Chen et al. 2018; Phosri et al., 2019). Meteorological factors during the same period were controlled for the possible confounding effect, including mean temperature (tem_{il}), relative humidity (rhu_{il}), air pressure (prs_{il}) and wind speed (win_{il}). $s(\cdot)$ is the smooth function (thin plate spline function with the maximum 3 degrees of freedom) of a certain meteorological factor (Liu et al., 2020; Wang et al., 2018; Xie and Zhu, 2020). $log(y_{i,\ t-1})$ indicates the log-transformed COVID-19 counts reported on day t-1 in city i to account for the potential serial correlation in our data (Liu et al., 2020). In addition, we included city fixed effects ($city_i$) to control for time-invariant city characteristics such as population size and density, and we also included day fixed effects (day_t) to control for unobserved factors affecting all cities in each day such as national lockdown (Amuakwa-Mensah et al., 2017; Lu and Lu, 2017).

Two sensitivity analyses were conducted. First, since the number of confirmed cases in Wuhan city (the worst-hit region in China) was much larger than that in other cities, we excluded Wuhan from our data to test the robustness of our findings. Second, we applied two-pollutant models to examine whether the significant results from single-pollutant models were robust after controlling for other pollutants in the basic model (Chen et al. 2018; Phosri et al., 2019).

All analyses in this study were conducted using the "mgcv" package (version 1.8–28) in R statistical software (version 3.5.2). The statistical tests were two-sided, and $p < 0.05$ was considered statistically significant. Effect estimates were showed as percentage change (%) in daily COVID-19 confirmed cases per unit increase in pollutant concentration (i.e., 10 μg/m^3 increase in $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3 or 1 mg/m^3 increase in CO).

3. Results

3.1. Descriptive analysis

Table 1 shows the statistics for daily COVID-19 confirmed cases, concentration of air pollution, and meteorological variables. During the observation period, this study included over 58,000 cases with an average of 12.94. Average daily concentrations of $PM_{2.5}$, PM_{10}, SO_2, CO, NO_2 and O_3 were 46.43 μg/m^3, 62.97 μg/m^3, 12.23 μg/m^3, 0.85 mg/m^3, 19.28 μg/m^3 and 78.22 μg/m^3, respectively. The average of daily mean temperature, relative humidity, air pressure and wind speed were 2.82 °C, 67.25%, 964.08 hPa and 2.11 m/s, respectively.

Table 2 presents the spearman correlation coefficients between air pollutants and meteorological variables. Air pollutants had significant correlations with each other and all of them were correlated with mean temperature and relative humidity. SO_2, CO and O_3 were negatively correlated with air pressure, while $PM_{2.5}$ and NO_2 had positive correlations with air pressure. All of these air pollutants were significantly correlated with wind speed except for SO_2.

3.2. Relationship between air pollution and COVID-19 confirmed cases

Fig. 2 plots the moving average lag effects (lag0–7, lag0–14, lag0–21) of different air pollutants on daily confirmed cases of COVID-19 in single-pollutant models. We observed significantly positive associations of $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3 with COVID-19 confirmed cases. For example, a 10-μg/m^3 increase (lag0–14) in $PM_{2.5}$, PM_{10}, NO_2, O_3 and 1-mg/m^3 increase in CO (lag0–21) was associated with a 2.24% (95% CI: 1.02 to 3.46), 1.76% (95% CI: 0.89 to 2.63), 6.94% (95% CI: 2.38 to 11.51), 4.76% (95% CI: 1.99 to 7.52) and 15.11% (95% CI: 0.44 to 29.77) increase in the daily counts of COVID-19 confirmed cases, respectively. However, SO_2 was negatively associated with COVID-19 confirmed cases at

Table 2
Spearman correlation coefficients between air pollutants and meteorological variables across all cities and days.

	$PM_{2.5}$	PM_{10}	SO_2	CO	NO_2	O_3	Mean temperature	Relative humidity	Air pressure	Wind speed
$PM_{2.5}$	1.00									
PM_{10}	0.91*	1.00								
SO_2	0.37*	0.45*	1.00							
CO	0.69*	0.62*	0.39*	1.00						
NO_2	0.64*	0.65*	0.52*	0.63*	1.00					
O_3	0.13*	0.19*	0.11*	−0.04*	0.08*	1.00				
Mean temperature	−0.13*	−0.17*	−0.52*	−0.09*	−0.18*	0.08*	1.00			
Relative humidity	0.08*	−0.08*	−0.41*	0.12*	−0.07*	−0.40*	0.34*	1.00		
Air pressure	0.07*	0.02	−0.21*	−0.04*	0.04*	−0.04*	0.15*	0.27*	1.00	
Wind speed	−0.21*	−0.13*	−0.03	−0.22*	−0.22*	0.04*	−0.07*	−0.13*	0.12*	1.00

* $p < 0.05$.

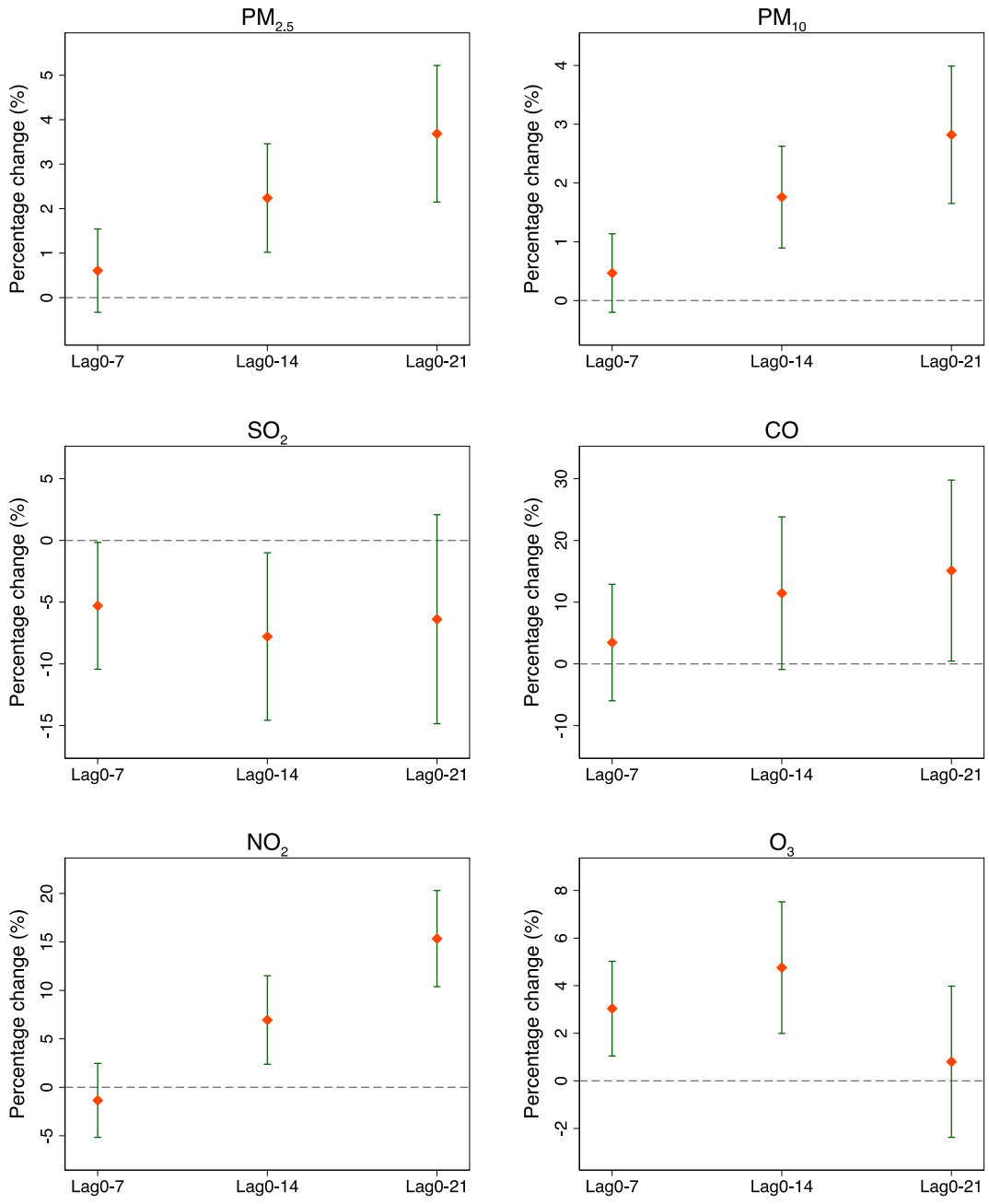

Fig. 2. Percentage change (%) and 95% CI of daily COVID-19 confirmed cases associated with a unit increase in pollutant concentration using single-pollutant models. Units are 10 μg/m^3 increase in $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3 and 1 mg/m^3 in CO.

lag0–7 (percentage change = −5.30%, 95% CI: −10.44 to −0.16) and lag0–14 (percentage change = −7.79%, 95% CI: −14.57 to −1.01).

3.3. Sensitivity analysis

In the first sensitivity analysis, the relationship between COVID-19 confirmed cases and air pollution was robust after excluding Wuhan from our data (Fig. 3). Fig. 4 shows the results of two-pollutant models. For $PM_{2.5}$ and PM_{10}, the effects on COVID-19 confirmed cases became insignificant only when controlling for NO_2. For SO_2, the association could not remain significant after adding NO_2 or O_3 into the model. For CO, its effect was robust only when SO_2 or O_3 was included in the model. For NO_2, the effect estimate did not alter much after the inclusion of SO_2, CO or O_3. The association of O_3 with daily confirmed cases of COVID-19 remained robust after adjustment for other air pollutants.

4. Discussion

In this paper, we used a generalized additive model to explore the relationship between ambient air pollutants and daily COVID-19 confirmed cases. We found significantly positive associations of $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3 with COVID-19 confirmed cases, while SO_2 was negatively associated with the number of daily confirmed cases. These findings could provide evidence that air pollution is an important factor in COVID-19 infection.

As demonstrated by previous literature, air pollution is also closely related to respiratory infection caused by other microorganisms (Chauhan and Johnston, 2003; Ciencewicki and Jaspers, 2007; Mehta et al., 2013). So, we compared our main findings with previous studies to find similarities and differences. Horne et al. (2018) reported that short-term exposure to higher $PM_{2.5}$ was associated with more

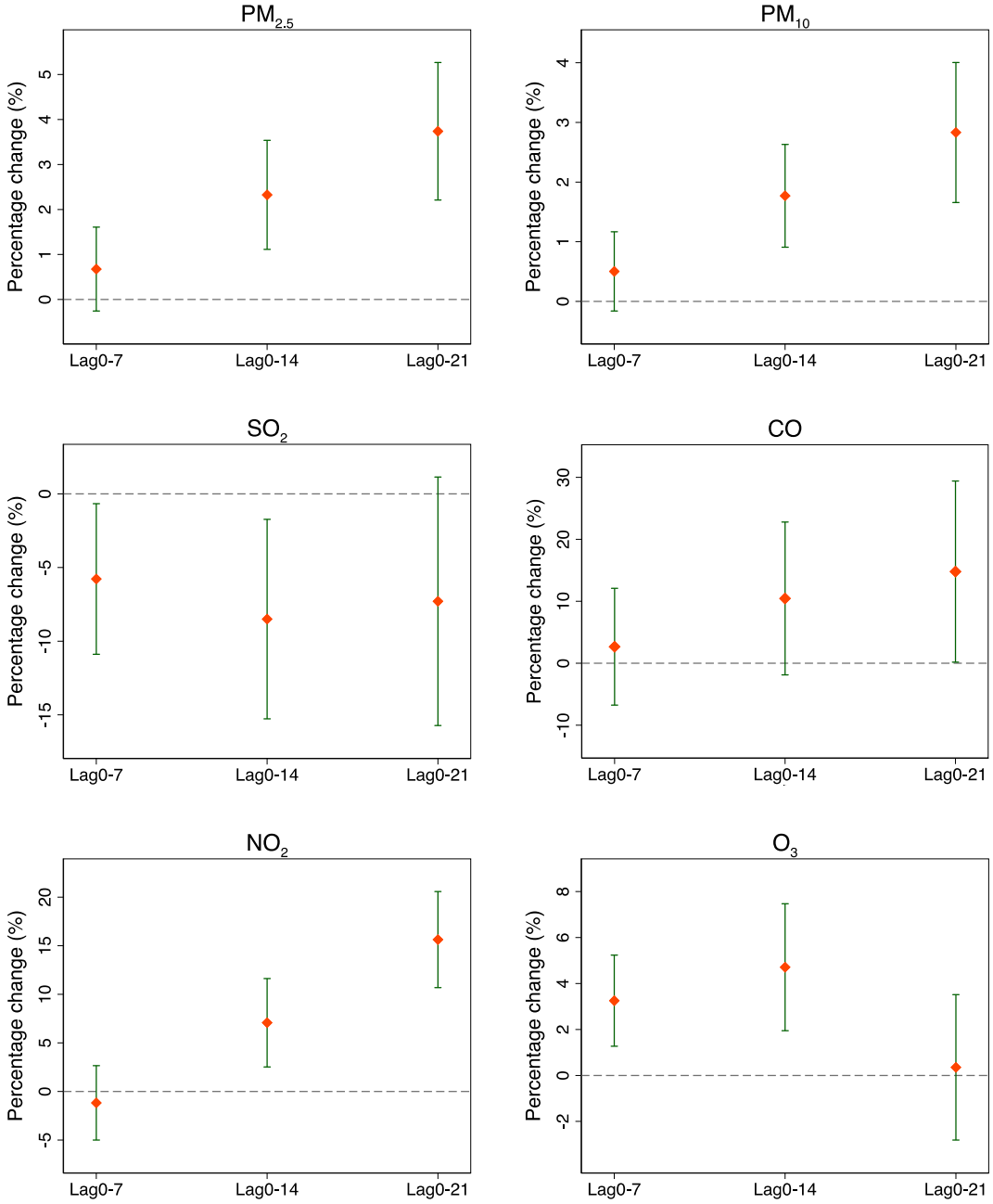

Fig. 3. Percentage change (%) and 95% CI of daily COVID-19 confirmed cases associated with a unit increase in pollutant concentration using single-pollutant models after excluding Wuhan. Units are 10 μg/m^3 increase in $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3 and 1 mg/m^3 in CO.

healthcare encounters for acute lower respiratory infection by a case-crossover design. Xie et al. (2019) also found a significant association of atmospheric particulate matter ($PM_{2.5}$ and PM_{10},) and hospitalizations for respiratory disease using a distributed lag nonlinear model. A time-series analysis conducted in Thailand observed that PM_{10}, SO_2, CO, NO_2 and O_3 were significantly related to increased risk of respiratory hospital admissions (Phosri et al., 2019). A literature review also showed that exposure to SO_2, CO and NO_2 was harmful to our health and increased the risk of respiratory disease (Chen et al., 2007). Overall, all of the six air pollutants could be risk factors in respiratory infection. However, our results are different from previous studies since we observed a negative relationship between SO_2 and COVID-19 confirmed cases. The virucidal property of SO_2 may be a possible reason (Berendt et al., 1971, 1972), and additional research is needed to determine the biological mechanisms behind this phenomenon.

Our study has some implications for the control and prevention of COVID-19. First, governments and the public should pay more attention to regions with high concentrations of $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3, since these regions may suffer more serious COVID-19 epidemic. In other words, reducing air pollutants (not include SO_2) could be a useful way to control COVID-19 infection. Additionally, it is noteworthy that SO_2 has a negative association with COVID-19 confirmed cases, and further laboratory research needs to be conducted to elucidate the underlying mechanism.

Our study has several limitations. First, we only focused on the association between air pollutants and COVID-19 confirmed cases and not the causal effect of air pollution on COVID-19 infection. Second, our data did not include gender- or age-specific confirmed cases, so we could not conduct subgroup analyses. Third, our findings were not globally representative since cities of other countries

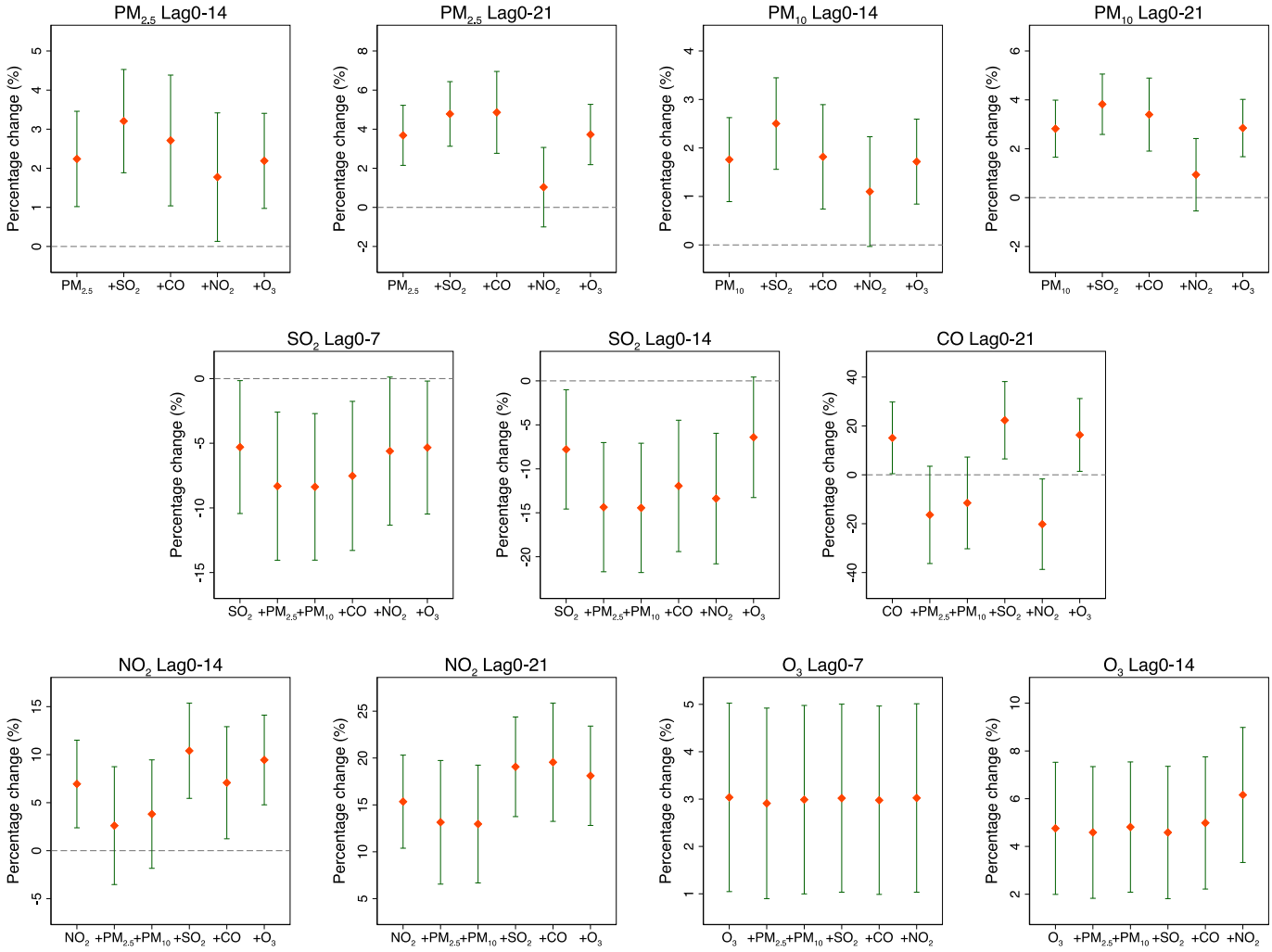

Fig. 4. Percentage change (%) and 95% CI of daily COVID-19 confirmed cases associated with a unit increase in pollutant concentration using single and two-pollutant models. Units are 10 μg/m^3 increase in $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3 and 1 mg/m^3 in CO.

were not included in this study. Future studies are needed to overcome these limitations.

5. Conclusion

Our study suggests that there is a statistically significant relationship between air pollution and COVID-19 infection. Short-term exposure to higher concentrations of $PM_{2.5}$, PM_{10}, CO, NO_2 and O_3 is associated with an increased risk of COVID-19 infection. However, short-term exposure to a higher concentration of SO_2 is related to the decreased risk of COVID-19 infection. Further laboratory studies are needed to explore the underlying mechanisms.

CRediT authorship contribution statement

Yongjian Zhu: Data curation, Writing - original draft, Visualization, Investigation. **Jingui Xie:** Conceptualization, Methodology, Supervision. **Fengming Huang:** Validation, Investigation. **Liqing Cao:** Validation, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Association between long-term exposure to particulate air pollution with SARS-CoV-2 infections and COVID-19 deaths in California, U.S.A.

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ABSTRACT

Previous studies have reported associations between air pollution and COVID-19 morbidity and mortality, but most have limited their exposure assessment to a large area, have not used individual-level variables, nor studied infections. We examined 3.1 million SARS-CoV-2 infections and 49,691 COVID-19 deaths that occurred in California from February 2020 to February 2021 to evaluate risks associated with long-term neighborhood concentrations of particulate matter less than 2.5 μm in diameter ($PM_{2.5}$). We obtained individual address data on SARS-CoV-2 infections and COVID-19 deaths and assigned 2000-2018 1km-1km gridded $PM_{2.5}$ surfaces to census block groups. We included individual covariate data on age and sex, and census block data on race/ethnicity, air basin, Area Deprivation Index, and relevant comorbidities. Our analyses were based on generalized linear mixed models utilizing a Poisson distribution. Those living in the highest quintile of long-term $PM_{2.5}$ exposure had risks of SARS-CoV-2 infections 20% higher and risks of COVID-19 mortality 51% higher, compared to those living in the lowest quintile of long-term $PM_{2.5}$ exposure. Those living in the areas of highest long-term $PM_{2.5}$ exposure were more likely to be Hispanic and more vulnerable, based on the Area Deprivation Index. The increased risks for SARS-CoV-2 Infections and COVID-19 mortality associated with highest long-term $PM_{2.5}$ concentrations at the neighborhood-level in California were consistent with a growing body of literature from studies worldwide, and further highlight the importance of reducing levels of air pollution to protect public health.

1. Introduction

The United States has the most reported infections and deaths from severe acute respiratory distress syndrome due to coronavirus-2 (SARS-CoV-2) infection disease 2019 (COVID-19) in the world. California, the nation's most populous state, has the most infections and deaths of any state in the U.S., with approximately 8.5 million infections and 89,000 deaths as of 5/1/2022 (California Department of Public Health 2022). Among counties in the U.S., California has counties with some of the largest percentage of days exceeding national standards for particulate matter of aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) (e.g. in 2020, Fresno County had 18.6% of days annually which were over the national standard for $PM_{2.5}$)('National Environmental Public Health Tracking Network' 2022). According to the California Air Resources Board, air monitoring data show that over 90% of Californians are breathing unhealthy concentrations of one or more pollutants during some part of the year, indicating that pollution concentrations continue to be an important public health concern (California Air Resources Board 2021b).

Multiple studies in the U.S. and globally have investigated the association between long-term exposure to air pollution, primarily particulate matter (PM), and COVID-19 morbidity and mortality (Zang et al. 2022; Berg et al., 2021; Wu et al. 2020; Liang et al. 2020; Garcia et al. 2021; Cole, Ozgen, and Strobl 2020; Konstantinoudis et al. 2021; Coker et al. 2020). In one of the earliest studies in the U.S., the impact of long-term mean $PM_{2.5}$ exposure on SARS-CoV-2 infections was investigated (Wu et al. 2020). The authors used areal counts of COVID-19 deaths and controlled for areal confounders in an ecological regression

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analysis. They found that an increase of 1 μg/m^3 in long-term mean $PM_{2.5}$ was associated with an 11% increase in a county's COVID-19 mortality rate. Most of the earlier studies done in the U.S. and worldwide were ecological in nature, and were the subject of a recent review by Marques and Domingo (Marques and Domingo 2022). The deficiencies in these studies, in addition to the risk of finding spurious relationships in ecological studies, have been highlighted by Villenueve and Goldberg (2020). These deficiencies include the lack of individual data and misclassification of exposure by assigning the same mean air pollution concentrations to large areas. Kogevinas et al. (2021) used individual level data in a cohort study in Spain and found that air pollution exposure was associated with level of antibody response and severity of COVID-19 disease (defined by hospital admission, positive diagnostic tests, or a combination of contact history and symptoms), but not serologically confirmed SARS-Cov-2 infection. Mendy et al. used individual data from University of Cincinnati hospitals and clinics and linked long-term $PM_{2.5}$ exposure estimates to the ZIP code of residence (Mendy et al. 2021). They found a 62% higher risk of hospitalization in COVID-19 patients with 1 μg/m^3 increment in 10-year mean $PM_{2.5}$, but only in patients with pre-existing asthma or coronary obstructive pulmonary disease.

In this study, we aim to address some of the limitations in the previous literature in a California dataset by using individual address-level data to analyze SARS-CoV-2 infection and COVID-19 death counts by age group and sex, and by assigning local high resolution pollution exposure values to census block groups to reduce exposure misclassification. We focused on fine particulate matter ($PM_{2.5}$) as there are large differences in population exposure to $PM_{2.5}$ by geographic region in California and because of the availability of geographically-detailed historically modeled concentrations of this pollutant. This is the first study to focus on California statewide using individual-level patient data and highly localized exposure estimates to investigate the effect of long-term $PM_{2.5}$ exposure on both COVID-19 mortality and SARS-Cov-2 infections.

2. Methods

2.1. SARS-CoV-2 infection and COVID-19 death data

We obtained individual SARS-CoV-2 infection data and COVID-19 death data for age, sex, date of diagnosis/death, and residential street address from the California Department of Public Health (CDPH) for all infections and deaths from February 21, 2020 through February 21, 2021, resulting in a total of 3,508,518 infections and 49,691 deaths. The time period was chosen because there were very few cases reported before 2/21/20, and was ended by 2/21/21 to reduce the probability of widespread availability of vaccination confounding the study results and to diminish the effects of emerging variants. The addresses of the infections and deaths were geocoded and aggregated by census block group. Infections and deaths are those reported to the CDPH California Reportable Disease Information Exchange (CalREDIE) surveillance system by local health departments. Infections are reported based on positive SARS-CoV-2 tests, which may have been dependent on local testing rates. The data file received from CDPH's CalREDIE contained 3,560,222 records; this included all records from the onset of the pandemic through February 21, 2021. There were 231,164 records (6.5%) that were not geocoded. We reprocessed any ungeocoded records by manually editing any special characters in the address; compiling addresses that occurred in multiple frequencies; manually searching for and correcting batch addresses using multiple matching variables from the dataset; and re-geocoding records using corrected addresses. Using this process, we were able to assign geographic coordinates to an additional 179,460 records. In total, 98.5% of records (n=3,508,518) were successfully geocoded.

Once corrected addresses were re-geocoded, final data exclusions were made. We excluded records if they were missing information on sex (n=53,058), age (n=2,923), geocoded address (n=51,704), or if cases were coded as 'probable' (n=113,611), as there was no description as to how 'probable' was defined. In addition, 164 cases were geocoded, but could not be assigned to a California block group. Finally, we limited the data to a single year of cases and excluded any records with a date of diagnosis occurring before or after February 21, 2020 through February 21, 2021.

The State of California Health and Human Services Agency Committee for the Protection of Human Subjects approved the project following IRB approvals from the researchers' respective institutions (University of California San Francisco, Public Health Institute).

2.2. Particulate matter and temperature data

We obtained modeled $PM_{2.5}$ concentration data from the Washington University Atmospheric Concentration Analysis Group at a 1 km-1 km grid resolution (Atmospheric Composition Analysis Group 2021; van Donkelaar et al. 2019). These surfaces use a chemical transport model and satellite observations combined with ground-based observations to model $PM_{2.5}$ concentrations with high accuracy and detail. For the period 2000-2016, average cross-validated agreement after statistical fusion of the model over North America for total $PM_{2.5}$ mass (derived vs. in situ) was R^2=0.7 (van Donkelaar et al. 2019). As mentioned above, the COVID-19 morbidity and mortality data are from 2020-2021. As for this study we wanted to characterize previous long-term exposure to $PM_{2.5}$, we used the mean concentrations from the model for 2000-2018 (modeled data available). We averaged $PM_{2.5}$ grid values across years of modeled data (2000-2018) and aggregated this output to block groups using an area-weighted mean. The year 2018 was the most recent year of validated model data available. We assigned all census block groups to one of 15 California air basins defined by the California Air Resources Board according to their similar meteorological and geographic conditions (California Air Resources Board 2021a). As air temperature could be a possible confounder between COVID-19 transmission and air pollution exposure, and for consistency with previous investigations on COVID-19 and air pollution that included temperature as a potential confounder (Berg, et al. 2021; Wu et al. 2020), we allocated 4km- 4km gridded meteorological surfaces for daily mean summer temperature (degrees Celsius) to block groups (modeled data were averaged when a block group intersected with multiple grids) (Abatzoglou 2013). The data cover 100% of California's populated block groups.

2.3. Demographic and health data

We obtained population estimates by age and sex at the census block group level from the U.S. Census Bureau 2015-19 American Community Survey (United States Census Bureau). Block groups are subdivisions of census tracts and generally represent neighborhoods with between 600 and 3000 people. We obtained information on the percentage of the population of each block group for the following categories: Hispanic, non-Hispanic Black, and Non-Hispanic Asian. We used data on population density as measured by population per square mile.

For a block-group level socioeconomic measure we used the Area Deprivation Index (ADI) which is based on census data from the American Community Survey from 2015-2019 (Kind and Buckingham 2018; University of Wisconsin School of Medicine Public and Health 2019) .The ADI incorporates 17 factors at the block group level, including education, median family income, income disparity, families below poverty level, unemployment, and household crowding. The ADI was computed into statewide deciles, 1-10, where 1 represents the least disadvantaged neighborhoods and 10 the most disadvantaged neighborhoods.

Comorbidity information was drawn from California's Office of Statewide Health Planning and Development (OSHPD) hospital discharge database (Office of Statewide Health Planning and Development 2022) for hospitalizations in 2017-2019 with any ICD-10 code

diagnosis of asthma, chronic obstructive pulmonary disease (COPD), heart failure, coronary artery disease, or cardiomyopathy. Prevalence estimates for adult obesity, diabetes, and smoking were obtained from the 2018 California Health Interview Survey (CHIS)(California Health Interview Survey 2018). We aggregated these data by ZIP code, calculated age-adjusted rates per 10,000, adjusted to the 2000 U.S. census standard population (Centers for Disease Control and Prevention 2001) for each risk factor independently, and assigned them to census block groups using the U.S. Department of Housing and Urban Development's ZIP code-to-census tract crosswalk file (Office of Policy Development and Research 2012). The observed ZIP code prevalence or rate was assigned equally to all block groups associated with that respective ZIP code. Hospitalization rates were suppressed for a ZIP code when counts were <12. CHIS ZIP code level prevalence estimates were suppressed when the ZIP code population was less than 1,000 or the estimate was unstable based on a coefficient of variance ≥0.30.

Due to numerous large COVID-19 outbreaks among incarcerated populations, we excluded 275 block groups with a prison, jail, or detention center. We excluded an additional 1,392 block groups that were missing information for any of the covariates which included population percentages by race/ethnicity, ADI, summer temperature, obesity, diabetes, smoking, and hospitalization rates for asthma, chronic obstructive pulmonary disease (COPD), heart failure, coronary artery disease, and cardiomyopathy. Deaths from those under age 20 (N=73) were excluded in our primary analyses. The final number of block groups included in our analyses was 21,545 which was 93% of the total block groups (N=23,212) in California.

2.4. Statistical methods

To leverage the combination of individual-level age, gender, and home address data, census block group $PM_{2.5}$ modeled concentrations, we employed a mixed effects Poisson multivariable modeling approach (Zou 2004). This model, which contains both fixed and random effects, was used to estimate risk of SARS-CoV-2 infections and COVID-19 deaths with long-term $PM_{2.5}$ exposure. All models included a random intercept for block group to account for correlation of the responses across age and sex groups within the block group and to account for overdispersion. The outcome variables in each block group were counts by sex and 5-year age-group of SARS-CoV-2 infections and COVID-19 deaths. To account for the denominator we used an offset term of the log of the sex and age group population estimates for that block group. The primary predictor variable in each model was the estimated $PM_{2.5}$ exposure measured at the block group level. We modeled this both as a continuous linear predictor and by categorical quintiles for the primary result. We report risk ratios and 95% confidence intervals (CI) per additional 1 $\mu g/m^3$ of $PM_{2.5}$ (for the linear model) and for each quintile compared to the lowest quintile (for the categorical model). Covariates at the block group level included percent population Hispanic, non-Hispanic Black, and Asian, Area Deprivation Index decile, log-transformed population density, and mean summer temperature. Additional models were run controlling for block-group level measures of the eight comorbidities described above. Using a negative binomial distribution did not result in improved fit and did not attenuate model parameters of $PM_{2.5}$ (estimates were same or slightly larger) (not shown). To address residual spatial autocorrelation, we employed a range of approaches. We included air basins in the model, however due to the small number of events in less-populated areas, some adjacent air basins were combined as necessary (e.g., Lake Tahoe and Mountain Counties air basins were combined). Other approaches to adjusting for spatial autocorrelation included the addition of either census tract or county-level effects to the model. All models were run using the glimmix procedure in SAS version 9.4.

3. Results

3,139,804 SARS-CoV-2 infections and 49,691 COVID-19 deaths were included in this analysis (Table 1). Among the infections, there were slightly more females than males, although the opposite was observed for deaths, where males were the majority. Those under age 40 years comprised 56% of the infections but only 3% of deaths. Those aged 60 years and older made up only 16% of the total infections but 83% of total deaths. South Coast air basin residents comprised over 53% of the infections and 59% of COVID-19 deaths (Table 2). Residents in the more economically deprived areas of the state, based on the ADI, comprised higher proportions of infections and deaths than their percentage in the population (Table 2).

The long-term modeled mean $PM_{2.5}$ at the block group level in California for the years 2000 through 2018 was 12.0 $\mu g/m^3$ with a range of 2.2 $\mu g/m^3$ to 18.8 $\mu g/m^3$ and an interquartile range of 5.3 $\mu g/m^3$. Figure 1 shows a map of California with the long-term (2000-2018) mean estimates of $PM_{2.5}$ at the block group with the air basins outlined. The mean estimated concentrations of $PM_{2.5}$ varied greatly among the 15 air basins (Figure 2). The heavily populated South Coast air basin, which includes Los Angeles, had the highest mean value of 15.2 $\mu g/m^3$. The lowest median concentrations were seen in the less populated northern parts of the State with the lowest in the Lake County air basin at 4.9 $\mu g/m^3$. This area is predominantly rural and has lower $PM_{2.5}$ compared to the South Coast region due to low population density and as a result, less traffic and transportation sources. On average, the neighborhoods with the highest concentrations of $PM_{2.5}$ (based on statewide quintiles) had a much higher proportion of the population that is Hispanic (59%) compared to the neighborhoods with the lowest concentrations (21%). The neighborhoods with the highest proportions of Hispanic residents are concentrated in the highly urban areas of the South Coast air basin and in the San Joaquin Valley air basin, areas with high concentrations of $PM_{2.5}$ pollution. There are also some disparities for the ADI, which was 6.5 on average in areas with the highest $PM_{2.5}$ compared to 4.7 in the lowest $PM_{2.5}$ areas.

The areas of the State with the highest quartile of percentage Hispanic population had a long-term $PM_{2.5}$ mean of 14.7 $\mu g/m^3$, compared to 10.7 $\mu g/m^3$ in the areas with the lowest quartile of percentage Hispanic population. In areas with larger percentage non-Hispanic Black population, the comparison of long-term $PM_{2.5}$ means in the highest to lowest quartiles was 13.2 to 12.1 $\mu g/m^3$. The most vulnerable areas (the top decile of the ADI) had a long-term mean of 13.3 $\mu g/m^3$ compared to a mean of 10.9 $\mu g/m^3$ in the least vulnerable areas of the State (bottom decile).

We examined risk estimates for SARS-CoV-2 infections and COVID-19 deaths for the key covariates of interest, only adjusted for age group and sex (Table 3). As observed in prior studies, risks of COVID-19

Table 1
Distribution of SARS-CoV-2 infections, COVID-19 deaths and population, California, February 2020 – February 2021.

POPULATION GROUP	INFECTIONS		DEATHS		POPULATION ESTIMATE	
	N	%	N	%	N	%
TOTAL	3,139,804		49,691		36,792,302	
BY AGE GROUP IN YEARS:						
<20	518,739	17%	73	0%	9,470,527	26%
20-29	644,098	21%	327	1%	5,340,891	15%
30-39	558,278	18%	890	2%	5,203,110	14%
40-49	481,492	15%	2,071	4%	4,797,227	13%
50-59	436,777	14%	4,994	10%	4,716,174	13%
60-69	277,183	9%	9,487	19%	3,811,427	10%
70-79	131,474	4%	11,600	23%	2,152,015	6%
80+	91,763	3%	20,249	41%	1,300,931	4%
BY SEX:						
FEMALE	1,650,088	53%	21,052	42%	18,614,859	51%
MALE	1,489,716	47%	28,639	58%	18,177,443	49%

Table 2
Distribution of SARS-CoV-2 infections, COVID-19 deaths and population by characteristics assigned by census block groups, California, February 2020 – February 2021.

	Infections		Deaths		Population	
	N	%	N	%	N	%
Air basin						
Great Basin Valley	1,625	0.1%	21	0.0%	20,948	0.1%
Lake County	2,538	0.1%	28	0.1%	54,203	0.1%
Lake Tahoe	2,294	0.1%	6	0.0%	34,665	0.1%
Mojave Desert	112,148	3.6%	1,334	2.7%	968,914	2.6%
Mountain Counties	11,441	0.4%	186	0.4%	288,750	0.8%
North Central Coast	56,120	1.8%	541	1.1%	723,432	2.0%
North Coast	7,822	0.2%	89	0.2%	236,815	0.6%
Northeast Plateau	1,675	0.1%	4	0.0%	33,588	0.1%
Sacramento Valley	155,015	4.9%	2,351	4.7%	2,661,006	7.2%
Salton Sea	67,205	2.1%	1,335	2.7%	582,010	1.6%
San Diego County	226,868	7.2%	2,890	5.8%	3,028,002	8.2%
San Francisco Bay	356,497	11.4%	4,669	9.4%	6,993,131	19.0%
San Joaquin Valley	359,133	11.4%	5,623	11.3%	3,881,421	10.5%
South Central Coast	114,171	3.6%	1,419	2.9%	1,453,231	3.9%
South Coast	1,665,252	53.0%	29,195	58.8%	15,832,186	43.0%
Area Deprivation Index decile						
Least deprived 1	86215	3%	1594	3%	2835582	8%
2	157422	5%	2972	6%	3562476	10%
3	200869	6%	3493	7%	3559179	10%
4	272693	9%	4817	10%	3649276	10%
5	345687	11%	5753	12%	3941132	11%
6	396039	13%	6299	13%	3943297	11%
7	454488	14%	6568	13%	3964592	11%
8	449301	14%	6388	13%	3969987	11%
9	403962	13%	5667	11%	3825716	10%
Most deprived 10	373128	12%	6140	12%	3541065	10%
Percent Population Hispanic						
>58%	1401393	45%	20106	40%	10197116	28%
30-58%	910176	29%	14169	29%	9982257	27%
13-29%	529866	17%	9558	19%	9041521	25%
<13%	298369	10%	5858	12%	7571408	21%
Percent Population non-Hispanic Black						
>6%	962003	31%	14847	30%	10002825	27%
1.7-6%	855767	27%	13966	28%	10062627	27%
1-1.6%	591980	19%	9973	20%	7479861	20%
<1%	730054	23%	10905	22%	9246989	25%
Percent Population non-Hispanic Asian						
>17%	666643	21%	12051	24%	10273530	28%
7-17%	794848	25%	12867	26%	9736364	26%
2-6%	809933	26%	12213	25%	8910404	24%
<2%	842491	27%	12175	25%	7585481	21%

morbidity and mortality were highest in the neighborhoods with the highest percentage of Hispanic and non-Hispanic Black populations, and in those with greater measures of deprivation. Areas with high non-Hispanic Asian populations had lower risks than areas with high percentages of Hispanics and non-Hispanic Black populations. Areas with the highest population density (> 12,055 people per square mile) and highest mean summer air temperatures (≥24.7 C°) had higher risks of morbidity and mortality (e.g. highest population density vs. lowest < 3,233 people per square mile) was 1.40 and highest mean summer air temperatures vs. lowest (<21.0 C°) was 2.31 (Table 3). Places with higher obesity, smoking, and diabetes prevalence, and higher chronic obstructive pulmonary disease hospitalization rates, had higher infection and death risks as well (data not shown).

The estimated risk statewide for SARS-CoV-2 infections associated with a 1 μg/m^3 increase in the $PM_{2.5}$ long-term exposure (2000-2018) was 1.039 (95% CI 1.035, 1.043) in the model adjusted for the main covariates, which included age group, percent population Hispanic, percent population non-Hispanic Black, percent population non-Hispanic Asian, air basin, population density, mean summer temperature and ADI (Table 4). When the model also included the comorbidities (obesity, smoking, diabetes, asthma, and heart diseases), the risk was slightly attenuated but still statistically significant at 1.036 (95% CI 1.032, 1.040). The risk estimate for infections was 1.21 per interquartile range (IQR) (not shown). We re-ran the models using death counts by age group and sex. In the model adjusted for the main covariates the estimated risk of death for the $PM_{2.5}$ long-term exposure was 1.041 per 1 μg/m^3 (95% CI 1.029, 1.052) (Table 4). When the additional comorbidity conditions were added into the model the risk was similar at 1.038 (95% CI 1.027, 1.050); this mortality risk estimate translates to 1.22 per IQR.

We subsequently calculated risks for $PM_{2.5}$ long-term exposure by statewide quintiles (Table 4). The areas with $PM_{2.5}$ means in the highest and second highest quintile were only found in the South Coast and San Joaquin Valley air basins. In models adjusted for the main covariates previously described, the risk estimate for SARS-CoV-2 infections in the highest quintile of $PM_{2.5}$ compared to the lowest quintile of $PM_{2.5}$ was 1.27 (95% CI 1.23, 1.31). When the comorbidities were added to the model the risk estimate was 1.20 (95% CI 1.17, 1.24). For deaths, the risk estimate was higher than for infections at 1.56 (95% 1.43, 1.71) when adjusted for the main covariates. When the comorbidities were included in the model, the risk estimate for deaths was 1.51 (95% CI 1.38, 1.65) for the highest quintile compared to the lowest. The COVID-19 morbidity and mortality risk estimates for $PM_{2.5}$ were similar across ADI levels (Supplemental Table 1). All analyses were repeated with just the most recent available year (2018) of statewide $PM_{2.5}$ modeled data, and the results did not differ from those using the long-term means (data not shown).

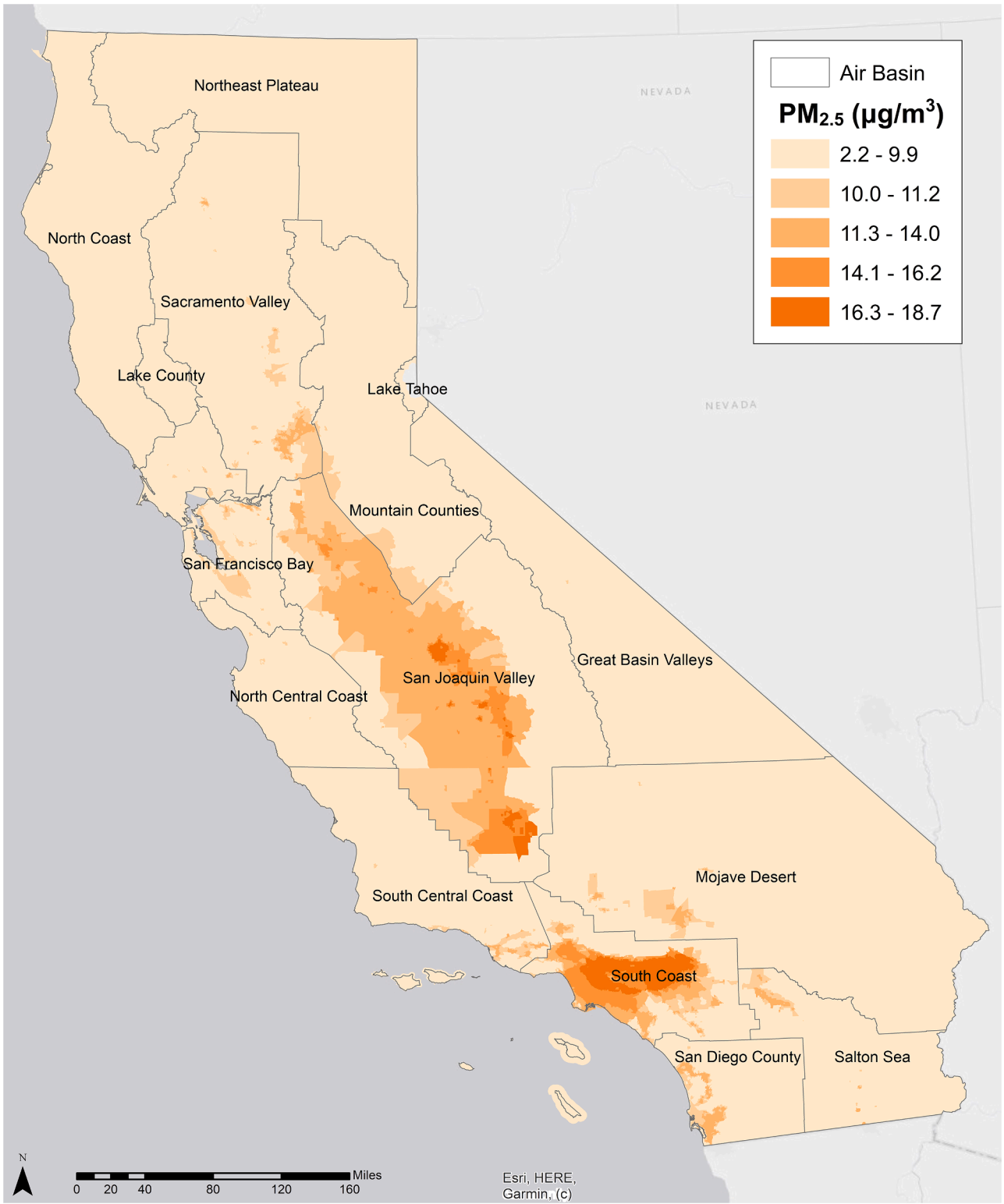

Fig. 1. Long-term (2000-2018) mean estimates of PM2.5 at the census block group level.

4. Discussion and conclusion

In this study we found that those living in the highest quintile of long-term $PM_{2.5}$ exposure in California (16.2-18.8 $\mu g/m^3$) had risks of SARS-CoV-2 infections 20% higher and risk of COVID-19 mortality 51% higher, than those living in the lowest quintile of long-term $PM_{2.5}$ exposure, after adjusting for covariates including comorbidities. Each 1 $\mu g/m^3$ of long-term $PM_{2.5}$ exposure was associated with a 4% increase in SARS-CoV-2 infection risk and COVID-19 mortality risk, after adjustment for covariates.

This is the first large population-based study to assess the relationship between long-term mean $PM_{2.5}$ air pollution concentrations and COVID-19 infections and mortality at a local geographic resolution of neighborhood (block group) with individual counts by age and sex for

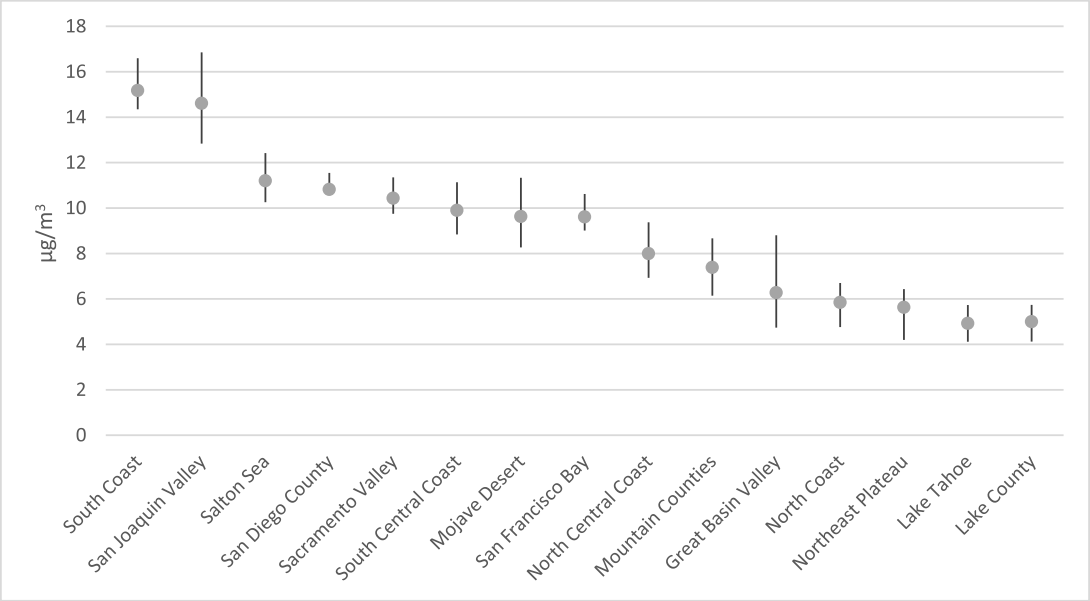

Fig. 2.. Mean $PM_{2.5}$ (2000-2018) and Interquartile Range by Air Basin, California.

both infections and deaths. This statewide analysis included over 3 million SARS-CoV-2 infections and almost 50,000 COVID-19 deaths in a geographically and ethnically diverse population of 36 million people. The statewide scope of our study provided an opportunity to evaluate the COVID-19 and $PM_{2.5}$ relationship across a broad range of exposure concentrations, including the counties in the U.S. with the highest mean PM concentrations (American Lung Association 2021). A strength of our study is that it is unique among those published to date in our ability to assess the relationship between $PM_{2.5}$ concentrations at a small neighborhood scale with individual infection information on SARS-CoV-2 infections. Risk associations for mortality were higher than those for infections.

There are now over 20 ecologic studies that have examined the relationship between $PM_{2.5}$ and COVID-19 mortality, half of which have been conducted in the United States. Early in the pandemic Wu et al. conducted an ecological regression analysis based on data at the county level in the United States (Wu et al. 2020). They found that an increase of 1 $\mu g/m^3$ in the long-term mean of $PM_{2.5}$ was associated with a statistically significant 11% (95% CI, 6 - 17%) increase in the COVID-19 mortality rate. Similarly, an early ecologic study conducted in Italy found that an increase of 1 $\mu g/m^3$ in the long-term mean $PM_{2.5}$ concentration ($\mu g/m^3$) was associated with a 9% (95% CI: 6–12%) increase in COVID-19 related mortality (Coker et al. 2020). Additional analyses have similarly reported increases in COVID-19 mortality associated with $PM_{2.5,}$ including studies conducted in the United States (Berg et al., 2021; Garcia et al. 2021; Liang et al. 2020; Kim and Bell 2021) and internationally (Konstantinoudis et al. 2021; Cole, Ozgen, and Strobl 2020; Yao et al. 2020; Dales et al. 2021; Valdes Salgado et al. 2021; Tian et al. 2021; Rodriguez-Villamizar et al. 2021; Elliott et al. 2021; Bray, Gibson, and White 2020; Tchicaya et al. 2021; Dettori et al. 2021; Lopez-Feldman, et al. 2021), as well as a recent meta-analysis (Zang et al. 2022). Only a few studies have reported no association (Millett et al. 2020; Adhikari and Yin 2020; Rodriguez-Villamizar et al. 2021; Elliott et al. 2021; Kim and Bell 2021). In California, Garcia et al. analyzed COVID-19 mortality at the census tract level during the first year of the pandemic, and found an adjusted rate ratio of 1.13 per standard deviation increase for $PM_{2.5}$ during the spring and summer months and an adjusted rate ratio of 1.06 per standard deviation increase during the winter (Garcia et al. 2021). Our study found a somewhat lower increase of 4%, but our findings are overall consistent with the other studies, and the greater geographic precision of our analysis and more comprehensive analysis of covariates may have generated a more reliable estimate.

Ambient air pollution exposures are known to have many adverse human health effects, including respiratory and cardiovascular disease, adverse reproductive outcomes, neurologic disease, and premature death (Guarnieri and Balmes 2014; An et al. 2018; Klepac et al. 2018; Calderon-Garciduenas et al. 2016). Approximately 140,000 total deaths per year were attributable to total outdoor air pollution exposure in the U.S. from 2000 to 2010 (Lelieveld et al. 2015). There is evidence for both short and long-term exposure of air pollution to increase SARS-CoV-2 infections (transmission) as well as COVID-19 severity and mortality (Ali et al. 2021; Woodby, Arnold, and Valacchi 2021). Chronic exposure to air pollution results in increases in all-cause, cardiovascular, and influenza mortality (Jiang, Mei, and Feng 2016; Pope et al. 2004). Air pollution induces oxidative stress and inflammation which damage the airway epithelium and can lead to both acute and chronic effects on obstructive airway diseases (Wong, Magun, and Wood 2016). Chronic air pollution exposure may also increase respiratory disease severity by increasing the prevalence of comorbidities associated with higher mortality and adversely affecting immune responses (Yan et al., 2020; Tsai et al., 2019; Ciencewicki and Jaspers, 2007).

There also is increasing evidence that air pollution exposure increases the severity and transmission of viral respiratory disease. In a recent review, Domingo and Rovira (2020) conclude that there is evidence to support an association between chronic exposure to air pollution and adverse effects on the respiratory system leading to increased severity of respiratory viral infections.

We had information on eight potentially important comorbidities at the neighborhood level, including obesity and diabetes prevalence as well as hospitalization rates for asthma and COPD. However, we found little change in our risk estimates when controlling for these comorbidities. This suggests that comorbidities may not act as an intervening variable between long-term $PM_{2.5}$ exposure and COVID-19 morbidity and mortality risk. Alternatively, the lack of change in risk estimates may reflect our inability to control for these comorbidities at an individual level.

There are several limitations to note with the type of ecologic analysis used in the present study. Although we had individual information on the age, sex, and address of every infection and death, we used census-based neighborhood-level population estimates and measures of demographic factors. Although we received what is considered a

Table 3
Risk estimates for SARS-CoV-2 infections and COVID-19 deaths for selected covariates, only adjusted for age group and sex.

	INFECTIONS	DEATHS
Air basin	Risk Estimate (95% CI)	Risk Estimate (95% CI)
Great Basin and Mojave Desert	2.29 (2.16, 2.43)	2.59 (2.31, 2.90)
Lake County	1.06 (0.87, 1.29)	0.63 (0.38, 1.05)
North Coast, North Plateau, Lake Tahoe, Mountains	0.87 (0.82, 0.93)	0.52 (0.44, 0.61)
North and South Central Coast	1.48 (1.42,1.54)	1.41 (1.29, 1.53)
Sacramento Valley and San Joaquin Valley	1.78 (1.73, 1.83)	2.21 (2.09, 2.35)
Salton Sea	2.51 (2.33, 2.70)	3.12 (2.74, 3.56)
San Diego County	1.57 (1.52, 1.63)	1.62 (1.50, 1.75)
San Francisco Bay	1.0	1.0
South Coast	2.21 (2.16, 2.27)	3.15 (2.99, 3.31)
Percent Population Hispanic, quartiles		
1 Highest quartile (≥58%)	3.78 (3.71, 3.86)	5.66 (5.40, 5.93)
2 (30-57%)	2.35 (2.31, 2.40)	2.86 (2.73, 3.00)
3 (13-29%)	1.48 (1.45, 1.51)	1.61 (1.53, 1.69)
4 Lowest quartile (<13%)	1.0	1.0
Percent Population non-Hispanic black, quartiles		
1 Highest quartile (≥6%)	1.36 (1.33, 1.40)	1.62 (1.55, 1.70)
2 (3-5%)	1.16 (1.13, 1.19)	1.26 (1.20, 1.32)
3 (1-2%)	1.06 (1.03, 1.09)	1.11 (1.06, 1.17)
4 Lowest quartile (<1%)	1.0	1.0
Percent Population non-Hispanic Asian quartiles		
1 Highest quartile (≥18%)	0.60 (0.58, 0.61)	0.56 (0.53, 0.59)
2 (7-17%)	0.75 (0.73, 0.77)	0.69 (0.66, 0.72)
3 (2-6%)	0.82 (0.80, 0.84)	0.71 (0.68, 0.75)
4 Lowest quartile (<2%)	1.0	1.0
Area Deprivation Index decile		
1 Least deprived	1.0	1.0
2	1.40 (1.35, 1.45)	1.52 (1.38, 1.66)
3	1.78 (1.72, 1.85)	1.94 (1.77, 2.12)
4	2.38 (2.30, 2.46)	2.73 (2.50, 2.98)
5	2.75 (2.66, 2.85)	3.43 (3.15, 3.74)
6	3.22 (3.11, 3.34)	4.02 (3.69, 4.38)
7	3.65 (3.52, 3.78)	4.73 (4.34, 5.15)
8	3.52 (3.40, 3.65)	4.81 (4.41, 5.23)
9	3.22 (3.11, 3.33)	4.10 (3.76, 4.46)
10 Most deprived	3.37 (3.26, 3.49)	5.07 (4.66, 5.53)
Population density quartile (people square mile)		
Highest 1 (≥12,055)	1.40 (1.36, 1.44)	2.48 (2.36, 2.60)
2 (7,000-12,054)	1.24 (1.21, 1.28)	1.71 (1.63, 1.80)
3 (3,233-6,999)	1.15 (1.12, 1.18)	1.38 (1.31, 1.45)
Lowest 4 (< 3,233)	1.0	1.0
Mean Summer air temperature quartiles (degrees C)		
Highest 1 (≥24.7 C°)	2.31 (2.26, 2.37)	2.91 (2.77, 3.07)
2 (23.2- 24.6 C°)	1.87 (1.83, 1.92)	2.42 (2.30, 2.55)
3 (21.0 - 23.1C°)	1.62 (1.59, 1.66)	2.05 (1.95, 2.16)
Lowest 4 (<21.0 C°)	1.0	1.0

Table 4
Risks estimates for long-term mean $PM_{2.5}$ concentrations (2000-2018) and SARS-CoV-2 infections and COVID-19 deaths, California, February 2020 – February 2021.

	Model: adjusted for main covariates*	Model: adjusted for main covariates* and comorbidities**
	Risk (95% CI)	Risk (95% CI)
INFECTIONS		
Per one unit, continuous	1.039 (1.035, 1.043)	1.036 (1.032, 1.040)
$PM_{2.5}$ quintiles		
$PM_{2.5}$ 16.2-18.8 μg/m^3 (highest quintile)	1.27 (1.23, 1.31)	1.20 (1.17, 1.24)
$PM_{2.5}$ 14.0-16.2 μg/m^3	1.31 (1.27, 1.35)	1.23 (1.20, 1.27)
$PM_{2.5}$ 11.2-14.0 μg/m^3	1.19 (1.16, 1.22)	1.16 (1.14, 1.19)
$PM_{2.5}$ 9.9-11.2 μg/m^3	1.13 (1.11, 1.16)	1.13 (1.11, 1.15)
$PM_{2.5}$ <9.9 μg/m^3 (lowest quintile)	1.00 (ref)	1.00 (ref)
DEATHS		
Per one unit, continuous	1.041 (1.029, 1.052)	1.038 (1.027, 1.050)
$PM_{2.5}$ quintiles		
$PM_{2.5}$ 16.2-18.8 μg/m^3 (highest quintile)	1.56 (1.43, 1.71)	1.51 (1.38, 1.65)
$PM_{2.5}$ 14.0-16.2 μg/m^3	1.59 (1.47, 1.72)	1.50 (1.38, 1.63)
$PM_{2.5}$ 11.2-14.0 μg/m^3	1.32 (1.23, 1.42)	1.30 (1.21, 1.39)
$PM_{2.5}$ 9.9-11.2 μg/m^3	1.18 (1.11, 1.25)	1.16 (1.09, 1.24)
$PM_{2.5}$ <9.9 μg/m^3 (lowest quintile)	1.00 (ref)	1.00 (ref)

Adjusted for age group, sex, percent Hispanic, percent non-Hispanic Black, percent non-Hispanic Asian, air basin, population density, mean summer temperature, and ADI state ranked deciles. Death analysis excluded age < 20 years. **Comorbidities (n=8) from CHIS including: obesity, smoking, diabetes, and hospitalizations from OSHPD including: asthma, coronary artery disease, cardiomyopathy, COPD, and heart failure.

complete dataset, misreporting and/or delayed reporting of cases by local health departments could have affected the interpretation of our results, in particular if such misreporting was correlated with our study's explanatory variables. The data we received from the State health department on race/ethnicity was incomplete for 23% of individuals so we could not use it. The data on hospitalizations and ICU use was over 50% incomplete and we were not able to classify severity of infections. Although we had information on neighborhood socioeconomic conditions and we had neighborhood-level information on many comorbidities such as obesity, diabetes, heart disease, and asthma, there is the possibility of residual confounding. We could not adjust for different masking requirements, SARS-CoV-2 testing rates, percent of the population that was essential workers, or different mobility patterns during lock downs. Further, we had no information on residential history, so our exposure assessment is likely to be subject to random misclassification, which likely results in an underestimate of our risk estimates.

We focused on long-term $PM_{2.5}$ concentrations and did not factor in the possible effects of short-term and contemporaneous air pollution spikes caused by wildfires. In a recent study, Yu et al., using individual-level data, found that short-term air pollution exposure was associated with SARS-CoV-2 infections in Sweden (Yu et al. 2022).

Although we used a small geographic area of block group as a neighborhood level-proxy and we controlled for air basin, there is the possibility of remaining spatial correlation that may not be accounted for. We attempted to adjust for spatial autocorrelation by using the latitude and longitude of the block group centroids using explicit distance-based spatial autocorrelation functions. However, due to the very large size of the dataset with over 21,000 block groups each with 36 sex/age group strata, we were unable to include this in the model due to computational limitations. Other spatial adjustments, such as for county, yielded similar results. Most of the effect of spatial autocorrelation is likely to be on the confidence intervals, not on the effect estimates. Finally, our analysis was limited to $PM_{2.5}$, and some recent reports have implicated elevated risks from other air pollutants such as NO_2 (Zang et al. 2022; Liang et al. 2020; Chen et al. 2021; Lipsitt et al. 2021).

Estimates of COVID-19 risks per unit of $PM_{2.5}$ appeared to be relatively constant when stratified by air basin, ADI, and largely Hispanic or Black neighborhoods. The larger effects, however, for Hispanic and Black populations, and residents of areas characterized by a higher Area Deprivation Index, reflect the higher concentrations of $PM_{2.5}$ in these neighborhoods and suggest that the impact of air pollution may play a role above and beyond other factors influencing health challenges for these populations. In a national study of counties defined as Latino, Rodriguez-Diaz reported 20% higher COVID-19 mortality in counties at the highest quartile of $PM_{2.5}$ (Rodriguez-Diaz et al. 2020). It is known that air pollution exposures disproportionately impact persons of color

and disadvantaged populations (Tessum et al. 2021; Mehta et al. 2021; Pastor, Morello-Frosch, and Sadd 2005). Nationwide, people of color are three times more likely to live in areas with high air pollution concentrations compared to whites (American Lung Association 2021).

California is home to the highest concentrations of air pollution in the nation (American Lung Association 2021). The U.S. National Ambient Air Quality Standard for annual mean $PM_{2.5}$ is currently set at 12.0 μg/m^3 (United States Environmental Protection Agency 2021). In 2018, the estimated mean concentration in California was 12.1 μg/m^3 and 22 million Californians (59%) lived in areas that exceeded the national air quality standard. If all areas of California had long-term $PM_{2.5}$ concentrations below 12.0 μg/m^3, the current U.S. annual air quality standard, based on population attributable risk approximately 4,250 deaths from COVID-19 (8.5% of all deaths) might have been prevented during the time period of our study (see supplement Table 2). With the growing evidence from studies worldwide that suggest there is additional risk of COVID-19 morbidity and mortality associated with air pollution, reducing concentrations of air contaminants is now even more critical to protecting public health.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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DEPARTMENT OF JUSTICE

Environmental Justice at the Local and Regional Level
Legal Background

Cities, counties, and other local governmental entities have an important role to play in ensuring environmental justice for all of California's residents. Under state law:

> "[E]nvironmental justice" means the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.

(Gov. Code, § 65040.12, subd. (e).) Fairness in this context means that the *benefits* of a healthy environment should be available to everyone, and the *burdens* of pollution should not be focused on sensitive populations or on communities that already are experiencing its adverse effects.

Many local governments recognize the advantages of environmental justice; these include healthier children, fewer school days lost to illness and asthma, a more productive workforce, and a cleaner and more sustainable environment. Environmental justice cannot be achieved, however, simply by adopting generalized policies and goals. Instead, environmental justice requires an ongoing commitment to identifying existing and potential problems, and to finding and applying solutions, both in approving specific projects and planning for future development.

There are a number of state laws and programs relating to environmental justice. This document explains two sources of environmental justice-related responsibilities for local governments, which are contained in the Government Code and in the California Environmental Quality Act (CEQA).

Government Code

Government Code section 11135, subdivision (a) provides in relevant part:

> No person in the State of California shall, on the basis of race, national origin, ethnic group identification, religion, age, sex, sexual orientation, color, or disability, be unlawfully denied full and equal access to the benefits of, or be unlawfully subjected to discrimination under, any program or activity that is conducted, operated, or administered by the state or by any state agency, is funded directly by the state, or receives any financial assistance from the state….

While this provision does not include the words "environmental justice," in certain circumstances, it can require local agencies to undertake the same consideration of fairness in the distribution of environmental benefits and burdens discussed above. Where, for example, a general plan update is funded by or receives financial assistance from the state or a state agency, the local government should take special care to ensure that the plan's goals, objectives, policies

and implementation measures (a) foster equal access to a clean environment and public health benefits (such as parks, sidewalks, and public transportation); and (b) do not result in the unmitigated concentration of polluting activities near communities that fall into the categories defined in Government Code section 11135.[1] In addition, in formulating its public outreach for the general plan update, the local agency should evaluate whether regulations governing equal "opportunity to participate" and requiring "alternative communication services" (*e.g.*, translations) apply. (See Cal. Code Regs., tit. 22, §§ 98101, 98211.)

Government Code section 11136 provides for an administrative hearing by a state agency to decide whether a violation of Government Code section 11135 has occurred. If the state agency determines that the local government has violated the statute, it is required to take action to "curtail" state funding in whole or in part to the local agency. (Gov. Code, § 11137.) In addition, a civil action may be brought in state court to enforce section 11135. (Gov. Code, § 11139.)

California Environmental Quality Act (CEQA)

Under CEQA, "public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects …." (Pub. Res. Code, § 21002.) Human beings are an integral part of the "environment." An agency is required to find that a "project may have a 'significant effect on the environment'" if, among other things, "[t]he environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly[.]" (Pub. Res. Code, § 21083, subd. (b)(3); see also CEQA Guidelines,[2] § 15126.2 [noting that a project may cause a significant effect by bringing people to hazards].)

CEQA does not use the terms "fair treatment" or "environmental justice." Rather, CEQA centers on whether a project may have a significant effect on the physical environment. Still, as set out below, by following well-established CEQA principles, local governments can further environmental justice.

CEQA's Purposes

The importance of a healthy environment for all of California's residents is reflected in CEQA's purposes. In passing CEQA, the Legislature determined:

- "The maintenance of a quality environment for the people of this state now and in the future is a matter of statewide concern." (Pub. Res. Code, § 21000, subd. (a).)

- We must "identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds from being reached." (*Id.* at subd. (d).)

[1] To support a finding that such concentration will not occur, the local government likely will need to identity candidate communities and assess their current burdens.
[2] The CEQA Guidelines (Cal. Code Regs., tit. 14, §§ 15000, et seq.) are available at http://ceres.ca.gov/ceqa/.

- "[M]ajor consideration [must be] given to preventing environmental damage, while providing a decent home and satisfying living environment for every Californian." (*Id.* at subd. (g).)

- We must "[t]ake all action necessary to provide the people of this state with clean air and water, enjoyment of aesthetic, natural, scenic, and historic environmental qualities, and freedom from excessive noise." (Pub. Res. Code, § 21001, subd. (b).)

Specific provisions of CEQA and its Guidelines require that local lead agencies consider how the environmental and public health burdens of a project might specially affect certain communities. Several examples follow.

Environmental Setting and Cumulative Impacts

There are a number of different types of projects that have the potential to cause physical impacts to low-income communities and communities of color. One example is a project that will emit pollution. Where a project will cause pollution, the relevant question under CEQA is whether the environmental effect of the pollution is significant. In making this determination, two long-standing CEQA considerations that may relate to environmental justice are relevant – setting and cumulative impacts.

It is well established that "[t]he significance of an activity depends upon the setting." (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 718 [citing CEQA Guidelines, § 15064, subd. (b)]; see also *id.* at 721; CEQA Guidelines, § 15300.2, subd. (a) [noting that availability of listed CEQA exceptions "are qualified by consideration of where the project is to be located – a project that is ordinarily insignificant in its impact on the environment may in a particularly sensitive environment be significant."]) For example, a proposed project's particulate emissions might not be significant if the project will be located far from populated areas, but may be significant if the project will be located in the air shed of a community whose residents may be particularly sensitive to this type of pollution, or already are experiencing higher-than-average asthma rates. A lead agency therefore should take special care to determine whether the project will expose "sensitive receptors" to pollution (see, e.g., CEQA Guidelines, App. G); if it will, the impacts of that pollution are more likely to be significant.[3]

In addition, CEQA requires a lead agency to consider whether a project's effects, while they might appear limited on their own, are "cumulatively considerable" and therefore significant. (Pub. Res. Code, § 21083, subd. (b)(3).) "'[C]umulatively considerable' means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future

[3] "[A] number of studies have reported increased sensitivity to pollution, for communities with low income levels, low education levels, and other biological and social factors. This combination of multiple pollutants and increased sensitivity in these communities can result in a higher cumulative pollution impact." Office of Environmental Health Hazard Assessment, *Cumulative Impacts: Building a Scientific Foundation* (Dec. 2010), Exec. Summary, p. ix, available at http://oehha.ca.gov/ej/cipa123110.html.

projects." (*Id.*) This requires a local lead agency to determine whether pollution from a proposed project will have significant effects on any nearby communities, when considered together with any pollution burdens those communities already are bearing, or may bear from probable future projects. Accordingly, the fact that an area already is polluted makes it *more likely* that any additional, unmitigated pollution will be significant. Where there already is a high pollution burden on a community, the "relevant question" is "whether any additional amount" of pollution "should be considered significant in light of the serious nature" of the existing problem. (*Hanford, supra*, 221 Cal.App.3d at 661; see also *Los Angeles Unified School Dist. v. City of Los Angeles* (1997) 58 Cal.App.4th 1019, 1025 [holding that "the relevant issue … is not the relative amount of traffic noise resulting from the project when compared to existing traffic noise, but whether any additional amount of traffic noise should be considered significant in light of the serious nature of the traffic noise problem already existing around the schools."])

The Role of Social and Economic Impacts Under CEQA

Although CEQA focuses on impacts to the physical environment, economic and social effects may be relevant in determining significance under CEQA in two ways. (See CEQA Guidelines, §§ 15064, subd. (e), 15131.) First, as the CEQA Guidelines note, social or economic impacts may lead to physical changes to the environment that are significant. (*Id.* at §§ 15064, subd. (e), 15131, subd. (a).) To illustrate, if a proposed development project may cause economic harm to a community's existing businesses, and if that could in turn "result in business closures and physical deterioration" of that community, then the agency "should consider these problems to the extent that potential is demonstrated to be an indirect environmental effect of the proposed project." (See *Citizens for Quality Growth v. City of Mt. Shasta* (1988) 198 Cal.App.3d 433, 446.)

Second, the economic and social effects of a physical change to the environment may be considered in determining whether that physical change is significant. (*Id.* at §§ 15064, subd. (e), 15131, subd. (b).) The CEQA Guidelines illustrate: "For example, if the construction of a new freeway or rail line divides an existing community, the construction would be the physical change, but the social effect on the community would be the basis for determining that the effect would be significant." (*Id.* at § 15131, subd. (b); see also *id.* at § 15382 ["A social or economic change related to a physical change may be considered in determining whether the physical change is significant."])

Alternatives and Mitigation

CEQA's "substantive mandate" prohibits agencies from approving projects with significant environmental effects if there are feasible alternatives or mitigation measures that would substantially lessen or avoid those effects. (*Mountain Lion Foundation v. Fish and Game Commission* (1997) 16 Cal.4th 105, 134.) Where a local agency has determined that a project may cause significant impacts to a particular community or sensitive subgroup, the alternative and mitigation analyses should address ways to reduce or eliminate the project's impacts to that community or subgroup. (See CEQA Guidelines, § 15041, subd. (a) [noting need for "nexus" between required changes and project's impacts].)

Depending on the circumstances of the project, the local agency may be required to consider alternative project locations (see *Laurel Heights Improvement Assn. v. Regents of University of*

California (1988) 47 Cal.3d 376, 404) or alternative project designs (see *Citizens of Goleta Valley v. Board of Supervisors* (1988) 197 Cal.App.3d 1167, 1183) that could reduce or eliminate the effects of the project on the affected community.

The lead agency should discuss and develop mitigation in a process that is accessible to the public and the affected community. "Fundamentally, the development of mitigation measures, as envisioned by CEQA, is not meant to be a bilateral negotiation between a project proponent and the lead agency after project approval; but rather, an open process that also involves other interested agencies and the public." (*Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 93.) Further, "[m]itigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments." (CEQA Guidelines, § 15126.4, subd. (a)(2).)

As part of the enforcement process, "[i]n order to ensure that the mitigation measures and project revisions identified in the EIR or negative declaration are implemented," the local agency must also adopt a program for mitigation monitoring or reporting. (CEQA Guidelines, § 15097, subd. (a).) "The purpose of these [monitoring and reporting] requirements is to ensure that feasible mitigation measures will actually be implemented as a condition of development, and not merely adopted and then neglected or disregarded." (*Federation of Hillside and Canyon Assns. v. City of Los Angeles* (2000) 83 Cal.App.4th 1252, 1261.) Where a local agency adopts a monitoring or reporting program related to the mitigation of impacts to a particular community or sensitive subgroup, its monitoring and reporting necessarily should focus on data from that community or subgroup.

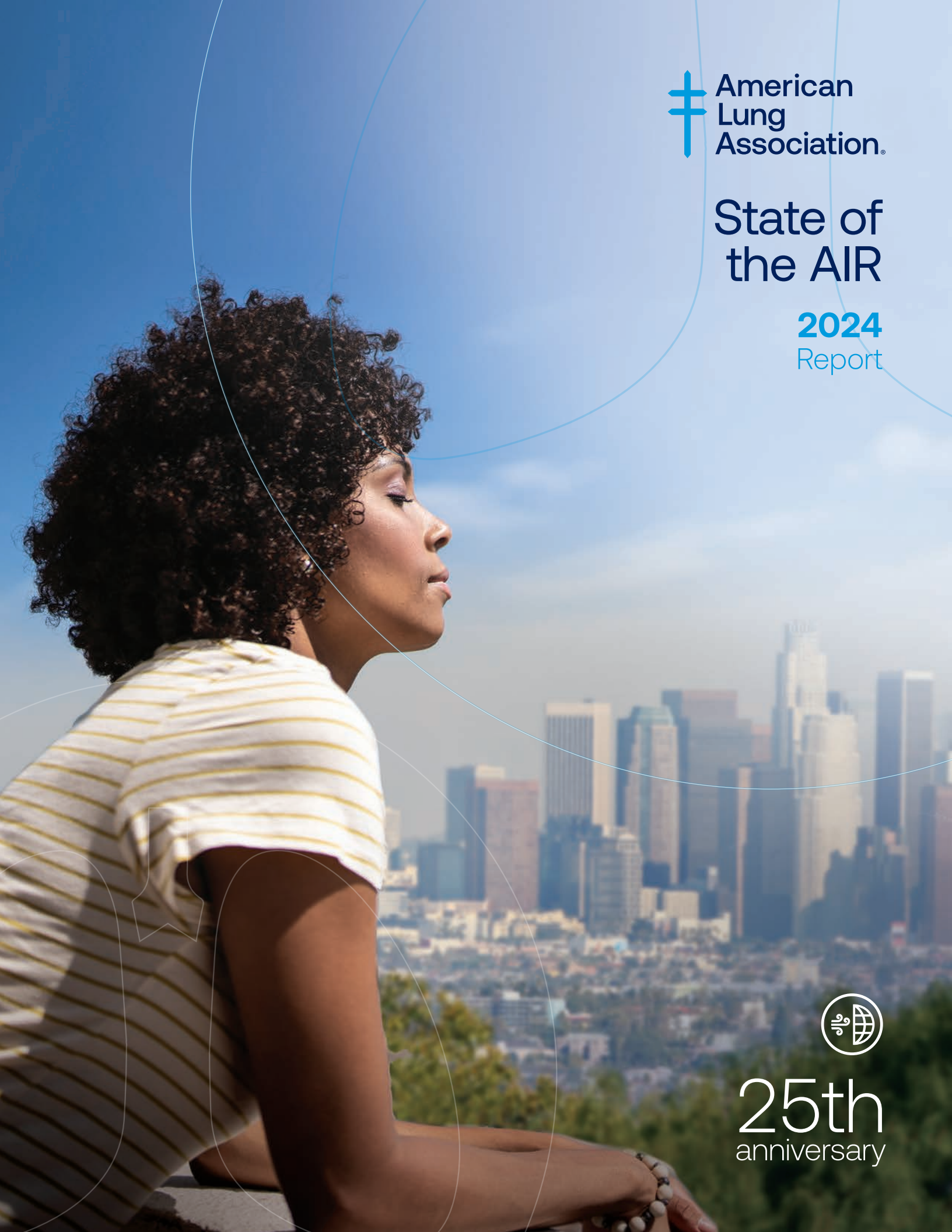
Transparency in Statements of Overriding Consideration

Under CEQA, a local government is charged with the important task of "determining whether and how a project should be approved," and must exercise its own best judgment to "balance a variety of public objectives, including economic, environmental, and social factors and in particular the goal of providing a decent home and satisfying living environment for every Californian." (CEQA Guidelines, § 15021, subd. (d).) A local agency has discretion to approve a project even where, after application of all feasible mitigation, the project will have unavoidable adverse environmental impacts. (*Id.* at § 15093.) When the agency does so, however, it must be clear and transparent about the balance it has struck.

To satisfy CEQA's public information and informed decision making purposes, in making a statement of overriding considerations, the agency should clearly state not only the "specific economic, legal, social, technological, or other benefits, including region-wide or statewide environmental benefits" that, in its view, warrant approval of the project, but also the project's "unavoidable adverse environmental effects[.]" (*Id.* at subd. (a).) If, for example, the benefits of the project will be enjoyed widely, but the environmental burdens of a project will be felt particularly by the neighboring communities, this should be set out plainly in the statement of overriding considerations.

* * * *

The Attorney General's Office appreciates the leadership role that local governments have played, and will continue to play, in ensuring that environmental justice is achieved for all of California's residents. Additional information about environmental justice may be found on the Attorney General's website at http://oag.ca.gov/environment.



American Lung Association®

State of the AIR

2024 Report

25th anniversary

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"State of the Air" 2024 would not have been possible but for the twenty years of inspiration, dedication and hard work of the late Janice E. Nolen. We still miss her every day.

The American Lung Association assumes sole responsibility for the content of "State of the Air" 2024.

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Why "State of the Air"?

The Clean Air Act requires the U.S. Environmental Protection Agency (EPA) to set health-based limits, called National Ambient Air Quality Standards (NAAQS), for six dangerous outdoor air pollutants: particulate matter, ozone, nitrogen oxides, sulfur dioxide, carbon monoxide and lead. "State of the Air" looks at two of the most widespread and dangerous pollutants from this group, fine particulate matter and ozone.

The NAAQS identify what is considered a safe level of each pollutant to breathe, based on the most recent health and medical science, including an adequate margin of safety for those most at risk. These standards require states and local governments to take steps to reduce emissions to attain the standards. The standards also serve to alert families with children, seniors, individuals with lung or heart conditions, and others about dangerous air pollution levels through color-coded air quality alerts. This enables them to take necessary precautions to minimize their exposure. Under the Clean Air Act, the standards must be based solely on what is needed to protect health and must be periodically updated as the science evolves.[i]

Setting national health-based standards and requiring states that violate the standards to enact plans to clean up their air pollution problems have been a great benefit to the public health of the nation. Since the Clean Air Act was passed in 1970, the combined emissions of six key air pollutants have fallen by 78%, according to EPA. But as "State of the Air" 2024 shows, millions of people in this country are still breathing unhealthy air.

Purpose and history of "State of the Air"

In the year 2000, the American Lung Association launched its annual "State of the Air" report to provide the public with easy-to-understand information about the quality of the air in their communities based on the credible data and sound science that EPA is required to use to set and enforce the air quality standards.

For the first several years, "State of the Air" focused solely on ozone pollution and included data for five populations at increased risk – children, older adults, children with asthma, adults with asthma and people with emphysema. In 2004, changes to the air quality standards and the deployment of air pollution monitoring enabled the addition of short-term and year-round fine particle pollution to the report. Over time, accumulating scientific evidence has shown significant health harms from both ozone and particle pollution among other groups of vulnerable individuals. "State of the Air" has accommodated this new information by gradually adding populations-at-risk categories to its reporting. "State of the Air" 2024 now includes data for 10 vulnerable groups.

Since its inception 25 years ago, "State of the Air" has been tremendously successful in raising awareness about particle pollution and ozone, two of the most dangerous and pervasive air pollutants nationwide. The American Lung Association is proud and grateful that the public, the media, clean air advocates and decision-makers have used this report every day, year after year, to call attention to the work that remains to be done to protect the public from the threat of air pollution.

How "State of the Air" can be used

We write and release "State of the Air" every year to make information on air quality and health clear and accessible to everyone. We show the progress each community has made and how much more needs to be done to achieve healthy air. In this report, you'll find information on local air quality nationwide. You'll also

i In February 2024, after a lengthy wait, EPA announced a new, more protective annual standard for fine particle pollution. That standard is being used in the 2024 "State of the Air" report. The ozone standard is also overdue for a revision based on the science, but that process has faced multiple delays.

find the latest research on how air pollution affects health. With these tools, you can take proactive steps to safeguard both your lungs and your family's lungs from unhealthy air.

This report also includes ideas for how you can become a champion for clean air. First, we have suggestions for concrete actions you can take to reduce your own contributions to air pollution and climate change. And second, we invite you to take advocacy action with the American Lung Association. Our report includes policy recommendations for every level of government. Your voice is powerful, and when you tell your leaders that your lungs depend on stronger limits on air pollution, you make a compelling case. Please share your story and add your name to our petition—and then, take the next step. Reach out to your representatives at every level of government, share the "State of the Air" results for your community, and call on them to take action to protect public health.

State of the Air 2024 Methodology

Statistical Methodology: The Air Quality Data

Data Sources

Ozone and short-term particle pollution. The data on air quality throughout the United States were obtained from the U.S. Environmental Protection Agency's Air Quality System (AQS). The American Lung Association contracted with Allen S. Lefohn, Ph.D., A.S.L. & Associates, Helena, Montana, to characterize the hourly averaged ozone concentration information and the 24-hour averaged fine particulate matter ($PM_{2.5}$) concentration information for the three-year period for 2020-2022 for each monitoring site.

Year-round particle pollution. Design values for the annual $PM_{2.5}$ concentrations by county for the period 2020-2022 were retrieved December 18, 2023 from data posted on May 23, 2023, at the U.S. Environmental Protection Agency's website at https://www.epa.gov/air-trends/air-quality-design-values.

The Lung Association received important assistance from members of the National Association of Clean Air Agencies and the Association of Air Pollution Control Agencies. With their assistance, all state and local agencies were provided the opportunity to review and comment on the data in draft tabular form. The Lung Association reviewed any discrepancies with the agencies and, if needed, with Dr. Lefohn at A.S.L. & Associates. The American Lung Association wishes to express its continued appreciation to the state and local air directors for their willingness to assist in ensuring that the characterized data used in this report are correct.

Ozone Data Analysis

The 2020, 2021 and 2022 AQS hourly ozone data were used to calculate the daily 8-hour maximum concentration for each ozone-monitoring site. The hourly averaged ozone data were downloaded on June 26, 2023, following the close of the authorized period for quality review and assurance certification of data. Only the hourly average ozone concentrations derived from FRM and FEM monitors were used in the analysis. The data were considered for a three-year period for the same reason that EPA uses three years of data to determine compliance with the ozone standard: to prevent a situation in which anomalies of weather or other factors in any single year create air pollution levels that inaccurately reflect typical conditions. The highest 8-hour daily maximum concentration in each county was identified for each day of the EPA-defined ozone season for 2020, 2021 and 2022.

The current National Ambient Air Quality Standard for ozone is 70 parts per billion (ppb) measured over eight hours. EPA's Air Quality Index reflects the 70 ppb standard. A.S.L. & Associates prepared a table by county that summarized, for each of the three years, the number of days during the ozone season when the ozone level was within the ranges identified by EPA based on the Air Quality Index:

8-hour Ozone Concentration	Air Quality Index Levels
0-54 ppb	Good (Green)
55-70 ppb	Moderate (Yellow)
71-85 ppb	Unhealthy for Sensitive Groups (Orange)
86-105 ppb	Unhealthy (Red)
106-200 ppb	Very Unhealthy (Purple)
>200 ppb	Hazardous (Maroon)

The approach of this report was to identify the number of days that 8-hour daily maximum concentrations in each county occurred within the defined ranges. This provided an indication of the level of pollution for all monitored days, not just those days that fell under the requirements for attaining the National Ambient Air Quality Standards. Therefore, no data capture criteria were applied to eliminate monitoring sites or to require a number of valid days for the ozone season.

The daily maximum 8-hour average concentration for a given day is derived from the highest of the 17 consecutive 8-hour averages beginning with the 8-hour period from 7:00 a.m. to 3:00 p.m. and ending with the 8-hour period from 11:00 p.m. to 7:00 a.m. the following day. This follows the process EPA uses for the current ozone standard adopted in 2015. All valid days of data within the ozone season were used in the analysis. However, for computing an 8-hour average, at least 75 percent of the hourly concentrations (i.e., 6-8 hours) had to be available for the 8-hour period. In addition, an 8-hour daily maximum average was identified if valid 8-hour averages were available for at least 75 percent of possible hours in the day (i.e., at least 13 of the possible 17 8-hour averages). Because EPA includes days with inadequate data (i.e., not 75 percent complete) if the standard value is exceeded, our data capture methodology also included the site's 8-hour value if at least one valid 8-hour period were available, and it was 71 ppb or higher.

As instructed by the Lung Association, A.S.L. & Associates included the exceptional (e.g., wildfires) and natural events (e.g., stratospheric intrusions) that were identified in the database and identified for the Lung Association the dates and monitoring sites that experienced such events. Some data have been flagged by the state or local air pollution control agency to indicate that they had raised issues with EPA about those data. For each day across all sites within a specific county, the highest daily maximum 8-hour average ozone concentration was recorded and then the results were summarized by county for the number of days the ozone levels were within the ranges identified above.

Following receipt of the above information, the American Lung Association identified the number of days each county with at least one ozone monitor experienced air quality designated as orange (Unhealthy for Sensitive Groups), red (Unhealthy) or purple (Very Unhealthy). When insufficient data were available in any year, an "incomplete" was identified for the 3-year period. Insufficient data exist for various reasons. For example, when a specific monitor was used for a special study and the monitor was then discontinued in other years, an "incomplete" is assigned.

Short-Term Particle Pollution Data Analysis

A.S.L. & Associates identified the maximum daily 24-hour AQS $PM_{2.5}$ concentration for each county for each day in 2020, 2021 and 2022 with monitoring information. The 24-hour averaged $PM_{2.5}$ data were downloaded on August 2, 2023, following the close of the authorized period for quality review and assurance certification of data. The hourly averaged $PM_{2.5}$ concentration data in the EPA AQS database were characterized into 24-hour average $PM_{2.5}$ values by EPA and provided to A.S.L. & Associates. Using these results, A.S.L. & Associates prepared a table by county that summarized, for each of the three years, the number of days the maximum of the daily $PM_{2.5}$ concentration was within the ranges identified by EPA based on the Air Quality Index, as adopted by EPA on December 14, 2012[ii]:

ii Analysis of the daily $PM_{2.5}$ data for "State of the Air" 2024 was completed in January 2024, before EPA announced the finalization of the revised $PM_{2.5}$ NAAQS and Air Quality Index. The values used in this report are based on the 2012 Air Quality Index.

24-hour $PM_{2.5}$ Concentration	Air Quality Index Levels
0.0 µg/m³ to 12.0 µg/m³	Good (Green)
12.1 µg/m³ to 35.4 µg/m³	Moderate (Yellow)
35.5 µg/m³ to 55.4 µg/m³	Unhealthy for Sensitive Groups (Orange)
55.5 µg/m³ to 150.4 µg/m³	Unhealthy (Red)
150.5 µg/m³ to 250.4 µg/m³	Very Unhealthy (Purple)
greater than or equal to 250.5 µg/m³	Hazardous (Maroon)

All previous data collected for 24-hour average $PM_{2.5}$ were characterized using the AQI thresholds listed above.

The goal of this report was to identify the number of days that the maximum in each county of the daily $PM_{2.5}$ concentration occurred within the defined ranges. This approach provided an indication of the level of pollution for all monitored days, not just those days that fell under the requirements for attaining the National Ambient Air Quality Standards. Therefore, no data capture criteria were used to eliminate monitoring sites. Both 24-hour averaged PM data, as well as hourly averaged PM data averaged by EPA over 24 hours, were used. Included in the analysis are data collected using only FRM and FEM methods, which reported hourly and 24-hour averaged data. As instructed by the Lung Association, A.S.L. & Associates included the exceptional and natural events that were identified in the database and identified for the Lung Association the dates and monitoring sites that experienced such events. Some data have been flagged by the state or local air pollution control agency to indicate that they had raised issues with EPA about those data. For each day across all sites within a specific county, the highest daily maximum 24-hour $PM_{2.5}$ concentration was recorded and then the results were summarized by county for the number of days the concentration levels were within the ranges identified above.

Following receipt of the above information, the American Lung Association identified the number of days each county with at least one $PM_{2.5}$ monitor experienced air quality designated as orange (Unhealthy for Sensitive Groups), red (Unhealthy), purple (Very Unhealthy) or maroon (Hazardous).

Description of County Grading System

Ozone and Short-Term Particle Pollution (24-hour $PM_{2.5}$)

The grades for ozone and short-term particle pollution (24-hour $PM_{2.5}$) were based on a weighted average calculation. To determine weighted averages, the Lung Association followed these four steps separately for each pollutant in each county:

1. Assigned weighting factors to each category of the Air Quality Index. Days of poor air quality were given the following weighting factors:

   Orange days 1.0
   Red days 1.5
   Purple days 2.0
   Maroon days 2.5

   This ensured that days when the air pollution levels were worse received appropriately greater weight.

2. Multiplied the total number of days within each AQI category by its assigned factor, and added all the categories to calculate a total:

   Total = [Orange days x 1] + [Red days x 1.5] + [Purple days x 2] + [Maroon days x 2.5]

3. Divided the total by three to determine the weighted average, since the monitoring data were collected over a three-year period:

Weighted Average = Total ÷ 3

Weighted average was then used to determine each county's grades for ozone and 24-hour $PM_{2.5}$ according to the following table:

Weighted Average	Grade
0.0	A
0.3 to 0.9	B
1.0 to 2.0	C
2.1 to 3.2	D
3.3 or higher	F

All counties with a weighted average of zero (corresponding to no exceedances of the standard over the three-year period) were given a grade of "A."

For ozone, an "F" grade was set to generally correlate with the number of unhealthy air days that would place a county in nonattainment for the ozone standard.

For short-term particle pollution, fewer unhealthy air days are required for an F than for nonattainment under the $PM_{2.5}$ standard. The 2012 national air quality standard is set to allow two percent of the days during the three years to exceed 35 µg/m^3 (called a "98th percentile" form) before violating the standard. That could be as many as 21 unhealthy days in three years. The grading used in this report is roughly equivalent to allowing only about one percent of the days to be those on which $PM_{2.5}$ concentrations were over 35 µg/m^3 (called a "99th percentile form"). The American Lung Association supports using the 99th percentile form as a more appropriate form of the standard that is intended to protect the public from short-term episodes or spikes in pollution.

Weighted averages allow comparisons to be drawn based on severity of air pollution. For example, if one county had nine orange days and no red days, it would earn a weighted average of 3.0 and a D grade. However, another county that had only eight orange days but also two red days, which signify days with more serious air pollution, would receive an F. That second county would have a weighted average of 3.7.

Note that this system differs significantly from the methodology EPA uses to determine violations of both the ozone and the 24-hour $PM_{2.5}$ standards. EPA determines whether a county violates the ozone standard based on the fourth maximum daily 8-hour ozone reading each year averaged over three years. Multiple days of unhealthy air beyond the highest four in each year are not considered. By contrast, the system used in this report recognizes when a community's air quality repeatedly results in unhealthy air throughout the three years. Consequently, some counties will receive grades of "F" in this report, showing repeated instances of unhealthy air, even while still meeting the EPA's 2015 ozone standard. This is consistent with the American Lung Association's position is that the evidence shows that the 2015 ozone standard fails to adequately protect public health.

Counties were ranked by weighted average. Metropolitan areas were ranked by the highest weighted average among the counties within a given Metropolitan Statistical Area as of 2020 as defined by the White House Office of Management and Budget (OMB).

Weighted average values from earlier years are from prior reports and updated when new standards are implemented.

Year-Round Particle Pollution (Annual $PM_{2.5}$)

Since no comparable Air Quality Index exists for year-round particle pollution (annual $PM_{2.5}$), the grading was based on the 2024 National Ambient Air Quality Standard for annual $PM_{2.5}$ of 9 µg/m^3. Counties that EPA listed as being at or below 9 µg/m^3 were given grades of "Pass." Counties that EPA listed as being above 9 µg/m^3 were given grades of "Fail." Where data was collected but was insufficient for EPA to determine a design value, those counties received a grade of "Incomplete."

A design value is the calculated concentration of a pollutant based on the form of the National Ambient Air Quality Standard and is used by EPA to determine whether the air quality in a county meets the standard. Counties were ranked by design value. Metropolitan areas were ranked by the highest design value among the counties within a given Metropolitan Statistical Area as of 2020 as defined by the OMB.

Statistical Methodology: Population Data

The Lung Association calculates the county population at risk from these pollutants based on the population from the entire county where the monitor is located. The Lung Association then calculates the metropolitan population at risk based upon the largest metropolitan area that contains that county. Not only do people from that county or metropolitan area circulate within the county and the metropolitan area, but the air pollution also circulates to that monitor from throughout the county and metropolitan area.

Details about how the populations-at-risk numbers are derived can be found in **Understanding Grades and Tables**.

Key Findings

Nearly **4 in 10** people live in places with unhealthy levels of air pollution

People of color were 2.3 times as likely as white people to live in a county with 3 failing grades.

Climate change is making the job of cleaning up the air more difficult.

The "State of the Air" 2024 report finds that despite decades of progress cleaning up air pollution, 39% of Americans—131.2 million people—still live in places with failing grades for unhealthy levels of ozone or particle pollution. This is 11.7 million more people breathing unhealthy air compared to last year's report.

The significant rise in the number of individuals whose health is at risk is the result of a combination of factors. Extreme heat, drought and wildfires are contributing to a steady increase in deadly particle pollution, especially in the western U.S. Also, this year's "State of the Air" report is using EPA's new, more protective national air quality standard for year-round levels of fine particle pollution, which allows for the recognition that many more people are breathing unhealthy air than was acknowledged under the previous weak standard.

Again this year, "State of the Air" finds that the burden of living with unhealthy air is not shared equally. Although people of color make up 41.6% of the overall population of the U.S., they are 52% of the people living in a county with at least one failing grade. In the counties with the worst air quality that get failing grades for all three measures of air pollution, 63% of the nearly 44 million residents are people of color, compared to 37% who are white.

The "State of the Air" report looks at two of the most widespread and dangerous air pollutants, fine particles and ozone. The air quality data used in the report are collected at official monitoring sites across the United States by the federal, state, local and Tribal governments. The Lung Association calculates values reflecting the air pollution problem and assigns grades for daily and long-term measures of particle pollution and daily measures of ozone. Those values are also used to rank cities (metropolitan areas) and counties. This year's report presents data from 2020, 2021 and 2022, the most recent quality-assured nationwide air pollution data publicly available. See ***About This Report*** for more detail about the methodology for data collection and analysis.

"State of the Air" 2024 is the 25th edition of this annual report, which was first published in 2000. From the beginning, the findings in "State of the Air" have reflected the successes of the Clean Air Act, as emissions from transportation, power plants and manufacturing have been reduced. In recent years, however, the findings of the report continue adding to the evidence that a changing climate is making it harder to protect human health. High ozone days and spikes in particle pollution related to extreme heat, drought and wildfires are putting millions of people at risk and adding challenges to the work that states and cities are doing across the nation to clean up air pollution.

> When we started doing "State of the Air" in 2000, I never imagined that in the 25th edition we would be reporting that more than 100 million people are still breathing unhealthy air. It's unacceptable.
>
> **Paul Billings,**
> **American Lung Association**

The combination of policy-driven reductions in emissions on the one hand and climate change-fueled increases in pollution on the other hand have resulted in an ongoing and marked disparity between air quality in eastern and western states, especially for the daily measure of fine particle pollution. In this year's report, only 4 large counties in three states east of the Mississippi River, earned failing grades for daily spikes in fine particle pollution, compared to 108 counties in 16 western states.

When looking at levels of year-round particle pollution, however, the story becomes more nuanced. The majority of the 119 counties earning failing grades for year-round particle pollution are in the western U.S., but the new, stronger standard is revealing remaining air quality problems in eastern and midwestern states. In "State of the Air" 2024 there were 47 counties in 12 states east of the Mississippi River with unhealthy year-round levels of fine particles.

In "State of the Air" 2024, the metropolitan areas that ranked worst in the country for each of the three pollutant measures were unchanged from last year's report. Bakersfield, California topped the list for worst short-term particle pollution again this year. Bakersfield also continued as the metropolitan area with the worst level of year-round particle pollution for the 5th year in a row. Los Angeles remains the city with the worst ozone pollution in the nation, as it has been in 24 of the 25 years of reporting in "State of the Air"– even though city residents are exposed to unhealthy levels of ozone an average of 55 days a year fewer than now than they were in 2000.

Short-term Particle Pollution Trends

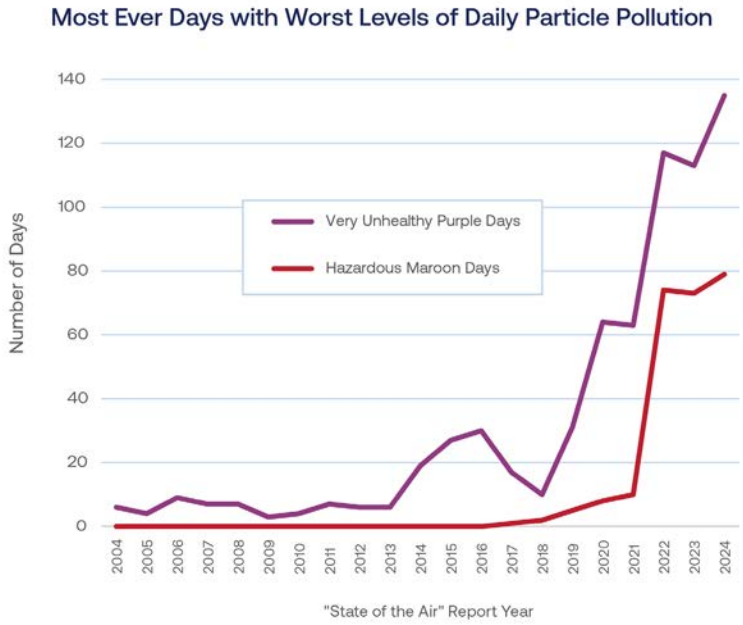
65 million people live in counties with **F grades** for daily particle pollution.

In the years 2020, 2021 and 2022, there were 65 million people living in the 112 counties in 19 states that earned an F grade for unhealthy spikes in particulate matter air pollution. This represents an increase of 1.3 million more people than in last year's report, the sixth straight year of increasing health threat of this deadly pollutant.

Even compared with the past several years of "State of the Air" reports—in which many cities and counties experienced their highest weighted average number of days ever reported for fine particle pollution—results this year were again worse, especially throughout much of the western United States. This trend in recent years is a reversal after roughly a decade of improvements resulting from the requirements of the Clean Air Act.

In 2004, with data from 2001, 2002 and 2003, the "State of the Air" report added grades and ranks for fine particle pollution. It was the first time three years of data was available from a network of monitors put in place following EPA's adoption in 1997 of a new health standard to address particle pollution. At that time, 106 counties in 30 states earned an F grade for short-term particle pollution, affecting the health of 81 million people. The air quality standard was weaker than it is now, meaning that in fact many more people were breathing unhealthy air. If the current standard had been in effect, 189 counties in 36 states would have gotten failing marks.

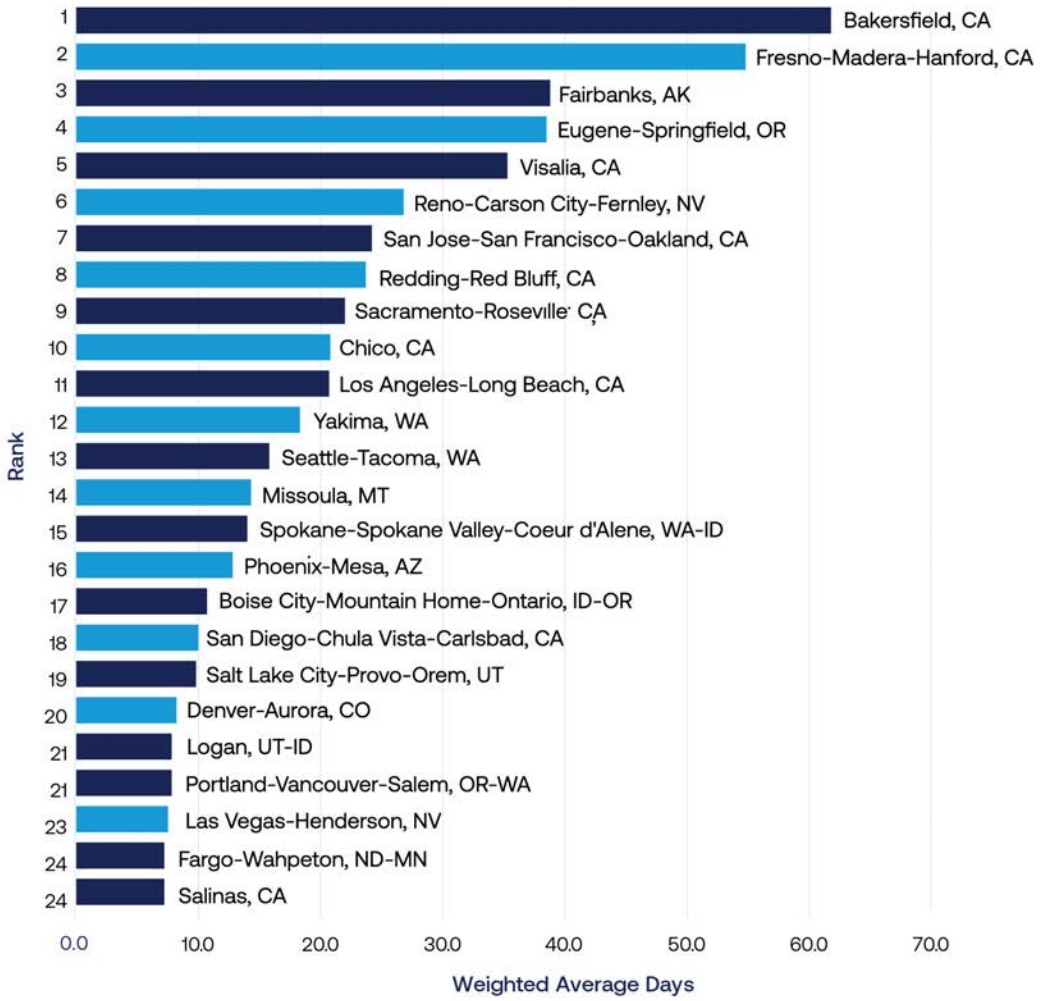
Wildfires in the western United States and Canada remain the major contributing factor to the increasing number of days and places with unhealthy levels of particle pollution in recent years. Wildfires are also continuing to increase the severity of pollution, resulting in the highest ever number of days designated as either purple or maroon (135 and 79 days, respectively). These are the levels on the Air Quality Index that carry the strongest health warnings. On purple Very Unhealthy days, "the risk of health effects is increased for everyone." On maroon Hazardous days, the highest category, a health warning of emergency conditions is issued, saying, "Everyone is more likely to be affected."



In the years 2020, 2021 and 2022, the health of 32.3 million people across 58 counties in ten states was put at risk on "purple" or "maroon" days for fine particle pollution. This is slightly worse than the findings in last year's "State of the Air" and a worrisome sign of a trend that is continuing as climate change worsens.

In this year's report, thirty-three metropolitan areas equaled or exceeded their previous worst-ever weighted average number of days with unhealthy levels of fine particle pollution. Among those cities ranked the worst 25, the average number of days per year that residents were exposed to high levels of fine particle pollution increased by more than two days, to a weighted average of 20.8 days. Seven of the 25 most polluted cities for this measure posted their highest-ever number of unhealthy days: Fairbanks, Alaska; Visalia, California; Boise City, Idaho; Eugene, Oregon; Las Vegas and Reno, Nevada and Spokane, Washington. Only one city, Logan, Utah, recorded its fewest-ever number of unhealthy days, though it still earned an "F" grade.

25 Cities Most Polluted by Daily PM



All the 25 worst cities for short-term particle pollution are in the Western U.S.

Twenty-two of last year's worst 25 cities remained listed among the worst 25 in this year's report, with most of their relative ranks shifting by no more than two places. Three metro areas saw declines in their air quality that moved them up among the worst 25: Las Vegas, Nevada, for the first time, and well as Portland, Oregon and Seattle, Washington. Medford, Oregon, and Lancaster and Pittsburgh, Pennsylvania improved enough to leave the list. Pittsburgh, in 26th place this year, narrowly avoided the 25 worst list, noteworthy as first time that Steel City has earned that distinction for this measure.

In "State of the Air" 2024, with the departure of Lancaster and Pittsburgh, for the first time in the report's history, no cities among the 25 worst for short-term particle pollution were in the eastern United States. The farthest east of any metro area on the list was Fargo-Wahpeton, ND-MN.

The New National Standard for Particle Pollution in "State of the Air"

In February 2024, the U.S. EPA made a long-overdue update to the National Ambient Air Quality Standards for fine particle pollution. In the final rule, EPA revised the annual standard from 12 to 9 micrograms per cubic meter (µg/m3) and opted not to revise the current 24-hour standard of 35 µg/m3. Although this stronger annual standard will yield significant health benefits to millions of people nationwide, it falls short of what the American Lung Association and other health organizations were calling for, based on existing science (see ***Health Impact of Air Pollution***).

The grades and rankings for annual particle pollution in "State of the Air" 2024 were calculated using the new 9 µg/m3 standard. As a result, many more places across the country earned a failing grade this year compared to the year before, a change that more accurately reflects the actual health risk from breathing the air in those communities.

Another component of EPA's new rule was some changes to the Air Quality Index (AQI) to better reflect recent health science on exposure to fine particles. EPA made adjustments to the breakpoints between the color-coded categories, so that the health warnings associated with those categories will be issued at lower pollution levels than they were previously. After the changes go into effect in April 2024, the breakpoint between green Good and yellow Moderate was changed to align with the updated annual standard. Furthermore, some days that would have been red Unhealthy days will be declared purple Very Unhealthy days, and some purple Very Unhealthy days will be recognized as maroon Hazardous days.

The updated Air Quality index is not reflected in this year's report, but will be applied to the grades and weighted averages for short-term particle pollution in next year's "State of the Air".

Year-round Particle Pollution Trends

Nearly 90.7 million people live in counties with failing grades for year-round particle pollution

With the recent adoption of a more protective air quality standard for year-round levels of fine particle pollution, "State of the Air" 2024 finds that nearly 90.7 million people are living in 119 counties where year-round particle pollution levels do not meet the national air quality standard, and therefore receive a failing grade. This is a dramatic increase from last year's report that, using the previous weaker standard, identified slightly fewer than 18.8 million people living in 17 counties with failing marks for year-round levels of fine particle pollution.

Most of the additional 71.9 million more people now included in the total population living in areas with failing grades for year-round particle pollution have in fact been breathing unhealthy air for years. The big change this year is the standard, and the overdue recognition of the health risk from year-round exposure to this deadly pollutant. The severity of annual particle pollution only worsened slightly in this year's report. When looking nationwide at all the counties with measurements for this pollutant, there was little change in the national average of those counties' year-round levels, with about an equal number improving as got worse.

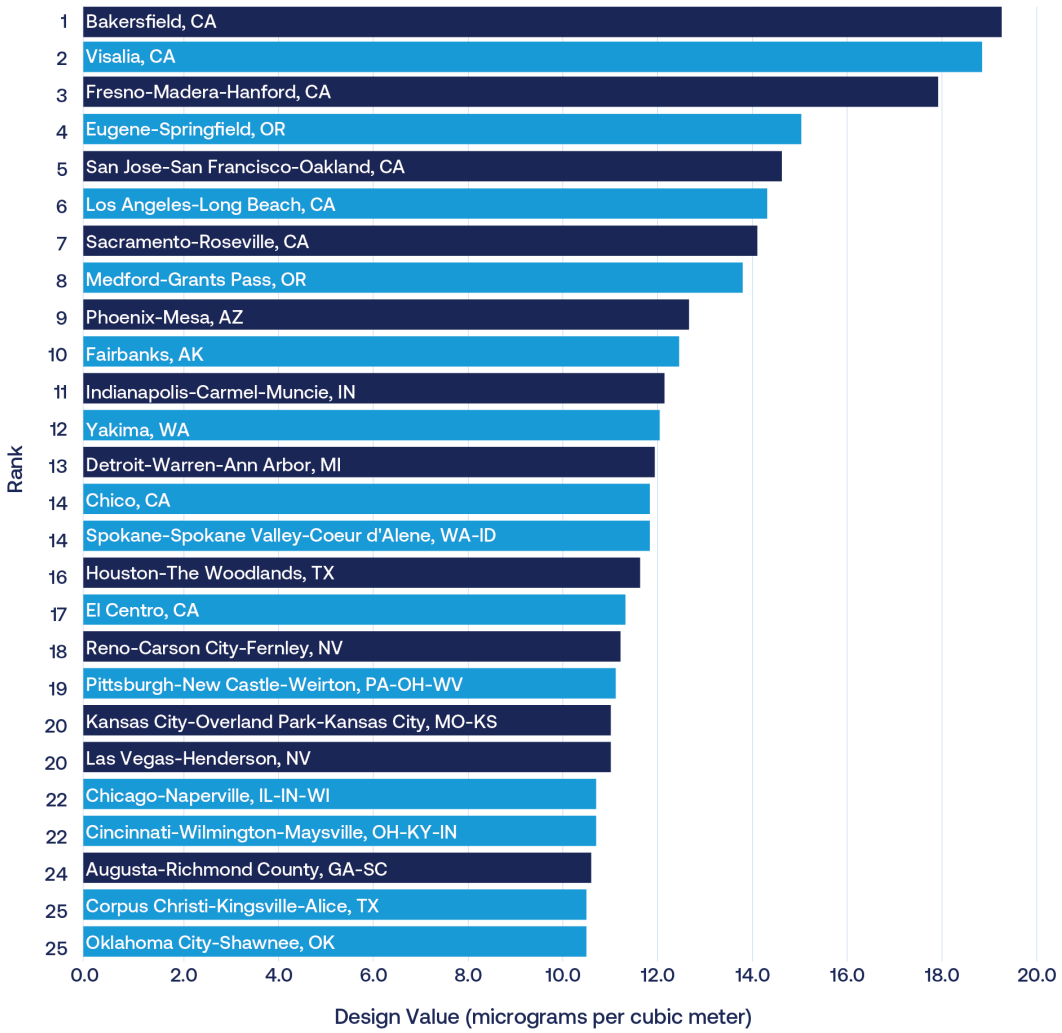
In 2004, with data from 2001, 2002 and 2003, the "State of the Air" report added grades and ranks for fine particle pollution. It was the first time three years of data was available from a new network of monitors put in place following EPA's adoption of a new health standard to address particle pollution in 1997. At that time, 120 counties in 22 states earned an F grade for annual particle pollution, affecting the health of 66 million people. The air quality standard was weaker than it is now, meaning that in fact many more people were breathing unhealthy air. If the 2024 standard had been in effect at that time, 365 of the monitored counties in 47 states would have gotten failing marks.

By its nature, the year-round measure of average particle pollution is not as volatile as the daily measure. Changes over time may look smaller, but because they typically represent recurring exposures over many days and weeks, seemingly minor differences can have a big impact on public health. In "State of the Air" 2024, the most polluted cities for year-round particle pollution continued the worsening trend of recent years by an average of about 0.25 micrograms per cubic meter (from 12.3 to 12.55 µg/m3), with 16 metro areas worsening compared with 7 improving.

Five of the 26 most polluted cities for this measure posted their worst-ever levels of year-round particle pollution. Yakima, Washington remained unchanged from last year's value, making this the third consecutive year at the same record level. The other four in the worst-ever group were Sacramento, California; Reno, Nevada; Eugene, Oregon; and Spokane, Washington. Of these four, only Sacramento had also posted a new worst-ever performance in last year's report.

In contrast, seven of the 26 most polluted cities had lower year-round levels compared to last year. Three of these tied or exceeded their previous best-ever performance in "State of the Air" 2024: Los Angeles, California; Cincinnati, Ohio and Pittsburgh, Pennsylvania. Nevertheless, all 26 of the worst-ranked metro areas, along with 46 others, had poor enough long-term average particle pollution levels to earn failing grades in this year's report.

25 Cities Most Polluted by Annual PM



Twenty of last year's worst 25 cities remained listed among the 26 (because of a tie for 25th place) in this year's report. Even though most of their relative ranks shifted by no more than two places, there were some significant changes among the other metro areas. Eugene, Oregon's increase in its annual average level of fine particle pollution was worst in the country, resulting in its rank dropping from 15th worst in last year's report to 4th worst in "State of the Air" 2024. In contrast, Birmingham, Alabama's improvement to its best-ever annual average level of particle pollution was the largest in the country and resulted in its rank improving from 18th to 96th worst.

Five metro areas improved enough to leave the worst-cities list for this measure. In addition to Birmingham, they were Louisville, Kentucky; Bend, Oregon; and Laredo and McAllen, Texas. Six metro areas replaced them, five of them debuting on the list: Kansas City; Reno, Nevada; Oklahoma City, Oklahoma; Corpus Christi, Texas; and Spokane, Washington. Las Vegas, Nevada rejoined the list for the first time since the 2018 "State of the Air" report.

Unlike the worst 25 cities for the daily measure of particle pollution that were all in the west, the 25 worst cities for annual particle pollution were somewhat more widely distributed around the country. Cities predominantly affected by western drought and wildfires, notably eight in California, and two each in Nevada, Oregon, and Washington, still made up the highest share. However, cities less

affected by wildfire smoke in this year's report, but still grappling with pollution from local industrial and mobile sources, continued to show up on this list. There were ten of these spread among nearly as many states: Indianapolis, Detroit, Houston, Pittsburgh, Kansas City, Cincinnati, Chicago, Augusta, Corpus Christi, and Oklahoma City.

Ozone Pollution Trends

Exposure to unhealthy levels of ozone air pollution continues to make breathing difficult for more Americans across the country than any other single pollutant. In the years 2020, 2021, and 2022, some 100.6 million people lived in the 125 counties in 26 states that earned an "F" grade for ozone. This means that three of every ten people, including 22.5 million infants and children, 15.5 million people age 65 or older, and tens of millions in other groups at highest risk of health harm, are exposed to high levels of ozone on enough days to earn the air they breathe a failing grade.

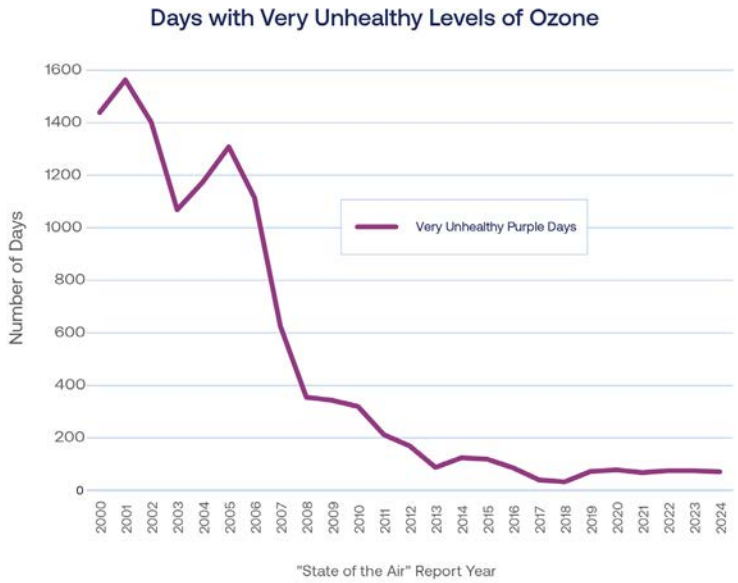
More than 100 million people live in counties with **F grades** for ozone smog.

Although ozone air pollution remains a serious threat to public health, one trend in this year's "State of the Air" report is continuing in a positive direction. For the fourth consecutive report, the number of people living in counties with a failing grade for ozone declined, this year by 2.4 million people.

Ambient ozone levels are influenced by a complex interaction of natural and human-driven factors that can vary from year to year, with some years being better overall than others. However, the long-term trend of improvement in ozone levels can be attributed to the fact that the Clean Air Act has been working. Controls placed on emissions have increasingly resulted in the replacement of more polluting engines, fuels, and industrial processes nationwide. The transition of the economy away from coal-fired power plants, the dirtiest fossil fuel, and towards clean renewable sources of energy, has unquestionably had an impact, especially in parts of the eastern United States.

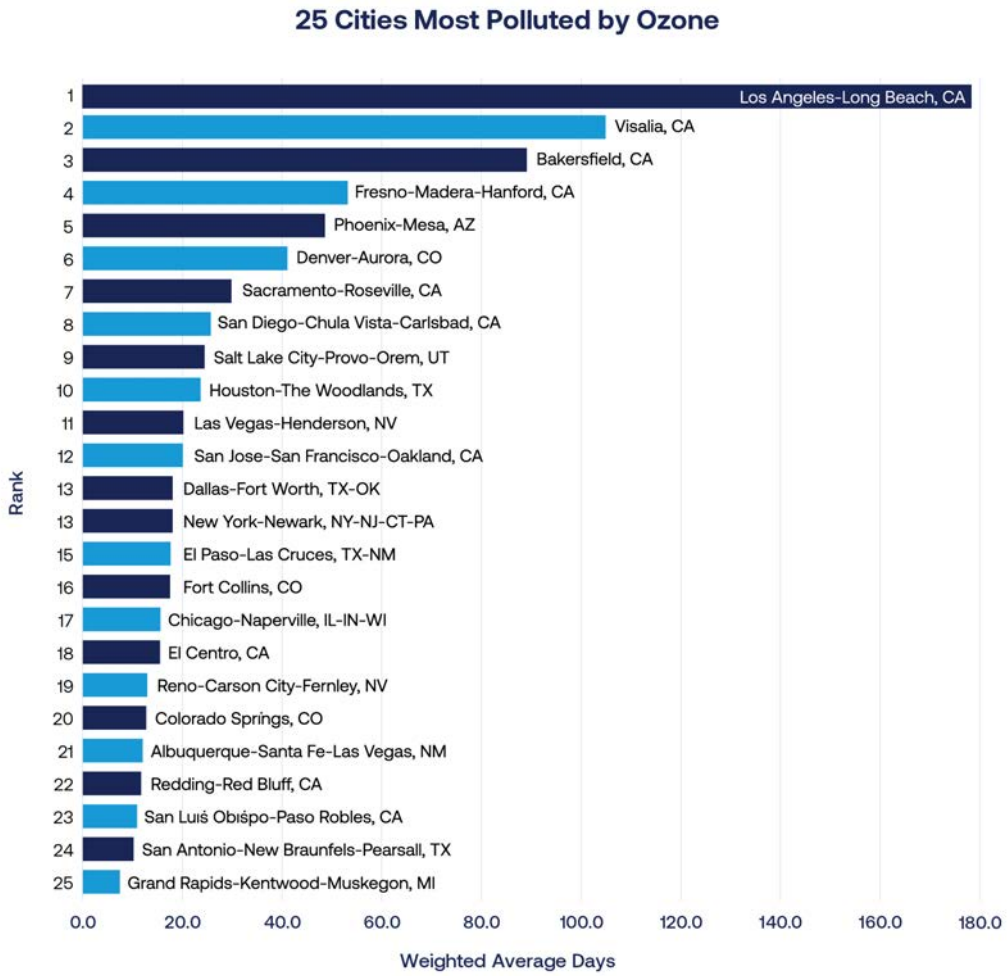
When the first "State of the Air" report was released in 2000, with ozone data from 1996, 1997 and 1998, 332 counties in 38 states earned an F grade, putting the health of 132.5 million people at risk. The air quality standard was weaker than it is now, meaning that in fact many more people were breathing unhealthy air. If the current standard had been in effect at that time, 463 counties in 43 states would have gotten failing marks. Of the counties where data was being collected, only 9 would have received an A.

In many parts of the country, the weighted average number of days of unhealthy ozone has declined substantially over the years. It is worth noting that the severity of ozone pollution has also dropped. In 2001, the "State of the Air" report recorded a 25-year high of 1,563 very unhealthy Purple days for ozone around the country. In 2024, that number has dropped to a 25-year low of 71 days. That is still 71 days too many, but an important indicator of progress.



In spite of the promising trend, some trouble signs appear in this year's report, and time will tell whether they are the result of expected fluctuations or more systemic threats. Nationwide, nearly twice as many counties worsened as improved. The weighted average number of unhealthy ozone days of all counties taken together increased by about 6%. And although the number of counties earning "F" grades remained nearly unchanged from the 2023 report, those earning "A" grades dropped by more than 10%, from 302 to 270.

The list of 25 cities with the worst ozone pollution in "State of the Air" 2024 and their order of ranking remained remarkably stable compared with last year's report. The largest change in rank was only 5 places as Dallas-Fort Worth worsened from 18th to 13th worst. This year, Hartford Connecticut was the only city that improved enough to move off the worst 25 list. It was replaced by Grand Rapids, Michigan, which earned a spot on the list for the first time in 8 years. None of the cities on the list reported a worst-ever average number of days of ozone smog. Two cities, Fresno and El Centro, California recorded their fewest-ever number of unhealthy days for ozone, though they still earned "F" grades.



The geographical distribution of cities with the worst ozone problems confirms a pattern seen over nearly a decade of reporting: the great majority are western cities. Cities in the West and the Southwest continue to dominate the list of the most ozone-polluted cities. California retains its position of being the state with the most metro areas on the list, with 10 of the 25 most-polluted cities, while the six states of Arizona, Colorado, Nevada, New Mexico, Texas, and Utah accounted for 12 others. They are joined this year by only three more easterly cities, New York, Chicago, and Grand Rapids.

Although cleanup of ozone precursor pollutants has been working to reduce ozone concentrations, the impact of climate change in the West has meant higher temperatures, dry, sunny skies and more frequent stagnation events that are contributing to the number of unhealthy ozone days being higher than it would otherwise be. Simply, climate change is undercutting the progress we would have made.

Mike Nelson, chief meteorologist at Denver7, goes beyond the seven-day forecast to educate viewers on climate issues. Alongside the daily high temperature and precipitation, his weather graphics include the Denver area's air quality rating and the planet's current amount of carbon dioxide, the heat-trapping gas that's a major contributor to global warming.

He says on-air meteorologists have a special responsibility to talk about climate change.

"The television meteorologist is as close to a scientist as most Americans are going to get. People invite us into their homes every single day to explain something complicated – the weather," Nelson says. "Why would we shy away from talking about the most important thing we face globally?"

Nelson has been forecasting weather in Colorado for more than 30 years. During that time, the Clean Air Act and other regulations have helped improve air quality, he says. But he notes that the increase in large wildfires across the West in recent years is exacerbating particulate matter pollution. A hotter, drier climate is helping to fuel these more intense wildfires and days with heavy smoke, Nelson says.

Although related, climate and weather aren't the same. Climate is the long-term average of conditions, whereas weather refers to short-term changes and is often fast-changing. Nelson uses a football analogy: "Climate is the history of the National Football League; weather is one play in a game."

Nelson says the birth of his first grandchild 11 years ago pushed him to speak more about climate implications. Today's children and future generations are most at risk if we don't reduce carbon emissions, he notes.

"We can still fix it," Nelson says, "but the clock is ticking, and we should get going on it at a faster pace."

Mike Nelson
Chief Meteorologist at Denver7

Populations at Risk

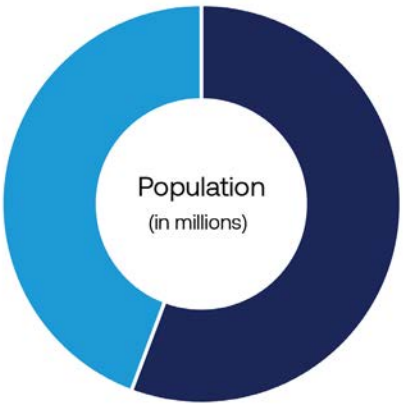
Nearly 263 million people live in the 885 counties with enough monitoring data to be assigned a grade for at least one pollutant in this year's report. The majority of U.S. counties actually don't have monitors—which means that many communities, especially rural ones, don't have official monitored information on their air quality. It is important to note that the population numbers included in this section are only for those places that collect air pollution data, and do not reflect the entire population of these groups in the U.S. The availability of data, and hence the population that is included in this report, differs for each pollutant.

Grade	Population
A	50.3
B	37.0
C	38.5
D	18.6
F	100.6

Population (millions) by County Ozone Grade

Grade	Population
A	49.2
B	64.8
C	41.2
D	7.1
F	65.0

Population (millions) by Daily PM Grade



Grade	Population
Pass	114.1
Fail	90.7

Population (millions) by Annual PM Grade

All of the 131.2 million Americans living in places with failing grades for unhealthy levels of ozone or particle pollution are at risk of harm to their health. But some groups of people are especially vulnerable to illness and death from their exposure. *See **People at Risk** for more detail about the factors that contribute to increased risk.*

The number of people in these high-risk groups in "State of the Air" 2024 are as follows:

- **People of color**—About 68.9 million people of color live in counties that received at least one failing grade for ozone and/or particle pollution. Over 27.5 million people of color live in counties that received failing grades on all three measures, including some 16.8 million Hispanics.
- **People experiencing poverty**—Sixteen million people with incomes meeting the federal poverty definition live in counties that received an F for at least one pollutant. More than 5.4 million people in poverty live in counties failing all three measures.
- **Children and older adults**—More than 29.2 million children under age 18 and some 20.6 million adults age 65 and over live in counties that received an F for at least one pollutant. More than 9.7 million children and more than 6.7 million seniors live in counties failing all three measures.
- People with underlying health conditions
  - **Asthma**—More than 1.9 million children and nearly 9.8 million adults with asthma live in counties that received an F for at least one pollutant. More than 600,000 children and some 3.1 million adults with asthma live in counties failing all three measures.
  - **Chronic Obstructive Pulmonary Disease (COPD)**—Some 6.0 million people with COPD live in counties that received an F for at least one pollutant. More than 1.7 million people with COPD live in counties failing all three measures.
  - **Lung Cancer**—More than 55,000 people diagnosed with lung cancer in 2020 live in counties that received an F for at least one pollutant, and about 15,200 people diagnosed with lung cancer live in counties failing all three measures.
  - **Cardiovascular Disease**—More than 8.4 million people with cardiovascular disease live in counties that received an F for at least one pollutant. More than 2.5 million people live in counties failing all three measures.
  - **Pregnancy**—Adverse impacts from air pollution have been shown both for those who are pregnant as well as for the developing fetus. More than 1.4 million pregnancies were recorded in 2022 in counties that received at least one failing grade for particle pollution. Of those, more than 478,000 were in counties that received failing grades for all three measures.

*For more detail about the number of people at risk by grade and by pollutant, see **Data Table 1**. The populations at risk are also included by county in the **State Data Tables**.*

Most Polluted Places to Live

In addition to the 25 worst cities for each pollutant listed above, the 25 most polluted counties for ozone and particle pollution are ranked in the tables below.

Ozone Ranking	State	County	WA
1	California	San Bernardino	175.2
2	California	Riverside	128
3	California	Los Angeles	114.8
4	California	Tulare	103
5	California	Kern	87.5
6	California	Fresno	52.2
7	Arizona	Maricopa	47.7
8	Colorado	Jefferson	40.3
9	California	Placer	29.3
10	Colorado	Douglas	26
11	California	San Diego	25.2
12	California	Nevada	24
12	Utah	Salt Lake	24
14	Texas	Harris	23.2
15	California	Madera	22.3
16	Arizona	Pinal	21.8
17	New Mexico	Eddy	21.7
18	Colorado	Arapahoe	20.8
19	California	Kings	20.5
20	Nevada	Clark	19.8
21	California	Stanislaus	19.7
22	California	El Dorado	19.3
23	California	Mariposa	18.7
24	California	Orange	18.3
25	Connecticut	Fairfield	17.7
25	Texas	Tarrant	17.7

PM Ranking	State	County	WA
1	California	Kern	61.8
2	California	Fresno	54.8
3	California	Mono	43.2
4	California	Kings	42.8
5	Oregon	Klamath	39.3
6	California	Inyo	39
7	Alaska	Fairbanks North Star	38.8
8	Oregon	Lane	38.5
9	California	Tulare	35.3
10	California	Siskiyou	27.8
11	Nevada	Washoe	26.8
12	Nevada	Douglas	26.7
13	California	Plumas	25.3
14	Nevada	Carson City	24.7
15	California	Stanislaus	24.2
16	California	Tehama	23.7
17	California	Madera	22.2
18	California	Placer	22
18	California	Sacramento	22
20	California	Butte	20.8
20	California	Nevada	20.8
22	California	Los Angeles	20.7
23	California	Colusa	19.8
24	California	Sutter	19
25	California	San Joaquin	18.3
25	Washington	Yakima	18.3

Annual PM Ranking	State	County	DV
1	California	Mono	19.5
2	California	Kern	18.8
3	California	Tulare	18.4
4	California	Fresno	17.5
5	California	Plumas	17
6	California	Kings	16.6
7	Oregon	Klamath	15.6
8	Oregon	Lane	14.7
9	California	Stanislaus	14.3
10	California	San Bernardino	14
11	California	Sutter	13.8
12	California	Riverside	13.6
13	Oregon	Jackson	13.5
14	California	Los Angeles	13.4
14	Montana	Lincoln	13.4
14	Washington	Okanogan	13.4
17	California	Madera	13.2
18	Arizona	Pinal	12.4
19	California	Merced	12.3
19	California	San Joaquin	12.3
21	Alaska	Fairbanks North Star	12.2
22	Indiana	Marion	11.9
23	Washington	Yakima	11.8
24	California	Sacramento	11.7
24	Michigan	Wayne	11.7

Thirty counties, listed alphabetically by state below, received failing grades for all three measures of pollution:

Arizona	Maricopa, Pinal
California	Alameda, Butte, Contra Costa, Fresno, Imperial, Kern, Kings, Los Angeles, Madera, Merced, Orange, Placer, Riverside, Sacramento, San Bernardino, San Diego, Santa Clara, Shasta, Stanislaus, Sutter, Tehama, Tulare
Colorado	Denver
Michigan	Wayne
Nevada	Clark, Washoe
New Mexico	Bernalillo
Utah	Salt Lake

Cleanest Places to Live

Many cities in the U.S. enjoy air that is considered clean for one or more of the pollution measures tracked in "State of the Air." In this year's report, 55 of the cities for which there is monitoring data had zero high short-term particle days and 75 cities had zero ozone days. Because year-round particle pollution is scored differently, the cleanest cities for this measure can be ranked, and the best 25 are considered cleanest. *See **Data Tables 3a-c**.*

In this year's report, only five cities rank on all three cleanest cities lists for particle pollution and ozone. They had zero days high in particle pollution and in ozone and are among the 26 cities with the lowest year-round particle levels. After last year's one-time appearance on all three cleanest lists, Asheville and Greenville, NC and Rochester NY all lost their place this year because of increases in ozone smog pollution. The other four again repeat their appearance on the combined list this year. Only Johnson City-Kingsport-Bristol, TN-VA, in its debut, was added to the list.

Listed alphabetically, the cleanest cities are:

Bangor, ME

Johnson City-Kingsport-Bristol, TN-VA

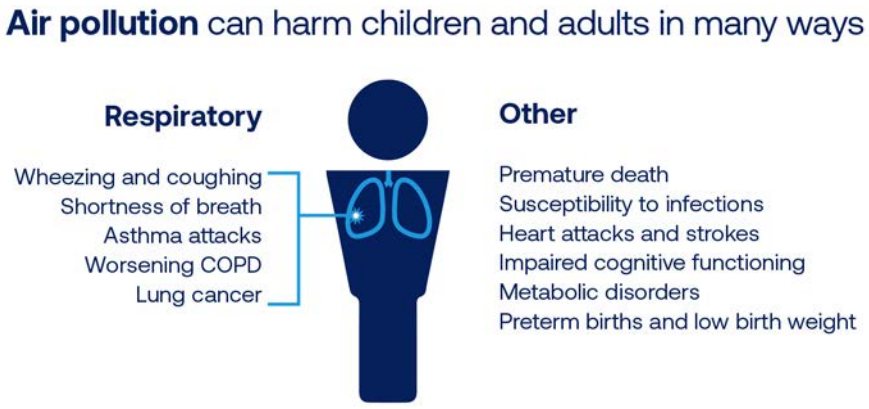
Lincoln-Beatrice, NE

Urban Honolulu, HI

Wilmington, NC

Health Impact of Air Pollution

Years of scientific research have clearly established that particle pollution and ozone are a threat to human health at every stage of life, increasing the risk of premature birth, causing or worsening lung and heart disease, and shortening lives. Some groups of people are more at risk of illness and death than others, because they are more likely to be exposed, or are more vulnerable to health harm, or often both.



Health Effects of Particle Pollution

Particle pollution—also known as particulate matter or soot—is a deadly and growing threat to public health in communities around the country. The more researchers learn about the health effects of particle pollution, the more dangerous it is recognized to be.

What is particle pollution?

Particle pollution refers to a mixture of tiny bits of solids and liquids in the air we breathe. Particle pollution comes from many sources. Factories, power plants, and diesel- and gasoline-powered vehicles and equipment either directly emit fine particles or generate other pollutants, such as nitrogen oxides (NO_X) and sulfur oxides (SO_X), known as precursors because they can then form into fine particles in the atmosphere. Other sources of particle pollution include wildfires, burning wood in wood stoves or residential fireplaces and burning biomass for electricity.

Researchers and regulators categorize particles according to size, grouping them as coarse, fine and ultrafine. Coarse particles, called PM10, can include wind-blown dust, ash, pollen and smoke. Fine particles, $PM_{2.5}$, are most often a by-product of burning wood or fossil fuels, and may include components such as toxic compounds, salts and metals. The tiniest are called ultrafine particles, or $PM_{0.1}$. They are also produced by combustion, and are included in the larger category of $PM_{2.5}$.

Individual fine particles are too small to be visible, but when pollution levels are high, they can make the air appear thick and hazy.

The differences in size make a big difference in how particles affect our health. Our bodies' natural defenses help us to keep the coarse particles we inhale out of the deepest parts of our lungs, although these particles do deposit in the larger airways. However, those defenses do not keep smaller fine or ultrafine particles from penetrating deep into the lungs and even all the way into the air sacs. Many of these particles get trapped there, while the smallest are so tiny that they can pass from the air sacs into the bloodstream and disperse to other organs of the body.

What can particles do to your health?

Particle pollution can be very dangerous to breathe, especially at higher concentrations. It can trigger illness, hospitalization and premature death. Researchers estimate that $PM_{2.5}$ is responsible for nearly 48,000 premature deaths in the United States every year.[1]

Short-Term Exposure

Short-term spikes in particle pollution that last from a few hours to a few days can kill. Premature deaths from breathing these particles can occur on the very day that particle levels are high, or up to a month or two afterward. Most premature deaths are from respiratory and cardiovascular causes. Particle pollution does not just make people die a few days earlier than they might otherwise—in many cases these deaths would not have occurred for years if the air were cleaner.[2]

Studies linking short-term exposure to $PM_{2.5}$ to death from all causes have been accumulating for a number of years. Taken together, this body of research provides consistent evidence of positive associations between particle pollution and mortality across diverse geographic locations and in populations with a wide range of demographic characteristics. In 2019, an international study looking at 499 cities across the globe reinforced these consistent findings.[3]

Exposure to even low levels of fine particles can be deadly. Looking nationwide in a 2017 study, researchers found that older adults faced a higher risk of premature death even when levels of short-term particle pollution remained well below the current national standard. This was consistent whether the older adults lived in cities, suburbs or rural areas.[4] Another study published in 2018 analyzed mortality data from 135 U.S. cities and found a causal relationship with exposure to $PM_{2.5}$ at concentrations below the federal standard.[5]

Particle pollution also has many other harmful effects, ranging from decreased lung function to heart attacks. Extensive research has linked short-term increases in particle pollution to:

- increased mortality in infants;[6]
- increased hospital admissions for cardiovascular disease, including heart attacks and strokes;[7]
- increased hospital admissions and emergency department visits for chronic obstructive pulmonary disease (COPD);[8]
- increased severity of asthma attacks and hospitalization for asthma among children.[9,10]

Year-Round Exposure

Decades of research have firmly established that breathing particle pollution day in and day out can also be deadly. Across numerous seminal studies that looked at different groups of people living in different parts of the country, the results consistently showed a clear relationship between long-term exposure to particulate matter and mortality.[11]

Research using publicly available data on a cohort of more than one million adults in the U.S. reconfirmed that long-term exposure to $PM_{2.5}$ was associated with elevated risks of early death. The increased risk was primarily associated with death from cardiovascular and respiratory causes, including heart disease, stroke, influenza and pneumonia. Researchers also found a similar association between exposure to fine particle pollution and an increased risk of death from lung cancer among never-smokers.[12] Another study of 68.5 million Medicare-enrolled adults in the United States between 2000 and 2016 found a 6-8% increase in risk of all-cause mortality for every 10µg/m3 increase in the annual average $PM_{2.5}$.[13]

Research has also linked year-round exposure to particle pollution to a wide array of serious health effects at every stage of life, from conception through old age. Among individuals who are pregnant, fetuses and children, long-term particle pollution exposure is linked to:

- Increased risk of preterm birth and low birth weight;[14]
- Increased fetal and infant mortality;[15]
- Impaired neurological development and cognition;[16]
- Reduced lung development and impaired lung function in children;[17]
- Higher likelihood of children developing asthma.[18]

In adults, long-term particle pollution exposure is linked to:

- Increased risk from existing cardiovascular and respiratory disease, including a worsening of heart disease, atherosclerosis and COPD;[19,20]
- Higher likelihood of developing diabetes and subsequent complications;[21,22]
- Higher likelihood of getting lung cancer and of dying from it;[23]
- Impaired cognitive functioning and an increased risk of Parkinson's disease, Alzheimer's disease and other dementias later in life;[24,25]
- Increased risk of clinical depression and anxiety.[26]

The good news is that cleaning up particle pollution makes a difference. Research has shown a consistent relationship between decreasing $PM_{2.5}$ concentrations and improving respiratory health in children and reduced mortality of adults in communities that have reduced their levels of year-round particle pollution.[27,28]

Who is most at risk from particle pollution?

Anyone who lives where particle pollution levels are high is at risk. Some people face greater risk, however, based on their underlying health and other characteristics. [See the People at Risk section for more information about vulnerable groups] Research has shown that the groups at the greatest risk from particle pollution include:

- Pregnant people and fetuses;[29]
- Infants, children and people age 65 and older;[30]
- People with lung disease, especially asthma, but also people with COPD;[31]
- People with cardiovascular disease;[32]
- People with lung cancer;[33]
- People of color;[34]
- Current or former smokers;[35]
- People with low incomes;[36] and
- People who are obese or have diabetes.[37]

Health Effects of Ozone Pollution

Ground-level ozone, sometimes known as smog, is one of the most widespread and dangerous pollutants in the United States. Scientists have studied the effects of ozone on human health for decades. Hundreds of studies have confirmed that ozone harms people at levels currently found in many parts of the United States.

What is Ozone Pollution?

Ozone is a gas composed of molecules with three oxygen atoms. (The oxygen we need for life is made up of molecules with two oxygen atoms.) Ozone forms in the lower atmosphere when a combination of pollutants, usually nitrogen oxides (NO_x) and volatile organic compounds (VOCs), "cook" together in sunlight through a series of chemical reactions. NO_x and VOCs are produced primarily when fossil fuels such as gasoline, diesel, oil, natural gas or coal are burned or when solvents and some other chemicals evaporate. NO_x is emitted from power plants, motor vehicles and other sources of high-heat combustion. VOCs are emitted from motor vehicles, oil and gas operations, chemical plants, refineries, factories, gas stations, paint, consumer products and other sources.

If these ingredients are present under the right conditions, they react to form ozone. Sunlight is key, with higher temperatures increasing ozone production. Because the reactions take place in the atmosphere, ozone often shows up downwind of the sources of the original emissions, sometimes many miles from where it formed.

Ozone air pollution is sometimes called ground-level ozone, to distinguish it from the much higher-altitude stratospheric ozone layer that protects people from damaging ultraviolet rays from the sun.

What Can Ozone Pollution Do to Your Health?

Ozone gas is a powerful lung irritant. When it is inhaled into the lungs, it reacts with the delicate lining of the small airways, causing inflammation and other damage that can impact multiple body systems. Ozone exposure can also shorten lives.

Ozone has a serious effect on the respiratory system, both in the short term and over the course of years of exposure.

When ozone levels are high, many people experience breathing problems such as chest tightness, coughing and shortness of breath, often within hours of exposure. Even healthy young adults may experience respiratory symptoms and decreased lung function.[38]

Other breathing problems that have been tied to short-term exposure to ozone include:

- Worsening of symptoms, increased medication use, and increased emergency department visits and hospital admissions for people with asthma and COPD;[39]
- Susceptibility to respiratory infections such as pneumonia, resulting in an increased likelihood of emergency department visits and hospitalizations.[40]

Living with ozone pollution long term may cause lasting damage to respiratory health, including:

- Development of new cases of asthma in children;[41]
- Damage to the airways, leading to development of COPD;[42]
- Increased allergic response.[43]

The inflammation and systemic stress caused by short- and long-term exposure to ozone can also do damage to tissues, genes and proteins throughout the body, which can cause or worsen other disease conditions over time. These include:

- Potential increased risk of metabolic disorders, including glucose intolerance, hyperglycemia and diabetes;[44]
- Potential impact on the central nervous system, including brain inflammation, structural changes and increased risk of cognitive decline;[45,46]
- Increased likelihood of reproductive and developmental harm, including reduced fertility, pregnancy complications, preterm birth, stillbirth and low birth weight;[47,48]
- Possible cardiovascular effects.[49]

The damage ozone does to the body can be deadly. Recent research has affirmed earlier findings that short-term exposure to ozone, even at levels below the current standard, likely increases the risk of premature death, particularly for older adults.[50] There is also a growing body of evidence that long-term exposures to ambient ozone may be associated with an increased risk of cardiovascular and respiratory disease mortality.[51]

Who is Most at Risk from Ozone Pollution?

Anyone who spends time outdoors where ozone pollution levels are high may be at risk. Some people face a higher-than-average risk, however, because of their underlying health and other characteristics. [See the People at Risk section for more information about vulnerable groups.] Research has shown that the groups at greatest risk from ozone pollution include:

- Pregnant people and fetuses;[52]
- Children;
- Anyone 65 and older;
- People with existing lung disease such as asthma and COPD;
- People who work or exercise outdoors.[53]

Air Pollution and COVID-19

Both ozone and particle pollution can impact the functioning of the immune system and increase susceptibility to respiratory infections. Air pollution also increases the risk of chronic lung and cardiovascular diseases that put people at higher risk of poor outcomes from COVID-19. It should come as no surprise, then, that a growing body of research has found an association between exposure to even low levels of air pollution and an increased risk of severe illness and death from COVID-19. People living with chronic conditions, the elderly, people of color and those living in low-wealth communities are more vulnerable to poor outcomes.[54,55] A 2022 study in California found that people living in the most polluted areas of the state had a 20% higher risk of COVID infection and a 51% higher risk of death than residents in the least polluted areas.[56]

People at Risk

The health burden of air pollution is not evenly shared. Some people are more at risk of illness and death from air pollution than others. Several key factors affect an individual's level of risk:

- Exposure—Where someone lives, where they go to school and where they work makes a big difference in how much air pollution they breathe. In general, the higher the exposure, the greater the risk of harm.
- Susceptibility—Individuals who are pregnant and their fetuses, children, older adults and people living with chronic conditions, especially heart and lung disease, may be physically more susceptible to the health impacts of air pollution than other adults.
- Access to healthcare—Whether or not a person has health coverage, a healthcare provider, and access to linguistically and culturally appropriate health information may influence their overall health status and how they are impacted by environmental stressors like air pollution.
- Psychosocial stress—There is increasing evidence that non-physical stressors such as poverty, racial/ethnic discrimination and migration status can amplify the harmful effects of air pollution.

These risk factors are not mutually exclusive and often interact in ways that lead to significant health inequities among subgroups of the population. Taken all together, these high-risk categories account for a large proportion of the U.S. population.

People of color

Research has shown that people of color are more likely to be exposed to air pollution and more likely to suffer harm to their health from air pollution than white people.[57,58] Much of this inequity can be traced to the long history of systemic racism in the United States. Practices such as redlining, the discriminatory outlining of so-called "riskier" neighborhoods by mortgage lenders, institutionalized residential segregation in the 20th century, impairing the ability of many people of color to build wealth and limiting their mobility and political power. Over the years, decision-makers have found it easier to place sources of pollution, such as power plants, industrial facilities, landfills and highways, in economically disadvantaged communities of color than in more affluent, predominantly white neighborhoods. The resulting disproportionate exposure to air pollution has contributed to high rates of emergency department visits for asthma and other diseases.[59,60]

People of color are also more likely than white people to be living with one or more chronic conditions that make them more susceptible to the health impact of air pollution, including asthma and diabetes.[61]

People experiencing poverty

There is evidence that having low income or living in lower income areas puts people at increased risk from air pollution, although the correlation is not as strong as with race and ethnicity.[62,63] People living in poverty are more likely to live in close proximity to sources of pollution and have fewer resources to relocate than people with more financial security.[64] Poverty itself, along with the problems that beset many low-income communities, such as lack of safety, green space, and high-quality food access, have been associated with increased psychosocial distress and chronic stress, which in turn make people more vulnerable to pollution-related health effects.[65] People with low income also have lower rates of health coverage and less access to quality and affordable health care to provide relief to them when they get sick.

Dr. Aaron Levy works directly with those who are among the most vulnerable to poor air quality—children.

"The impacts of poor air quality start prenatally," says Levy, a pediatrician at Atrium Health's Levine Children's Hospital in Charlotte, North Carolina. "We know that women who are exposed to higher levels of poor air quality including particulate pollution have a greater risk of having babies born premature and low birth weight."

Levy is an advocate for integrating climate health into medical training. He says the impacts of air pollution on people's health should be as ingrained in education as the effects of cigarette smoke.

When physicians understand how climate change is related to patient care, they're better equipped to help protect and educate patients, he says. For example, Levy points to the Air Quality Index as a tool that people with asthma and other respiratory diseases can use to prepare for days when they may need to limit their outdoor exposure.

Levy says air quality has improved in recent years in the Charlotte area due to policy and behavioral changes but that continuing to push for cleaner energy and transportation is critical to healthier air. He adds that warming temperatures has been linked to longer and more intense allergy seasons, worsening the impacts of asthma.

"This past summer was a perfect example that we do not live in a vacuum," Levy says, noting that wildfire smoke from Canada reached the Carolinas. "We're all globally interconnected with the effects of climate change and we all play a role to help ensure every child grows up breathing healthy air."

Dr. Aaron Levy
Pediatrician at Atrium Health's Levine Children's Hospital
Charlotte, North Carolina

Children

Children are both more susceptible to harm from air pollution and more likely to be exposed than adults. The growth and development of a child's lungs and breathing ability start in utero and continue into early adulthood. Long-term exposure to particle pollution during pregnancy and early childhood has been linked to reduced lung growth and long-term exposure to ozone has been linked to increased potential for the development of asthma. The developing brain and heart may also be affected, with life-long consequences.[66] In addition, the body's defenses that help adults fight off infections are still developing in children. Children have more respiratory infections than adults, which also seems to increase their susceptibility to air pollution.[67]

Children breathe more rapidly and inhale more air relative to their size than do adults. They are more likely to spend time outdoors, running around, being active and breathing hard. Consequently, they are more exposed to polluted outdoor air than adults typically are.

Older adults

Much of the illness and premature death caused by air pollution occurs in older adults, who are at increased risk of harm for several reasons. As a person ages, the normal process of thinning and weakening of the lung tissue and the supporting muscle and bones of the ribcage results in diminishing lung function over time. The impairment that results from exposure to air pollutants then has an add-on effect, putting stress on the lungs and heart. Older people are also more likely to be living with chronic diseases, and there is evidence that co-existing chronic lung, heart or circulatory conditions may worsen following exposure to environmental pollutants.[68]

The strength of the immune system also declines with age, leaving older people at greater risk of contracting infections and less able to get them under control before they become serious. Because exposure to air pollution increases susceptibility to respiratory infections, it also increases the risk of severe illness and death in older adults.

People with underlying health conditions

For the millions of people in the U.S. living with illnesses such as asthma, COPD, diabetes, heart disease and lung cancer, exposure to air pollution places them at greater risk of harm to their health than those without disease. The cellular injury and systemic inflammation triggered by breathing ozone and particle pollution put additional stress on people's lungs, heart and other organs already compromised by disease. This can result in a worsening of symptoms, increased medication use, more frequent emergency department visits and hospitalizations, an overall reduced quality of life and far too often premature death.

Individuals who are pregnant and fetuses

Pregnancy is always a susceptible time for both the individual who is pregnant and the developing fetus. The pregnant body undergoes dramatic physiological changes in hormone levels, metabolism and circulation throughout months of gestation. The rapid and complex development of the fetus is a precisely timed and sequenced process. The inflammation and oxidative stress resulting from exposure to air pollution during pregnancy can increase the risk of hypertensive disorders, including preeclampsia, and lead to intrauterine inflammation and damage to the placenta that can disrupt the growth and development of the fetus. Fetal health may also be impacted in a number of ways by environmental contaminants that have been shown to cross the placenta.[69]

Exposure to both ozone and particle pollution during pregnancy is associated with premature birth, low birth weight and stillbirth. These risks are amplified when the individual who is pregnant is also at higher risk of health harm from air pollution in other ways, such living in poverty or having asthma.[70]

People with a smoking history

There is some recent evidence suggesting that current and former smokers are at greater risk of health harm from exposure to fine particle pollution compared with never-smokers. They are more likely to develop lung cancer and to die prematurely.[71] Smoking damages the lungs, heart, blood vessels and other organs.[72] This impairment leaves the person with a smoking history more vulnerable to the health impact of air pollution than a never-smoker.

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Recommendations for Action

We need action at every level to clean up air pollution and address climate change.

Federal Government

The Biden administration has made major progress on protecting public health and advancing environmental justice through their efforts to tackle the climate crisis and clean up the air. In "State of the Air" 2023, we called for the U.S. Environmental Protection Agency to finalize a suite of lifesaving clean air measures. Many of those policy measures are now in place, and other critical protections are well underway.

- **DONE: Updated national particle pollution standards.** EPA strengthened the annual fine particulate matter pollution standards from 12 µg/m3 to 9 µg/m3. While the standards aren't as strong as what the Lung Association called for, they'll still save lives and prevent significant health harms.
- **DONE: Rules to clean up methane and other air pollutants from the oil and gas industry.** EPA finalized rules to address leaks of methane from the oil and gas production process, like drilling operations. This is a crucial climate measure and will also reduce emissions of dangerous volatile organic compounds (VOCs). This is especially important for people living near oil and gas sites, making this final rule an environmental justice victory as well as a climate victory.
- **DONE: Stronger multi-pollutant standards for future cars.** EPA finalized a rule that will make future light- and medium-duty vehicles cleaner. The rule will help get more zero-emission vehicles on the road and make new gasoline-powered cars less polluting too.
- **DONE: Stronger carbon pollution limits on future trucks and buses.** EPA finalized a rule that will make future heavy-duty vehicles less polluting. The rule tightens emissions limits of the carbon pollution that drives climate change and will help drive a transition to zero-emission trucks and buses, a win for environmental justice.
- **IN PROGRESS: Implementing the largest-ever climate and clean energy investments passed in the Inflation Reduction Act.** This landmark law is the largest action the U.S. has ever taken to tackle climate change. Investments in clean electricity, electric vehicles, zero-emission appliances, air quality monitoring, environmental justice and more are rolling out.
- **IN PROGRESS: Addressing wildfires.** The Biden Administration created a Wildland Fire Mitigation and Management Commission, which released a report with recommendations for federal action to address the nation's accelerated and climate-driven wildfire crisis. We're pushing for many of those recommendations to be adopted.

We applaud this progress. Now, we call for President Biden and EPA to build on these successes with additional final rules to clean up air pollution, and on Congress to help ensure these protections are funded, implemented and enforced. Additional actions needed include:

- **EPA must set stronger national standards for ozone**. The research shows that a standard of no higher than 60 parts per billion would protect health. Stronger standards would drive cleanup of polluting sources nationwide and enable families across the country to be better informed about when local air quality may put their health at risk. In 2023, EPA announced a major delay by essentially starting over in their work to update the standard. There is no time to waste in moving forward. Take action at Lung.org/sota-petition.

- **EPA must clean up power plant pollution.** EPA must finalize rules to limit carbon emissions on coal and gas-fired power plants. These measures will help address climate change and provide important reductions in other pollutants at the same time. EPA must also finalize tighter limits on mercury and other toxic emissions from coal- and oil-fired power plants, and strengthen monitoring requirements to help ensure that cleanup happens quickly.
- **Congress must defend the Clean Air Act and its protections and pass funding bills that adequately invest in EPA.** There are partisan efforts underway to undermine federal clean air protections and the Clean Air Act itself. Congress must safeguard the Clean Air Act and the administration's efforts to clean up deadly air pollution and climate pollution. Congress must also increase funding for EPA to set and enforce these lifesaving rules and to provide assistance to state, local and Tribal air agencies to monitor and clean up harmful air pollution.

State, Territorial and Tribal Governments

Not only can states, territories and Tribes strengthen clean air protections, they are crucial to the success of EPA's stronger standards, and they can reap the benefits of Inflation Reduction Act investments.

- **Implement EPA's new clean air protections.** EPA's final rules require work from states, territories and Tribes to ensure their residents see the benefit of stronger air pollution standards. This includes cleaning up areas where the air violates the new particle pollution standards, writing plans to clean up carbon from the power sector and implementing the recently finalized limits on methane.
- **Set a clean or renewable electricity standard or clean peak** standard that phases out the use of coal, oil, methane gas (often called natural gas) and other combustion energy sources and replaces it with wind, solar, geothermal and tidal and other non-combustion forms of electricity. Do not allow for the increased use of biomass or municipal solid waste for electricity because of their contributions to dangerous air pollution.
- **Prioritize deployment of clean energy production.** In order to hit clean energy goals, it is imperative for states, territories and Tribes to prioritize major deployment of non-combustion clean power as well as battery energy storage.
- **Leverage Inflation Reduction Act funding** available to state, territorial and Tribal governments to reduce emissions, including reducing air pollution at ports, investing in zero-emission school buses, electrifying buildings, expanding electric vehicle infrastructure, and improving air quality monitoring. Ensure that environmental justice communities that have long borne the brunt of pollution impacts are prioritized for investment.
- **States: Use Clean Air Act authority to adopt the California zero-emissions standards for cars and trucks.** These include California's Low-Emission Vehicle criteria pollutant and greenhouse gas regulations; Zero-Emission Vehicle regulations; and Advanced Clean Trucks regulations.

Evelyn Mateos racks up around 1,000 miles each month driving between her home in Orange County, California and Las Vegas, where she lived for a few years until recently.

"In Southern California, we're built on cars. We drive pretty much everywhere," she says.

But a proposed high-speed electric train connecting Las Vegas and suburban San Bernardino County near Los Angeles would give people another option for traveling. Construction on the 218-mile Brightline West project is expected to start this year.

The zero-emission system is projected to lower greenhouse gasses by more than 400,000 tons of CO2 each year and reduce annual vehicle miles traveled by more than 700 million, according to Brightline[iii]. Traveling at speeds of up to 200 miles an hour, the trains would be nearly twice as fast as driving.

Mateos says she believes many people in Southern California care about reducing pollution from vehicles and that an alternative to driving or flying to Las Vegas would be appealing.

"Not having to put those miles on your car and risk getting stuck in traffic could be exciting for Californians," she says. "It could potentially get many cars off the road."

Evelyn Mateos
Orange County, CA

Local Governments

Local governments have the power to help ensure that city and county operations are zero-emission and that residents have the ability to choose zero-emission forms of transportation and electricity. These actions must benefit the communities most impacted by unhealthy air.

- **Adopt a climate action plan.** Reduce city- and county-wide emissions by supporting walking, biking and transit and zero-emission vehicle infrastructure and ensuring that building and parking policies support these goals. Include measures to address the impacts of climate change on residents, including health impacts. Under the Inflation Reduction Act, municipalities can opt in to get federal planning grants to reduce climate pollution.
- **Purchase zero-emission fleet vehicles.** Commit to purchasing zero-emission garbage and recycling trucks, transit buses, school buses and other vehicles. Under the Inflation Reduction Act, there are tax credits for the purchase of new and used electric vehicles that are available through up-front direct pay, as opposed to in a tax filing. EPA also has a Clean School Bus Program that has provided several rounds of rebates and grant programs to eligible entities purchasing zero-emission school buses.
- **Establish purchasing goals for renewable, non-combustion electricity.** Power city and county operations with truly clean sources of electricity like wind, solar, geothermal or tidal. The Inflation Reduction Act also included direct-pay tax credits for the purchase of renewable energy.

iii https://wwwbrightlinewest.com/overview/project

Individuals

You can take action to protect yourself and your family from the dangers of air pollution. Regardless of its grade or ranking in this report, any community can experience days with unhealthy levels of air pollution. Some simple precautions will reduce your risk:

- **Check daily air pollution forecasts in your area at airnow.gov.** The color-coded forecasts let you know when the air is unhealthy in your community. When the air is bad, move your exercise plans and other activities indoors. If you live in a fire-prone area, learn more about using N-95 masks and creating a clean room inside your home with our wildfire resources at Lung.org/wildfire.
- **Reduce your own contributions to air pollution.** Prioritize walking, biking and clean public transit over diesel or gasoline-powered vehicles. Conserve electricity and purchase your power from clean, non-combustion sources if you can. When heating and cooling, adjusting your thermostat just one degree can save you money and reduce energy use. Don't burn leaves or trash and avoid burning wood whenever possible.
- **Consider taking advantage of tax incentives to reduce emissions from your home and vehicle.** One of the best ways to reduce pollution is to switch from vehicles and appliances that burn fuel—like gasoline-powered cars and natural gas stoves and furnaces—to zero-emission versions that run on electricity. Under the Inflation Reduction Act passed in 2022, you may be able to get tax credits for buying a new or used electric vehicle or for upgrading your home with efficient, zero-emissions appliances like induction stoves or heat pumps. Learn more here.
- **Show up at the local level.** In addition to taking action with the Lung Association, you can advocate for air quality and climate policy change in your community. Get engaged with local policymakers and civic organizations. Learn about local advocacy opportunities. Show up at public hearings and meet with your local leaders to share why cleaning up air pollution and addressing climate change matters to you and your community. You are the best advocate for action in your community.

Rohan Arora watched his father coughing at home and relying more on his inhaler. Smog and other air pollution he encountered while commuting to and working in Washington, D.C. aggravated his asthma to the point that sleeping became difficult.

Seeing the toll that poor air quality took on his father inspired Arora to make environmental health and climate activism his passion.

"When you see it in your own household, it becomes real," Arora says. "It's not something in the news, it's not hypothetical – you see it happening in front of you."

Arora is the founder and executive director of The Community Check-Up, a national environmental health organization that empowers youth to be changemakers in their communities. He says grassroots efforts are instrumental in driving change and that young people can play a big role by discussing climate issues at home, attending town halls, and talking with local representatives.

Schools can also help educate on environmental and climate topics, he says, by integrating them into the curriculum so that students gain the skills needed to understand the most pressing challenges and instill change.

"Young people have a lot of energy," Arora says, "and that's what this movement really needs."

Rohan Arora
Executive Director of The Community Check-Up

Understanding Grades and Tables

*See **Methodology** for a full explanation of data sources and calculations made for state grades.*

Notes for state grades tables

1. Not all counties have monitors for either ozone or particle pollution. If a county does not have any monitoring data for either pollutant, that county's name is not on the list in these tables. The decision about siting monitors in a county is made by the state and the U.S. Environmental Protection Agency, not by the American Lung Association.
2. **INC** (Incomplete) indicates that monitoring data is available for at least one year in that county, but not all three years.
3. **DNC** (Data Not Collected) indicates that data on that particular pollutant was not collected in that county during the three years covered in the report.
4. The **Weighted Average (Wgt. Avg.)** was derived by adding the three years of individual level data (2020-2022), multiplying the sums of each level by the assigned standard weights (i.e., 1=orange, 1.5=red, 2.0=purple and 2.5=maroon) and calculating the average. Grades are assigned based on the weighted averages as follows: A=0.0, B=0.3-0.9, C=1.0-2.0, D=2.1-3.2, F=3.3+.
5. The **Design Value** is the calculated concentration of a pollutant based on the annual National Ambient Air Quality Standard for PM2.5, which is 9 µg/m3. Counties with design values of 9.0 or lower received a grade of "Pass" for Annual $PM_{2.5}$. Counties with design values of 9.1 or higher received a grade of "Fail."

Notes for at-risk groups tables

1. Adding across rows does not produce valid estimates. Adding the at-risk categories (asthma, COPD, poverty, etc.) will double-count people who fall into more than one category.
2. **Total Population** is based on 2022 U.S. Census and represents the at-risk populations in counties with ozone or $PM_{2.5}$ pollution monitors; it does not represent the entire state's sensitive populations.
3. Those **18 & under** and **65 & over** are vulnerable to ozone and $PM_{2.5}$. Do not use them as population denominators for disease estimates—that will lead to incorrect estimates.
4. **Pediatric asthma** estimates are for those under 18 years of age and represent the estimated number of people in that age group who had asthma in 2022 based on the state rates, when available, or national rates when not (Behavioral Risk Factor Surveillance System, or BRFSS), applied to county population estimates (U.S. Census).
5. **Adult asthma** estimates are for those 18 years of age and older and represent the estimated number of people in that age group who had asthma during 2022 based on state rates (BRFSS) applied to county population estimates (U.S. Census).
6. **COPD** estimates are for adults 18 and over who had ever been diagnosed with chronic obstructive pulmonary disease, which includes chronic bronchitis and emphysema, based on state rates (BRFSS) applied to county population estimates (U.S. Census).
7. **Lung cancer** estimates are for all ages and represent the estimated number of people newly diagnosed with lung cancer in 2020 based on state rates (StateCancerProfiles.gov) applied to county population estimates (U.S. Census).
8. **Cardiovascular (CV) disease** estimates are for adults 18 and over who have been diagnosed within their lifetime, based on state rates (BRFSS) applied to county population estimates (U.S. Census). CV disease includes coronary heart disease, stroke and heart attack.
9. **Pregnancy** estimates are for females 18-49 and based on state rates of pregnancies resulting in live births applied to population estimates (U.S. Census).
10. **Poverty** estimates include all ages and come from the U.S. Census Bureau's Small Area Income and Poverty Estimates program. The estimates are derived from a model using estimates of income or poverty from the Annual Social and Economic Supplement and the Current Population Survey, 2021. Puerto Rico poverty estimates come from the U.S. Census Bureau's American Community Survey, 2018-2022.
11. **People of color** are defined as anyone Hispanic or as non-Hispanic Black, Asian, American Indian/Alaska Native, Native Hawaiian and Other Pacific Islander, or two or more races, based on 2022 county population estimates (U.S Census). Puerto Rico race and ethnicity estimates come from the U.S. Census Bureau's American Community Survey, 2018-2022.
12. Based on a request from Connecticut, the Census Bureau shifted from providing population estimates by county to county-equivalent Planning Regions for the state starting with 2022 data. As air quality data continues to be county-based and Planning Regions are incompatible with historic Connecticut counties, Census Bureau population estimates from 2021 are used in this year's report. Disease rates are still from the latest year available.

Table 1 Populations at Risk by Grade and by Pollutant

People at Risk from Short-Term Particle Pollution (Daily $PM_{2.5}$)

	Chronic Diseases					Age Groups						
In Counties Where the Grades Were:	Adult Asthma	Pediatric Asthma	COPD	Lung Cancer	CV Disease	Under 18	65 and Over	Pregnancies	Poverty	People of Color	Total Population	Number of Counties
Grade A (0.0)	3,970,783	738,191	2,740,423	24,796	3,702,636	10,075,706	9,086,964	535,499	6,238,636	20,133,803	49,179,066	189
Grade B (0.3-0.9)	5,079,528	1,053,752	3,343,322	32,211	4,555,333	14,142,191	10,582,970	730,466	8,024,747	30,112,204	64,840,472	179
Grade C (1.0-2.0)	3,183,931	663,488	2,148,425	20,680	2,882,999	9,264,054	6,450,259	479,719	5,301,718	19,333,435	41,192,333	101
Grade D (2.1-3.2)	579,875	110,798	347,307	3,318	479,497	1,544,532	1,159,404	81,049	882,683	2,663,062	7,059,894	28
Grade F (3.3+)	4,800,925	925,749	2,670,002	23,543	3,851,062	14,389,766	10,219,595	711,081	7,817,092	36,134,746	65,044,038	112
National Population in Counties with $PM_{2.5}$ Monitors	17,931,126	3,553,429	11,467,944	106,610	15,769,181	50,392,736	38,182,655	2,587,275	28,764,843	110,363,013	231,622,263	636

People at Risk from Year-Round Particle Pollution (Annual $PM_{2.5}$)

	Chronic Diseases					Age Groups						
In Counties Where the Grades Were:	Adult Asthma	Pediatric Asthma	COPD	Lung Cancer	CV Disease	Under 18	65 and Over	Pregnancies	Poverty	People of Color	Total Population	Number of Counties
Pass	9,222,608	1,812,844	5,973,467	55,600	8,048,151	24,326,263	19,491,673	1,265,020	13,213,602	46,641,380	114,105,251	404
Fail	6,570,024	1,328,951	4,177,859	38,337	5,837,318	20,443,163	13,942,272	1,027,505	11,961,128	52,027,008	90,697,300	119
National Population in Counties with $PM_{2.5}$ Monitors	17,931,126	3,553,429	11,467,944	106,610	15,769,181	50,392,736	38,182,655	2,587,275	28,764,843	110,363,013	231,622,263	636

People at Risk from Ozone

	Chronic Diseases				Age Groups						
In Counties Where the Grades Were:	Adult Asthma	Pediatric Asthma	COPD	CV Disease	Under 18	65 and Over	Pregnancies	Poverty	People of Color	Total Population	Number of Counties
Grade A (0.0)	3,972,552	732,003	2,837,241	3,876,249	10,254,455	9,804,844	530,474	6,128,907	18,155,334	50,328,508	270
Grade B (0.3-0.9)	2,915,199	628,750	2,056,559	2,734,650	8,193,121	6,338,228	402,750	4,366,591	14,661,103	37,020,487	184
Grade C (1.0-2.0)	3,178,504	620,749	2,007,272	2,691,177	8,291,092	6,346,079	429,708	4,277,158	15,240,131	38,497,671	123
Grade D (2.1-3.2)	1,500,563	280,480	966,305	1,317,279	3,869,457	3,157,808	207,931	2,285,164	8,268,388	18,562,314	50
Grade F (3.3+)	7,422,719	1,480,413	4,469,660	6,338,201	22,554,216	15,503,442	1,132,845	12,236,035	55,607,758	100,627,376	125
National Population in Counties with Ozone Monitors	19,079,014	3,761,012	12,391,695	17,036,793	53,387,344	41,353,243	2,714,245	29,423,476	112,270,906	246,076,336	775

Table 2a People at Risk in 25 U.S. Cities Most Polluted by Short-Term Particle Pollution (Daily $PM_{2.5}$)

2024 Rank	Metropolitan Statistical Areas	Total Population	Under 18	65 and Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	People of Color	Poverty
1	Bakersfield, CA	916,108	260,354	107,854	14,596	56,417	28,379	300	42,186	9,535	637,251	158,995
2	Fresno-Madera-Hanford, CA	1,328,427	364,850	170,959	20,454	83,063	42,575	435	63,876	14,004	963,186	244,173
3	Fairbanks, AK	95,356	22,335	11,980	1,558	7,969	3,736	48	5,422	1,264	30,210	7,117
4	Eugene-Springfield, OR	382,353	66,030	81,012	4,589	36,325	21,129	159	30,704	3,658	75,815	56,320
5	Visalia, CA	477,544	141,291	56,443	7,921	28,949	14,655	156	21,831	5,048	353,320	86,096
6	Reno-Carson City-Fernley, NV	670,258	134,060	131,583	9,590	53,609	39,220	330	52,843	6,532	246,590	68,783
7	San Jose-San Francisco-Oakland, CA	9,482,708	1,961,875	1,573,978	109,986	653,728	359,039	3,101	546,284	100,209	6,099,825	920,277
8	Redding-Red Bluff, CA	246,175	54,297	52,444	3,044	16,849	10,066	80	15,846	2,248	64,216	34,523
9	Sacramento-Roseville, CA	2,701,808	594,397	462,916	33,323	183,342	101,602	881	155,757	28,352	1,347,234	301,699
10	Chico, CA	207,303	41,519	38,407	2,328	14,390	7,874	68	12,254	2,266	66,108	37,152
11	Los Angeles-Long Beach, CA	18,372,485	3,969,521	2,794,005	222,539	1,248,866	671,276	6,005	1,011,872	198,882	13,051,016	2,271,941
12	Yakima, WA	257,001	74,062	37,021	5,414	20,057	9,348	107	13,306	2,600	154,133	41,877
13	Seattle-Tacoma, WA	4,982,019	1,019,132	787,087	74,496	434,665	202,311	2,078	287,133	54,671	1,904,537	431,909
14	Missoula, MT	121,041	21,492	20,930	1,344	11,932	6,031	49	7,815	1,454	14,034	10,920
15	Spokane-Spokane Valley-Coeur d'Alene, WA-ID	781,497	167,793	145,170	12,129	67,336	34,360	322	50,104	8,122	122,146	89,605
16	Phoenix-Mesa, AZ	5,069,600	1,130,197	852,129	91,111	388,402	253,096	1,843	353,875	55,202	2,370,614	547,851
17	Boise City-Mountain Home-Ontario, ID-OR	899,574	209,972	145,704	14,641	76,608	40,853	360	57,746	10,333	200,133	83,434
18	San Diego-Chula Vista-Carlsbad, CA	3,276,208	679,626	507,032	38,101	224,682	119,040	1,073	180,364	35,634	1,854,933	338,482
19	Salt Lake City-Provo-Orem, UT	2,774,686	770,595	304,302	56,642	221,082	85,938	555	125,539	37,945	683,083	207,439
20	Denver-Aurora, CO	3,663,515	766,328	525,621	53,443	316,841	145,696	1,307	191,864	40,359	1,325,547	314,518
21	Logan, UT-ID	155,362	45,129	16,455	3,300	12,120	4,694	34	6,747	2,235	25,377	17,801
21	Portland-Vancouver-Salem, OR-WA	3,285,859	672,210	557,059	47,229	299,024	160,562	1,369	226,870	32,484	953,505	341,525
23	Las Vegas-Henderson, NV	2,377,723	524,255	383,739	37,504	185,598	128,439	1,173	169,807	25,159	1,436,207	312,922
24	Fargo-Wahpeton, ND-MN	281,593	63,392	39,200	3,942	22,838	11,143	142	16,294	3,895	45,000	31,123
24	Salinas, CA	432,858	109,977	65,801	6,166	27,993	15,073	142	22,934	4,352	311,103	50,699

Notes:

Cities are ranked using the highest weighted average for any county within that Combined Metropolitan Statistical Area or Metropolitan Statistical Area.

Adding across rows does not produce valid estimates. Adding the disease categories (asthma, COPD, etc.) will double-count people who fall into more than one category.

Table 2b People at Risk in 25 U.S. Cities Most Polluted by Year-Round Particle Pollution (Annual $PM_{2.5}$)

2024 Rank	Metropolitan Statistical Areas	Total Population	Under 18	65 and Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	People of Color	Poverty
1	Bakersfield, CA	916,108	260,354	107,854	14,596	56,417	28,379	300	42,186	9,535	637,251	158,995
2	Visalia, CA	477,544	141,291	56,443	7,921	28,949	14,655	156	21,831	5,048	353,320	86,096
3	Fresno-Madera-Hanford, CA	1,328,427	364,850	170,959	20,454	83,063	42,575	435	63,876	14,004	963,186	244,173
4	Eugene-Springfield, OR	382,353	66,030	81,012	4,589	36,325	21,129	159	30,704	3,658	75,815	56,320
5	San Jose-San Francisco-Oakland, CA	9,482,708	1,961,875	1,573,978	109,986	653,728	359,039	3,101	546,284	100,209	6,099,825	920,277
6	Los Angeles-Long Beach, CA	18,372,485	3,969,521	2,794,005	222,539	1,248,866	671,276	6,005	1,011,872	198,882	13,051,016	2,271,941
7	Sacramento-Roseville, CA	2,701,808	594,397	462,916	33,323	183,342	101,602	881	155,757	28,352	1,347,234	301,699
8	Medford-Grants Pass, OR	309,374	61,544	75,565	4,277	28,473	18,150	129	27,212	2,498	61,158	42,920
9	Phoenix-Mesa, AZ	5,069,600	1,130,197	852,129	91,111	388,402	253,096	1,843	353,875	55,202	2,370,614	547,851
10	Fairbanks, AK	95,356	22,335	11,980	1,558	7,969	3,736	48	5,422	1,264	30,210	7,117
11	Indianapolis-Carmel-Muncie, IN	2,524,790	595,508	387,143	47,972	212,621	163,482	1,568	191,157	30,293	702,959	284,089
12	Yakima, WA	257,001	74,062	37,021	5,414	20,057	9,348	107	13,306	2,600	154,133	41,877
13	Detroit-Warren-Ann Arbor, MI	5,368,296	1,139,847	963,354	77,694	508,425	374,782	2,808	404,950	55,181	1,775,165	732,973
14	Chico, CA	207,303	41,519	38,407	2,328	14,390	7,874	68	12,254	2,266	66,108	37,152
14	Spokane-Spokane Valley-Coeur d'Alene, WA-ID	781,497	167,793	145,170	12,129	67,336	34,360	322	50,104	8,122	122,146	89,605
16	Houston-The Woodlands, TX	7,533,096	1,927,437	938,248	122,470	437,898	309,097	3,062	487,995	97,505	4,977,039	1,054,038
17	El Centro, CA	178,713	50,235	24,582	2,816	11,096	5,791	59	8,774	1,732	162,416	36,354
18	Reno-Carson City-Fernley, NV	670,258	134,060	131,583	9,590	53,609	39,220	330	52,843	6,532	246,590	68,783
19	Pittsburgh-New Castle-Weirton, PA-OH-WV	2,631,213	488,237	571,325	47,991	220,042	168,285	1,367	240,409	25,479	392,439	294,066
20	Las Vegas-Henderson, NV	2,377,723	524,255	383,739	37,504	185,598	128,439	1,173	169,807	25,159	1,436,207	312,922
20	Kansas City-Overland Park-Kansas City, MO-KS	2,545,616	584,469	411,249	45,921	209,138	149,179	1,444	181,445	29,818	694,254	271,520
22	Cincinnati-Wilmington-Maysville, OH-KY-IN	2,323,945	530,322	390,773	39,309	204,292	173,738	1,448	196,221	25,910	507,423	269,946
22	Chicago-Naperville, IL-IN-WI	9,806,184	2,133,205	1,603,748	102,751	698,287	459,008	5,279	652,054	102,567	4,695,471	1,097,326
24	Augusta-Richmond County, GA-SC	624,083	140,912	108,654	10,531	45,615	36,153	328	46,050	6,799	294,989	90,576
25	Corpus Christi-Kingsville-Alice, TX	526,006	126,558	85,073	8,040	31,317	23,498	214	38,183	6,371	372,711	95,416
25	Oklahoma City-Shawnee, OK	1,532,913	364,136	230,454	35,680	144,715	91,527	863	126,481	19,276	573,447	215,755

Notes:

Cities are ranked using the highest design value for any county within that Combined Metropolitan Statistical Area or Metropolitan Statistical Area.

Adding across rows does not produce valid estimates. Adding the disease categories (asthma, COPD, etc.) will double-count people who have been diagnosed with more than one disease.

Table 2c People at Risk in 25 Most Ozone-Polluted Cities

2024 Rank	Metropolitan Statistical Areas	Total Population	Under 18	65 and Over	Pediatric Asthma	Adult Asthma	COPD	CV Disease	Pregnancies	People of Color	Poverty
1	Los Angeles-Long Beach, CA	18,372,485	3,969,521	2,794,005	222,539	1,248,866	671,276	1,011,872	198,882	13,051,016	2,271,941
2	Visalia, CA	477,544	141,291	56,443	7,921	28,949	14,655	21,831	5,048	353,320	86,096
3	Bakersfield, CA	916,108	260,354	107,854	14,596	56,417	28,379	42,186	9,535	637,251	158,995
4	Fresno-Madera-Hanford, CA	1,328,427	364,850	170,959	20,454	83,063	42,575	63,876	14,004	963,186	244,173
5	Phoenix-Mesa, AZ	5,069,600	1,130,197	852,129	91,111	388,402	253,096	353,875	55,202	2,370,614	547,851
6	Denver-Aurora, CO	3,663,515	766,328	525,621	53,443	316,841	145,696	191,864	40,359	1,325,547	314,518
7	Sacramento-Roseville, CA	2,701,808	594,397	462,916	33,323	183,342	101,602	155,757	28,352	1,347,234	301,699
8	San Diego-Chula Vista-Carlsbad, CA	3,276,208	679,626	507,032	38,101	224,682	119,040	180,364	35,634	1,854,933	338,482
9	Salt Lake City-Provo-Orem, UT	2,774,686	770,595	304,302	56,642	221,082	85,938	125,539	37,945	683,083	207,439
10	Houston-The Woodlands, TX	7,533,096	1,927,437	938,248	122,470	437,898	309,097	487,995	97,505	4,977,039	1,054,038
11	Las Vegas-Henderson, NV	2,377,723	524,255	383,739	37,504	185,598	128,439	169,807	25,159	1,436,207	312,922
12	San Jose-San Francisco-Oakland, CA	9,482,708	1,961,875	1,573,978	109,986	653,728	359,039	546,284	100,209	6,099,825	920,277
13	Dallas-Fort Worth, TX-OK	8,449,932	2,088,213	1,067,016	133,067	499,117	353,049	557,626	110,300	4,671,878	879,392
13	New York-Newark, NY-NJ-CT-PA	23,060,028	4,823,603	3,992,690	370,126	1,851,337	981,963	1,506,612	248,085	12,253,432	2,841,933
15	El Paso-Las Cruces, TX-NM	1,095,532	277,026	151,301	19,324	68,237	44,422	69,847	13,503	939,748	230,904
16	Fort Collins, CO	366,778	66,337	64,064	4,626	32,806	15,663	20,787	4,126	70,080	39,357
17	Chicago-Naperville, IL-IN-WI	9,806,184	2,133,205	1,603,748	102,751	698,287	459,008	652,054	102,567	4,695,471	1,097,326
18	El Centro, CA	178,713	50,235	24,582	2,816	11,096	5,791	8,774	1,732	162,416	36,354
19	Reno-Carson City-Fernley, NV	670,258	134,060	131,583	9,590	53,609	39,220	52,843	6,532	246,590	68,783
20	Colorado Springs, CO	765,424	174,067	110,470	12,139	64,695	29,770	39,242	7,975	247,716	63,373
21	Albuquerque-Santa Fe-Las Vegas, NM	1,165,564	233,528	233,668	22,628	97,379	53,616	84,519	11,774	730,069	159,271
22	Redding-Red Bluff, CA	246,175	54,297	52,444	3,044	16,849	10,066	15,846	2,248	64,216	34,523
23	San Luis Obispo-Paso Robles, CA	282,013	47,941	63,001	2,688	20,460	11,858	18,774	2,828	92,649	31,956
24	San Antonio-New Braunfels-Pearsall, TX	2,673,157	647,578	368,120	41,146	158,172	113,406	180,383	34,270	1,816,116	374,553
25	Grand Rapids-Kentwood-Muskegon, MI	1,432,693	324,127	236,010	22,094	133,627	94,268	101,053	15,084	312,609	154,060

Notes:

Cities are ranked using the highest weighted average for any county within that Combined Metropolitan Statistical Area or Metropolitan Statistical Area.

Adding across rows does not produce valid estimates. Adding the disease categories (asthma, COPD, etc.) will double-count people who have been diagnosed with more than one disease.

Table 3a Cleanest U.S. Cities for Short-Term Particle Pollution (Daily $PM_{2.5}$)

Metropolitan Statistical Area	Population
Bangor, ME	153,704
Bloomington-Bedford, IN	206,449
Burlington-Fort Madison-Keokuk, IA-IL-MO	101,251
Cape Coral-Fort Myers-Naples, FL	1,261,786
Champaign-Urbana, IL	223,265
Charlottesville, VA	223,825
Cleveland-Indianola, MS	54,181
College Station-Bryan, TX	277,824
Dayton-Springfield-Kettering, OH	1,085,335
Erie-Meadville, PA	350,359
Fayetteville-Springdale-Rogers, AR	576,403
Florence, SC	199,119
Gadsden, AL	103,088
Greenville-Kinston-Washington, NC	272,447
Gulfport-Biloxi, MS	420,782
Harrisonburg-Staunton, VA	263,331
Hickory-Lenoir-Morganton, NC	368,347
Hot Springs-Malvern, AR	133,292
Houma-Thibodaux, LA	200,656
Johnson City-Kingsport-Bristol, TN-VA	521,528
Kahului-Wailuku-Lahaina, HI	164,351
Kokomo-Peru, IN	119,248
Lafayette-West Lafayette-Frankfort, IN	259,295
Lake Charles-Jennings, LA	239,346
Lansing-East Lansing, MI	540,870
Lima-Van Wert-Celina, OH	218,180
Lincoln-Beatrice, NE	364,031
Lynchburg, VA	263,613
Madison-Janesville-Beloit, WI	916,914
Midland-Odessa, TX	338,085
Mobile-Daphne-Fairhope, AL	672,968
Montgomery-Selma-Alexander City, AL	473,370
Morgantown-Fairmont, WV	196,993
New Orleans-Metairie-Hammond, LA-MS	1,485,510
North Port-Sarasota, FL	1,129,384
Orlando-Lakeland-Deltona, FL	4,428,098
Owensboro, KY	121,348
Palm Bay-Melbourne-Titusville, FL	630,693
Parkersburg-Marietta-Vienna, WV-OH	147,332
Pensacola-Ferry Pass, FL-AL	559,812
Ponce-Yauco-Coamo, PR	353,672
Portland-Lewiston-South Portland, ME	674,599
Rochester-Batavia-Seneca Falls, NY	1,171,569
Rockford-Freeport-Rochelle, IL	430,320
Rocky Mount-Wilson-Roanoke Rapids, NC	287,166
Saginaw-Midland-Bay City, MI	374,825
Salisbury-Cambridge, MD-DE	471,758
San Juan-Bayamón, PR	2,315,079
Scottsboro-Fort Payne, AL	124,889
Tuscaloosa, AL	277,494
Urban Honolulu, HI	995,638
Virginia Beach-Norfolk, VA-NC	1,898,944
Waterloo-Cedar Falls, IA	167,889
Wilmington, NC	300,658

Note:
Monitors in these cities reported no days when $PM_{2.5}$ levels reached the unhealthful range using the Air Quality Index based on the 2012 NAAQS.

Table 3b Top 25 Cleanest U.S. Cities for Year-Round Particle Pollution (Annual $PM_{2.5}$)

2024 Rank	Design Value	Metropolitan Statistical Area	Population
1	3.7	Urban Honolulu, HI	995,638
2	3.8	Casper, WY	79,601
3	4.0	Kahului-Wailuku-Lahaina, HI	164,351
4	4.4	Wilmington, NC	300,658
5	4.5	Bangor, ME	153,704
6	4.9	Cheyenne, WY	100,723
7	5.1	Duluth, MN-WI	291,323
8	5.5	Colorado Springs, CO	765,424
9	5.6	Anchorage, AK	400,470
9	5.6	St. George, UT	197,680
11	5.7	Elmira-Corning, NY	174,025
12	5.8	Asheville-Marion-Brevard, NC	554,180
12	5.8	Grand Junction, CO	158,636
12	5.8	Lubbock-Plainview-Levelland, TX	381,271
12	5.8	Saginaw-Midland-Bay City, MI	374,825
16	5.9	Amarillo-Pampa-Borger, TX	313,204
16	5.9	Lynchburg, VA	263,613
16	5.9	Salisbury-Cambridge, MD-DE	471,758
19	6.0	Rochester-Austin, MN	268,213
20	6.1	Greenville-Kinston-Washington, NC	272,447
20	6.1	Syracuse-Auburn, NY	728,631
22	6.2	Grand Island, NE	76,333
23	6.4	Lima-Van Wert-Celina, OH	218,180
23	6.4	Lincoln-Beatrice, NE	364,031
25	6.5	Johnson City-Kingsport-Bristol, TN-VA	521,528
25	6.5	Portland-Lewiston-South Portland, ME	674,599
25	6.5	Rochester-Batavia-Seneca Falls, NY	1,171,569

Notes:
Cities are ranked by using the highest design value for any county within that metropolitan area.

Table 3c Cleanest U.S. Cities for Ozone Air Pollution

Metropolitan Statistical Area	Population
Augusta-Richmond County, GA-SC	624,083
Bangor, ME	153,704
Bellingham, WA	230,677
Blacksburg-Christiansburg, VA	165,812
Bowling Green-Glasgow, KY	240,906
Brownsville-Harlingen-Raymondville, TX	445,351
Brunswick, GA	114,442
Burlington-South Burlington-Barre, VT	287,569
Cape Coral-Fort Myers-Naples, FL	1,261,786
Charleston-Huntington-Ashland, WV-OH-KY	763,796
Charleston-North Charleston, SC	830,529
Charlottesville, VA	223,825
Clarksville, TN-KY	336,605
Cleveland-Indianola, MS	54,181
Columbia-Moberly-Mexico, MO	263,686
Columbus-Auburn-Opelika, GA-AL	504,883
Crestview-Fort Walton Beach-Destin, FL	299,786
Des Moines-Ames-West Des Moines, IA	910,923
Duluth, MN-WI	291,323
Eau Claire-Menomonie, WI	219,295
Elmira-Corning, NY	174,025
Erie-Meadville, PA	350,359
Fairbanks, AK	95,356
Florence, SC	199,119
Gadsden, AL	103,088
Gainesville-Lake City, FL	420,190
Greensboro--Winston-Salem--High Point, NC	1,720,328
Harrisonburg-Staunton, VA	263,331
Hickory-Lenoir-Morganton, NC	368,347
Jackson-Vicksburg-Brookhaven, MS	660,563
Jacksonville-St. Marys-Palatka, FL-GA	1,807,412
Jefferson City, MO	150,350
Johnson City-Kingsport-Bristol, TN-VA	521,528
La Crosse-Onalaska, WI-MN	139,094
Lansing-East Lansing, MI	540,870
Laredo, TX	267,780
Lincoln-Beatrice, NE	364,031
Mayagüez-San Germán, PR	217,906
Missoula, MT	121,041
Mobile-Daphne-Fairhope, AL	672,968
Monroe-Ruston, LA	250,998
Montgomery-Selma-Alexander City, AL	473,370
Morgantown-Fairmont, WV	196,993
Myrtle Beach-Conway, SC-NC	600,887
New Bern-Morehead City, NC	191,868
North Port-Sarasota, FL	1,129,384
Orlando-Lakeland-Deltona, FL	4,428,098
Palm Bay-Melbourne-Titusville, FL	630,693
Panama City, FL	185,134
Pittsfield, MA	127,859
Quincy-Hannibal, IL-MO	113,474
Roanoke, VA	314,340
Rochester-Austin, MN	268,213
Rocky Mount-Wilson-Roanoke Rapids, NC	287,166
Salinas, CA	432,858
San Juan-Bayamón, PR	2,315,079
Savannah-Hinesville-Statesboro, GA	618,706
Scottsboro-Fort Payne, AL	124,889
Scranton--Wilkes-Barre, PA	567,998
Sebring-Avon Park, FL	105,618
Springfield, MO	487,061
State College-DuBois, PA	236,329
Syracuse-Auburn, NY	728,631
Tallahassee, FL	390,992
Tupelo-Corinth, MS	197,247
Tuscaloosa, AL	277,494
Urban Honolulu, HI	995,638
Victoria-Port Lavaca, TX	117,902
Waco, TX	283,885
Waterloo-Cedar Falls, IA	167,889
Watertown-Fort Drum, NY	116,637
Wausau-Stevens Point-Wisconsin Rapids, WI	311,045
Williamsport-Lock Haven, PA	151,035
Wilmington, NC	300,658

Notes:

1. This list represents cities with no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on 2015 NAAQS.

Table 4a Cleanest Counties for Short-Term Particle Pollution (Daily $PM_{2.5}$)

County	State	Metropolitan Statistical Area
Baldwin	AL	Mobile-Daphne-Fairhope, AL
Clay	AL	
DeKalb	AL	Scottsboro-Fort Payne, AL
Etowah	AL	Gadsden, AL
Madison	AL	Huntsville-Decatur, AL
Mobile	AL	Mobile-Daphne-Fairhope, AL
Montgomery	AL	Montgomery-Selma-Alexander City, AL
Tuscaloosa	AL	Tuscaloosa, AL
Arkansas	AR	
Ashley	AR	
Crittenden	AR	Memphis-Forrest City, TN-MS-AR
Garland	AR	Hot Springs-Malvern, AR
Jackson	AR	
Polk	AR	
Union	AR	
Washington	AR	Fayetteville-Springdale-Rogers, AR
Apache	AZ	
Pima	AZ	Tucson-Nogales, AZ
Kent	DE	Philadelphia-Reading-Camden, PA-NJ-DE-MD
Sussex	DE	Salisbury-Cambridge, MD-DE
Brevard	FL	Palm Bay-Melbourne-Titusville, FL
Escambia	FL	Pensacola-Ferry Pass, FL-AL
Lee	FL	Cape Coral-Fort Myers-Naples, FL
Palm Beach	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Pinellas	FL	Tampa-St. Petersburg-Clearwater, FL
Polk	FL	Orlando-Lakeland-Deltona, FL
Sarasota	FL	North Port-Sarasota, FL
Seminole	FL	Orlando-Lakeland-Deltona, FL
Volusia	FL	Orlando-Lakeland-Deltona, FL
Clayton	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Cobb	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Fulton	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Hall	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Hawaii	HI	
Honolulu	HI	Urban Honolulu, HI
Kauai	HI	
Maui	HI	Kahului-Wailuku-Lahaina, HI
Black Hawk	IA	Waterloo-Cedar Falls, IA
Clinton	IA	Davenport-Moline, IA-IL
Lee	IA	Burlington-Fort Madison-Keokuk, IA-IL-MO
Linn	IA	Cedar Rapids-Iowa City, IA
Montgomery	IA	
Van Buren	IA	
Champaign	IL	Champaign-Urbana, IL
DuPage	IL	Chicago-Naperville, IL-IN-WI
Jersey	IL	St. Louis-St. Charles-Farmington, MO-IL
Madison	IL	St. Louis-St. Charles-Farmington, MO-IL
McHenry	IL	Chicago-Naperville, IL-IN-WI
St. Clair	IL	St. Louis-St. Charles-Farmington, MO-IL
Winnebago	IL	Rockford-Freeport-Rochelle, IL
Bartholomew	IN	Indianapolis-Carmel-Muncie, IN
Clark	IN	Louisville-Jefferson County--Elizabethtown--Bardstown, KY-IN
Delaware	IN	Indianapolis-Carmel-Muncie, IN
Dubois	IN	
Greene	IN	
Hamilton	IN	Indianapolis-Carmel-Muncie, IN
Henry	IN	Indianapolis-Carmel-Muncie, IN
Howard	IN	Kokomo-Peru, IN
Madison	IN	Indianapolis-Carmel-Muncie, IN
Monroe	IN	Bloomington-Bedford, IN
Spencer	IN	
Tippecanoe	IN	Lafayette-West Lafayette-Frankfort, IN
Campbell	KY	Cincinnati-Wilmington-Maysville, OH-KY-IN
Carter	KY	Charleston-Huntington-Ashland, WV-OH-KY
Christian	KY	Clarksville, TN-KY
Daviess	KY	Owensboro, KY
Hardin	KY	Louisville-Jefferson County--Elizabethtown--Bardstown, KY-IN
Calcasieu Parish	LA	Lake Charles-Jennings, LA
Iberville Parish	LA	Baton Rouge, LA
Jefferson Parish	LA	New Orleans-Metairie-Hammond, LA-MS
Orleans Parish	LA	New Orleans-Metairie-Hammond, LA-MS
St. Bernard Parish	LA	New Orleans-Metairie-Hammond, LA-MS
Tangipahoa Parish	LA	New Orleans-Metairie-Hammond, LA-MS
Terrebonne Parish	LA	Houma-Thibodaux, LA
Bristol	MA	Boston-Worcester-Providence, MA-RI-NH-CT
Hampshire	MA	Springfield, MA
Baltimore City	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Dorchester	MD	Salisbury-Cambridge, MD-DE
Garrett	MD	
Harford	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Howard	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Kent	MD	
Montgomery	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Prince George's	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Washington	MD	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Androscoggin	ME	Portland-Lewiston-South Portland, ME
Cumberland	ME	Portland-Lewiston-South Portland, ME
Hancock	ME	
Kennebec	ME	
Penobscot	ME	Bangor, ME
Bay	MI	Saginaw-Midland-Bay City, MI

Notes:

Monitors in these counties reported no days when $PM_{2.5}$ levels reached the unhealthful range using the Air Quality Index based on the 2012 NAAQS.

Table 4a Cleanest Counties for Short-Term Particle Pollution (24-hour $PM_{2.5}$) (cont.)

County	State	Metropolitan Statistical Area
Genesee	MI	Detroit-Warren-Ann Arbor, MI
Ingham	MI	Lansing-East Lansing, MI
Lenawee	MI	Detroit-Warren-Ann Arbor, MI
Macomb	MI	Detroit-Warren-Ann Arbor, MI
Manistee	MI	
Oakland	MI	Detroit-Warren-Ann Arbor, MI
Cedar	MO	
Clay	MO	Kansas City-Overland Park-Kansas City, MO-KS
Bolivar	MS	Cleveland-Indianola, MS
DeSoto	MS	Memphis-Forrest City, TN-MS-AR
Hancock	MS	Gulfport-Biloxi, MS
Harrison	MS	Gulfport-Biloxi, MS
Jackson	MS	Gulfport-Biloxi, MS
Buncombe	NC	Asheville-Marion-Brevard, NC
Catawba	NC	Hickory-Lenoir-Morganton, NC
Davidson	NC	Greensboro--Winston-Salem--High Point, NC
Durham	NC	Raleigh-Durham-Cary, NC
Guilford	NC	Greensboro--Winston-Salem--High Point, NC
Johnston	NC	Raleigh-Durham-Cary, NC
New Hanover	NC	Wilmington, NC
Northampton	NC	Rocky Mount-Wilson-Roanoke Rapids, NC
Pitt	NC	Greenville-Kinston-Washington, NC
Rowan	NC	Charlotte-Concord, NC-SC
Lancaster	NE	Lincoln-Beatrice, NE
Cumberland	NJ	Philadelphia-Reading-Camden, PA-NJ-DE-MD
Gloucester	NJ	Philadelphia-Reading-Camden, PA-NJ-DE-MD
Hudson	NJ	New York-Newark, NY-NJ-CT-PA
Hunterdon	NJ	New York-Newark, NY-NJ-CT-PA
Morris	NJ	New York-Newark, NY-NJ-CT-PA
Chautauqua	NY	
Essex	NY	
Kings	NY	New York-Newark, NY-NJ-CT-PA
Monroe	NY	Rochester-Batavia-Seneca Falls, NY
New York	NY	New York-Newark, NY-NJ-CT-PA
Orange	NY	New York-Newark, NY-NJ-CT-PA
Richmond	NY	New York-Newark, NY-NJ-CT-PA
Suffolk	NY	New York-Newark, NY-NJ-CT-PA
Allen	OH	Lima-Van Wert-Celina, OH
Athens	OH	
Belmont	OH	Wheeling, WV-OH
Clark	OH	Dayton-Springfield-Kettering, OH
Harrison	OH	
Lake	OH	Cleveland-Akron-Canton, OH
Lawrence	OH	Charleston-Huntington-Ashland, WV-OH-KY
Medina	OH	Cleveland-Akron-Canton, OH
Montgomery	OH	Dayton-Springfield-Kettering, OH
Portage	OH	Cleveland-Akron-Canton, OH
Preble	OH	
Scioto	OH	Charleston-Huntington-Ashland, WV-OH-KY
Erie	PA	Erie-Meadville, PA
Bayamón	PR	San Juan-Bayamón, PR
Caguas	PR	San Juan-Bayamón, PR
Fajardo	PR	San Juan-Bayamón, PR
Guayama	PR	San Juan-Bayamón, PR
Guaynabo	PR	San Juan-Bayamón, PR
Ponce	PR	Ponce-Yauco-Coamo, PR
Washington	RI	Boston-Worcester-Providence, MA-RI-NH-CT
Chesterfield	SC	
Edgefield	SC	Augusta-Richmond County, GA-SC
Florence	SC	Florence, SC
Richland	SC	Columbia-Orangeburg-Newberry, SC
Spartanburg	SC	Greenville-Spartanburg-Anderson, SC
York	SC	Charlotte-Concord, NC-SC
Lawrence	TN	Nashville-Davidson--Murfreesboro, TN
Loudon	TN	Knoxville-Morristown-Sevierville, TN
McMinn	TN	Chattanooga-Cleveland-Dalton, TN-GA
Sullivan	TN	Johnson City-Kingsport-Bristol, TN-VA
Brazos	TX	College Station-Bryan, TX
Ector	TX	Midland-Odessa, TX
Ellis	TX	Dallas-Fort Worth, TX-OK
Albemarle	VA	Charlottesville, VA
Arlington	VA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Bristol City	VA	Johnson City-Kingsport-Bristol, TN-VA
Charles City	VA	Richmond, VA
Chesterfield	VA	Richmond, VA
Frederick	VA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Hampton City	VA	Virginia Beach-Norfolk, VA-NC
Lynchburg City	VA	Lynchburg, VA
Norfolk City	VA	Virginia Beach-Norfolk, VA-NC
Rockingham	VA	Harrisonburg-Staunton, VA
Salem City	VA	Roanoke, VA
Virginia Beach City	VA	Virginia Beach-Norfolk, VA-NC
Dane	WI	Madison-Janesville-Beloit, WI
Dodge	WI	Milwaukee-Racine-Waukesha, WI
Grant	WI	
Ozaukee	WI	Milwaukee-Racine-Waukesha, WI
Sauk	WI	Madison-Janesville-Beloit, WI
Berkeley	WV	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Brooke	WV	Pittsburgh-New Castle-Weirton, PA-OH-WV
Cabell	WV	Charleston-Huntington-Ashland, WV-OH-KY
Hancock	WV	Pittsburgh-New Castle-Weirton, PA-OH-WV
Harrison	WV	
Kanawha	WV	Charleston-Huntington-Ashland, WV-OH-KY
Marion	WV	Morgantown-Fairmont, WV

Notes:

Monitors in these counties reported no days when $PM_{2.5}$ levels reached the unhealthful range using the Air Quality Index based on the 2012 NAAQS.

Table 4a Cleanest Counties for Short-Term Particle Pollution (24-hour $PM_{2.5}$) (cont.)

County	State	Metropolitan Statistical Area
Monongalia	WV	Morgantown-Fairmont, WV
Ohio	WV	Wheeling, WV-OH
Wood	WV	Parkersburg-Marietta-Vienna, WV-OH
Sheridan	WY	

Notes:
Monitors in these counties reported no days when $PM_{2.5}$ levels reached the unhealthful range using the Air Quality Index based on the 2012 NAAQS.

Table 4b Top 25 Cleanest Counties for Year-Round Particle Pollution (Annual $PM_{2.5}$)

2024 Rank	County	State	Design Value	Metropolitan Statistical Area
1	Fremont	WY	2.0	
2	Carlton	MN	2.2	Duluth, MN-WI
3	Cook	MN	2.3	
4	Hancock	ME	3.2	
5	Hughes	SD	3.3	
6	Hawaii	HI	3.4	
7	Essex	NY	3.5	
8	Sublette	WY	3.6	
9	Honolulu	HI	3.7	Urban Honolulu, HI
10	Natrona	WY	3.8	Casper, WY
11	Gallatin	MT	3.9	
11	Hillsborough	NH	3.9	Boston-Worcester-Providence, MA-RI-NH-CT
13	Maui	HI	4.0	Kahului-Wailuku-Lahaina, HI
14	Custer	SD	4.1	
14	La Paz	AZ	4.1	
16	Santa Fe	NM	4.3	Albuquerque-Santa Fe-Las Vegas, NM
16	Washington	RI	4.3	Boston-Worcester-Providence, MA-RI-NH-CT
18	New Hanover	NC	4.4	Wilmington, NC
19	Belknap	NH	4.5	Boston-Worcester-Providence, MA-RI-NH-CT
19	Jackson	SD	4.5	
19	Kent	RI	4.5	Boston-Worcester-Providence, MA-RI-NH-CT
19	Matanuska-Susitna Borough	AK	4.5	Anchorage, AK
19	Penobscot	ME	4.5	Bangor, ME
19	Teton	WY	4.5	
25	Lake	MN	4.7	Duluth, MN-WI

Notes:
Counties are ranked by Design Value.

Table 4c Cleanest Counties for Ozone Air Pollution

County	State	Metropolitan Statistical Area
Denali Borough	AK	
Fairbanks North Star Borough	AK	Fairbanks, AK
Baldwin	AL	Mobile-Daphne-Fairhope, AL
DeKalb	AL	Scottsboro-Fort Payne, AL
Elmore	AL	Montgomery-Selma-Alexander City, AL
Etowah	AL	Gadsden, AL
Mobile	AL	Mobile-Daphne-Fairhope, AL
Montgomery	AL	Montgomery-Selma-Alexander City, AL
Morgan	AL	Huntsville-Decatur, AL
Russell	AL	Columbus-Auburn-Opelika, GA-AL
Sumter	AL	
Tuscaloosa	AL	Tuscaloosa, AL
Clark	AR	
Colusa	CA	
Glenn	CA	
Humboldt	CA	
Lake	CA	
Marin	CA	San Jose-San Francisco-Oakland, CA
Mendocino	CA	
Monterey	CA	Salinas, CA
San Francisco	CA	San Jose-San Francisco-Oakland, CA
Santa Cruz	CA	San Jose-San Francisco-Oakland, CA
Siskiyou	CA	
Sonoma	CA	San Jose-San Francisco-Oakland, CA
Archuleta	CO	
Delta	CO	
Sussex	DE	Salisbury-Cambridge, MD-DE
Alachua	FL	Gainesville-Lake City, FL
Baker	FL	Jacksonville-St. Marys-Palatka, FL-GA
Bay	FL	Panama City, FL
Brevard	FL	Palm Bay-Melbourne-Titusville, FL
Broward	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Collier	FL	Cape Coral-Fort Myers-Naples, FL
Columbia	FL	Gainesville-Lake City, FL
Duval	FL	Jacksonville-St. Marys-Palatka, FL-GA
Flagler	FL	Orlando-Lakeland-Deltona, FL
Highlands	FL	Sebring-Avon Park, FL
Holmes	FL	
Indian River	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Lake	FL	Orlando-Lakeland-Deltona, FL
Lee	FL	Cape Coral-Fort Myers-Naples, FL
Leon	FL	Tallahassee, FL
Liberty	FL	
Manatee	FL	North Port-Sarasota, FL
Martin	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Okaloosa	FL	Crestview-Fort Walton Beach-Destin, FL
Orange	FL	Orlando-Lakeland-Deltona, FL
Osceola	FL	Orlando-Lakeland-Deltona, FL
Palm Beach	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Pasco	FL	Tampa-St. Petersburg-Clearwater, FL
Pinellas	FL	Tampa-St. Petersburg-Clearwater, FL
Polk	FL	Orlando-Lakeland-Deltona, FL
Santa Rosa	FL	Pensacola-Ferry Pass, FL-AL
Sarasota	FL	North Port-Sarasota, FL
Seminole	FL	Orlando-Lakeland-Deltona, FL
St. Lucie	FL	Miami-Port St. Lucie-Fort Lauderdale, FL
Volusia	FL	Orlando-Lakeland-Deltona, FL
Wakulla	FL	Tallahassee, FL
Chatham	GA	Savannah-Hinesville-Statesboro, GA
Chattooga	GA	Chattanooga-Cleveland-Dalton, TN-GA
Clarke	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Columbia	GA	Augusta-Richmond County, GA-SC
Glynn	GA	Brunswick, GA
Muscogee	GA	Columbus-Auburn-Opelika, GA-AL
Pike	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Richmond	GA	Augusta-Richmond County, GA-SC
Rockdale	GA	Atlanta--Athens-Clarke County--Sandy Springs, GA-AL
Sumter	GA	
Honolulu	HI	Urban Honolulu, HI
Bremer	IA	Waterloo-Cedar Falls, IA
Clinton	IA	Davenport-Moline, IA-IL
Harrison	IA	Omaha-Council Bluffs-Fremont, NE-IA
Montgomery	IA	
Palo Alto	IA	
Polk	IA	Des Moines-Ames-West Des Moines, IA
Scott	IA	Davenport-Moline, IA-IL
Van Buren	IA	
Adams	IL	Quincy-Hannibal, IL-MO
Effingham	IL	
Jo Daviess	IL	
Brown	IN	Indianapolis-Carmel-Muncie, IN
Elkhart	IN	South Bend-Elkhart-Mishawaka, IN-MI
Hamilton	IN	Indianapolis-Carmel-Muncie, IN
Hendricks	IN	Indianapolis-Carmel-Muncie, IN
Neosho	KS	
Trego	KS	
Bell	KY	
Boone	KY	Cincinnati-Wilmington-Maysville, OH-KY-IN
Boyd	KY	Charleston-Huntington-Ashland, WV-OH-KY

Note:
This list represents counties with no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on 2015 NAAQS.

Table 4c Cleanest Counties for Ozone Air Pollution (cont.)

County	State	Metropolitan Statistical Area
Carter	KY	Charleston-Huntington-Ashland, WV-OH-KY
Christian	KY	Clarksville, TN-KY
Edmonson	KY	Bowling Green-Glasgow, KY
Fayette	KY	Lexington-Fayette--Richmond--Frankfort, KY
Greenup	KY	Charleston-Huntington-Ashland, WV-OH-KY
Morgan	KY	
Perry	KY	
Pike	KY	
Pulaski	KY	
Simpson	KY	
Trigg	KY	Clarksville, TN-KY
Warren	KY	Bowling Green-Glasgow, KY
Washington	KY	
Bossier Parish	LA	Shreveport-Bossier City-Minden, LA
Ouachita Parish	LA	Monroe-Ruston, LA
St. James Parish	LA	New Orleans-Metairie-Hammond, LA-MS
St. Martin Parish	LA	Lafayette-Opelousas-Morgan City, LA
St. Tammany Parish	LA	New Orleans-Metairie-Hammond, LA-MS
Berkshire	MA	Pittsfield, MA
Franklin	MA	Springfield, MA
Hampshire	MA	Springfield, MA
Middlesex	MA	Boston-Worcester-Providence, MA-RI-NH-CT
Garrett	MD	
Androscoggin	ME	Portland-Lewiston-South Portland, ME
Aroostook	ME	
Kennebec	ME	
Oxford	ME	
Penobscot	ME	Bangor, ME
Washington	ME	
Clinton	MI	Lansing-East Lansing, MI
Ingham	MI	Lansing-East Lansing, MI
Carlton	MN	Duluth, MN-WI
Crow Wing	MN	
Goodhue	MN	Minneapolis-St. Paul, MN-WI
Hennepin	MN	Minneapolis-St. Paul, MN-WI
Lake	MN	Duluth, MN-WI
Lyon	MN	
Mille Lacs	MN	Minneapolis-St. Paul, MN-WI
Olmsted	MN	Rochester-Austin, MN
Scott	MN	Minneapolis-St. Paul, MN-WI
St. Louis	MN	Duluth, MN-WI
Stearns	MN	Minneapolis-St. Paul, MN-WI
Boone	MO	Columbia-Moberly-Mexico, MO
Callaway	MO	Jefferson City, MO
Cedar	MO	
Greene	MO	Springfield, MO
Monroe	MO	
Ste. Genevieve	MO	
Bolivar	MS	Cleveland-Indianola, MS
Hancock	MS	Gulfport-Biloxi, MS
Hinds	MS	Jackson-Vicksburg-Brookhaven, MS
Lauderdale	MS	
Lee	MS	Tupelo-Corinth, MS
Yalobusha	MS	
Flathead	MT	
Missoula	MT	Missoula, MT
Alexander	NC	Hickory-Lenoir-Morganton, NC
Avery	NC	
Buncombe	NC	Asheville-Marion-Brevard, NC
Caldwell	NC	Hickory-Lenoir-Morganton, NC
Carteret	NC	New Bern-Morehead City, NC
Caswell	NC	
Durham	NC	Raleigh-Durham-Cary, NC
Edgecombe	NC	Rocky Mount-Wilson-Roanoke Rapids, NC
Forsyth	NC	Greensboro--Winston-Salem--High Point, NC
Guilford	NC	Greensboro--Winston-Salem--High Point, NC
Macon	NC	
Martin	NC	
Montgomery	NC	
New Hanover	NC	Wilmington, NC
Person	NC	Raleigh-Durham-Cary, NC
Pitt	NC	Greenville-Kinston-Washington, NC
Rockingham	NC	Greensboro--Winston-Salem--High Point, NC
Rowan	NC	Charlotte-Concord, NC-SC
Swain	NC	
Yancey	NC	
Burke	ND	
Burleigh	ND	Bismarck, ND
McKenzie	ND	
Ward	ND	
Lancaster	NE	Lincoln-Beatrice, NE
Belknap	NH	Boston-Worcester-Providence, MA-RI-NH-CT
Cheshire	NH	
Grafton	NH	
Hillsborough	NH	Boston-Worcester-Providence, MA-RI-NH-CT
Atlantic	NJ	Philadelphia-Reading-Camden, PA-NJ-DE-MD
Hunterdon	NJ	New York-Newark, NY-NJ-CT-PA
Morris	NJ	New York-Newark, NY-NJ-CT-PA
Passaic	NJ	New York-Newark, NY-NJ-CT-PA
Warren	NJ	Allentown-Bethlehem-Easton, PA-NJ
Albany	NY	Albany-Schenectady, NY
Hamilton	NY	

Note:
This list represents counties with no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on 2015 NAAQS.

Table 4c Cleanest Counties for Ozone Air Pollution (cont.)

County	State	Metropolitan Statistical Area
Jefferson	NY	Watertown-Fort Drum, NY
Onondaga	NY	Syracuse-Auburn, NY
Orange	NY	New York-Newark, NY-NJ-CT-PA
Oswego	NY	Syracuse-Auburn, NY
Rockland	NY	New York-Newark, NY-NJ-CT-PA
Saratoga	NY	Albany-Schenectady, NY
Steuben	NY	Elmira-Corning, NY
Fayette	OH	Columbus-Marion-Zanesville, OH
Lawrence	OH	Charleston-Huntington-Ashland, WV-OH-KY
Madison	OH	Columbus-Marion-Zanesville, OH
Noble	OH	
Wood	OH	Toledo-Findlay-Tiffin, OH
Columbia	OR	Portland-Vancouver-Salem, OR-WA
Bradford	PA	
Centre	PA	State College-DuBois, PA
Chester	PA	Philadelphia-Reading-Camden, PA-NJ-DE-MD
Clearfield	PA	State College-DuBois, PA
Erie	PA	Erie-Meadville, PA
Fayette	PA	Pittsburgh-New Castle-Weirton, PA-OH-WV
Franklin	PA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Lackawanna	PA	Scranton--Wilkes-Barre, PA
Lehigh	PA	Allentown-Bethlehem-Easton, PA-NJ
Luzerne	PA	Scranton--Wilkes-Barre, PA
Lycoming	PA	Williamsport-Lock Haven, PA
Monroe	PA	New York-Newark, NY-NJ-CT-PA
Somerset	PA	Johnstown-Somerset, PA
Tioga	PA	
Washington	PA	Pittsburgh-New Castle-Weirton, PA-OH-WV
Westmoreland	PA	Pittsburgh-New Castle-Weirton, PA-OH-WV
York	PA	Harrisburg-York-Lebanon, PA
Bayamón	PR	San Juan-Bayamón, PR
Mayagüez	PR	Mayagüez-San Germán, PR
Aiken	SC	Augusta-Richmond County, GA-SC
Anderson	SC	Greenville-Spartanburg-Anderson, SC
Berkeley	SC	Charleston-North Charleston, SC
Charleston	SC	Charleston-North Charleston, SC
Chesterfield	SC	
Darlington	SC	Florence, SC
Edgefield	SC	Augusta-Richmond County, GA-SC
Horry	SC	Myrtle Beach-Conway, SC-NC
Jackson	SD	
Anderson	TN	Knoxville-Morristown-Sevierville, TN
Claiborne	TN	
DeKalb	TN	
Jefferson	TN	Knoxville-Morristown-Sevierville, TN
Knox	TN	Knoxville-Morristown-Sevierville, TN
Loudon	TN	Knoxville-Morristown-Sevierville, TN
Sevier	TN	Knoxville-Morristown-Sevierville, TN
Sullivan	TN	Johnson City-Kingsport-Bristol, TN-VA
Brewster	TX	
Cameron	TX	Brownsville-Harlingen-Raymondville, TX
Hunt	TX	Dallas-Fort Worth, TX-OK
McLennan	TX	Waco, TX
Polk	TX	
Victoria	TX	Victoria-Port Lavaca, TX
Webb	TX	Laredo, TX
Albemarle	VA	Charlottesville, VA
Charles City	VA	Richmond, VA
Fauquier	VA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Frederick	VA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Giles	VA	Blacksburg-Christiansburg, VA
Hampton City	VA	Virginia Beach-Norfolk, VA-NC
Hanover	VA	Richmond, VA
Madison	VA	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Prince Edward	VA	
Roanoke	VA	Roanoke, VA
Rockbridge	VA	
Rockingham	VA	Harrisonburg-Staunton, VA
Wythe	VA	
Bennington	VT	
Chittenden	VT	Burlington-South Burlington-Barre, VT
Rutland	VT	
Clallam	WA	
Clark	WA	Portland-Vancouver-Salem, OR-WA
Skagit	WA	Seattle-Tacoma, WA
Whatcom	WA	Bellingham, WA
Eau Claire	WI	Eau Claire-Menomonie, WI
Forest	WI	
La Crosse	WI	La Crosse-Onalaska, WI-MN
Marathon	WI	Wausau-Stevens Point-Wisconsin Rapids, WI
Taylor	WI	
Vilas	WI	
Berkeley	WV	Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
Cabell	WV	Charleston-Huntington-Ashland, WV-OH-KY
Gilmer	WV	
Greenbrier	WV	
Kanawha	WV	Charleston-Huntington-Ashland, WV-OH-KY
Monongalia	WV	Morgantown-Fairmont, WV
Tucker	WV	

Note:
This list represents counties with no monitored ozone air pollution in unhealthful ranges using the Air Quality Index based on 2015 NAAQS.

ALABAMA

American Lung Association in Alabama

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Baldwin	0	0	0	0.0	A
Clay	DNC	DNC	DNC	DNC	DNC
DeKalb	0	0	0	0.0	A
Elmore	0	0	0	0.0	A
Etowah	0	0	0	0.0	A
Jefferson	4	0	0	1.3	C
Madison	2	0	0	0.7	B
Mobile	0	0	0	0.0	A
Montgomery	0	0	0	0.0	A
Morgan	0	0	0	0.0	A
Russell	0	0	0	0.0	A
Shelby	1	0	0	0.3	B
Sumter	0	0	0	0.0	A
Tuscaloosa	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Baldwin	0	0	0	0	0.0	A	7.5	Pass
Clay	0	0	0	0	0.0	A	6.8	Pass
DeKalb	0	0	0	0	0.0	A	7.2	Pass
Elmore	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Etowah	0	0	0	0	0.0	A	8.2	Pass
Jefferson	1	0	0	0	0.3	B	8.4	Pass
Madison	0	0	0	0	0.0	A	7.1	Pass
Mobile	0	0	0	0	0.0	A	7.9	Pass
Montgomery	0	0	0	0	0.0	A	INC	INC
Morgan	1	0	0	0	0.3	B	7.4	Pass
Russell	3	0	0	0	1.0	C	9.1	Fail
Shelby	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sumter	INC	INC	INC	INC	INC	INC	INC	INC
Tuscaloosa	0	0	0	0	0.0	A	7.6	Pass

ALABAMA

American Lung Association in Alabama

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Baldwin	246,435	51,268	54,040	3,648	18,745	19,589	132	27,965	2,471	30,195	41,947
Clay	14,198	2,963	3,040	211	1,083	1,127	8	1,605	142	2,371	2,790
DeKalb	71,998	17,044	13,004	1,213	5,290	5,221	39	7,311	742	13,248	15,270
Elmore	89,563	19,194	14,988	1,366	6,770	6,427	48	8,887	1,044	9,779	24,911
Etowah	103,088	22,075	20,545	1,571	7,783	7,857	55	11,096	1,100	17,990	23,602
Jefferson	665,409	149,721	113,774	10,654	49,244	46,572	354	64,654	8,017	106,000	340,769
Madison	403,565	85,566	64,566	6,089	30,559	28,466	216	39,135	4,664	44,142	146,840
Mobile	411,411	94,978	71,849	6,759	30,276	29,058	219	40,484	4,748	77,450	182,435
Montgomery	226,361	53,664	37,048	3,819	16,501	15,470	120	21,403	2,725	39,991	157,681
Morgan	124,211	28,336	22,959	2,016	9,221	9,126	67	12,797	1,278	15,935	32,292
Russell	58,555	14,207	9,088	1,011	4,263	3,987	31	5,487	685	12,882	32,574
Shelby	230,115	51,047	39,566	3,633	17,248	16,628	123	23,093	2,609	15,339	56,446
Sumter	11,853	2,280	2,344	162	902	864	6	1,215	152	3,377	8,733
Tuscaloosa	236,780	47,489	33,633	3,379	17,919	15,412	126	20,823	3,321	36,853	94,380

ALASKA

American Lung Association in Alaska

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Anchorage Municipality	DNC	DNC	DNC	DNC	DNC
Denali Borough	0	0	0	0.0	A
Fairbanks North Star Borough	0	0	0	0.0	A
Juneau City and Borough	DNC	DNC	DNC	DNC	DNC
Matanuska-Susitna Borough	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Anchorage Municipality	3	0	0	0	1.0	C	5.6	Pass
Denali Borough	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fairbanks North Star Borough	47	45	1	0	38.8	F	12.2	Fail
Juneau City and Borough	1	0	0	0	0.3	B	4.9	Pass
Matanuska-Susitna Borough	3	1	0	0	1.5	C	4.5	Pass

ALASKA

American Lung Association in Alaska

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Anchorage Municipality	287,145	67,508	36,895	4,708	23,750	11,752	143	17,039	3,924	29,127	128,950
Denali Borough	1,585	279	219	19	139	74	1	106	20	116	409
Fairbanks North Star Borough	95,356	22,335	11,980	1,558	7,969	3,736	48	5,422	1,264	7,117	30,210
Juneau City and Borough	31,685	6,451	5,091	450	2,681	1,475	16	2,181	411	2,455	11,731
Matanuska-Susitna Borough	113,325	28,963	15,660	2,020	9,027	4,758	57	6,970	1,386	10,866	25,716

ARIZONA

American Lung Association in Arizona

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Apache	DNC	DNC	DNC	DNC	DNC
Cochise	4	0	0	1.3	C
Coconino	1	0	0	0.3	B
Gila	29	4	0	11.7	F
La Paz	1	0	0	0.3	B
Maricopa	126	10	1	47.7	F
Navajo	2	0	0	0.7	B
Pima	17	0	0	5.7	F
Pinal	64	1	0	21.8	F
Santa Cruz	DNC	DNC	DNC	DNC	DNC
Yavapai	1	0	0	0.3	B
Yuma	4	0	0	1.3	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Apache	0	0	0	0	0.0	A	INC	INC
Cochise	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Coconino	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Gila	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
La Paz	1	0	0	0	0.3	B	4.1	Pass
Maricopa	15	6	1	0	8.7	F	10.5	Fail
Navajo	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Pima	0	0	0	0	0.0	A	6.1	Pass
Pinal	34	3	0	0	12.8	F	12.4	Fail
Santa Cruz	6	2	0	0	3.0	D	10.2	Fail
Yavapai	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Yuma	3	0	0	0	1.0	C	8.9	Pass

ARIZONA

American Lung Association in Arizona

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Apache	65,432	17,044	10,940	1,374	4,775	3,184	24	4,481	647	18,155	53,061
Cochise	125,663	26,113	30,648	2,105	9,795	7,281	46	10,599	1,110	21,447	57,074
Coconino	144,060	27,858	21,032	2,246	11,417	6,767	52	9,199	1,900	22,092	66,605
Gila	53,922	10,208	16,581	823	4,305	3,567	20	5,331	411	9,832	20,607
La Paz	16,506	2,603	6,885	210	1,362	1,266	6	1,947	108	3,258	7,161
Maricopa	4,551,524	1,019,236	737,530	82,166	348,328	224,399	1,654	312,542	50,443	487,571	2,139,139
Navajo	108,650	27,336	21,751	2,204	8,020	5,700	40	8,179	988	27,684	61,987
Pima	1,057,597	207,381	224,391	16,718	83,620	57,849	384	82,569	11,309	150,271	527,666
Pinal	464,154	100,753	98,018	8,122	35,769	25,130	169	36,002	4,348	50,448	210,868
Santa Cruz	48,759	12,370	9,515	997	3,586	2,507	18	3,584	485	9,009	41,182
Yavapai	246,191	37,675	84,113	3,037	20,535	17,567	89	26,447	1,784	32,990	52,051
Yuma	207,842	51,869	42,522	4,181	15,310	10,577	76	15,118	2,007	29,448	147,989

ARKANSAS

American Lung Association in Arkansas

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Arkansas	DNC	DNC	DNC	DNC	DNC
Ashley	DNC	DNC	DNC	DNC	DNC
Clark	0	0	0	0.0	A
Crittenden	9	1	0	3.5	F
Garland	DNC	DNC	DNC	DNC	DNC
Jackson	DNC	DNC	DNC	DNC	DNC
Newton	1	0	0	0.3	B
Polk	2	0	0	0.7	B
Pulaski	4	0	0	1.3	C
Union	DNC	DNC	DNC	DNC	DNC
Washington	3	0	0	1.0	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Arkansas	0	0	0	0	0.0	A	7.5	Pass
Ashley	0	0	0	0	0.0	A	INC	INC
Clark	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Crittenden	0	0	0	0	0.0	A	7.8	Pass
Garland	0	0	0	0	0.0	A	INC	INC
Jackson	0	0	0	0	0.0	A	INC	INC
Newton	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Polk	0	0	0	0	0.0	A	7.8	Pass
Pulaski	1	0	0	0	0.3	B	8.8	Pass
Union	0	0	0	0	0.0	A	INC	INC
Washington	0	0	0	0	0.0	A	7.5	Pass

ARKANSAS

American Lung Association in Arkansas

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Arkansas	16,512	3,802	3,406	265	1,369	1,353	10	1,852	175	3,049	5,212
Ashley	18,354	4,101	4,013	286	1,538	1,546	11	2,132	186	3,956	5,857
Clark	21,250	4,241	3,542	296	1,778	1,545	13	2,053	298	3,762	6,806
Crittenden	47,061	12,665	7,159	883	3,675	3,372	28	4,448	563	10,118	28,563
Garland	100,089	19,495	25,172	1,360	8,647	8,824	60	12,418	1,005	17,077	19,188
Jackson	16,624	3,307	3,032	231	1,417	1,310	10	1,756	191	3,515	4,043
Newton	7,078	1,321	1,932	92	620	651	4	926	62	1,357	551
Polk	19,337	4,253	4,543	297	1,624	1,651	12	2,306	186	3,325	2,483
Pulaski	399,145	91,469	67,999	6,379	32,703	30,003	237	40,015	4,907	67,560	198,627
Union	37,752	8,963	7,348	625	3,087	2,988	23	4,064	401	6,993	14,913
Washington	256,054	59,168	32,195	4,126	20,615	17,126	154	21,923	3,460	35,177	78,344

CALIFORNIA

American Lung Association in California

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Alameda	17	2	0	6.7	F
Amador	7	1	0	2.8	D
Butte	17	2	0	6.7	F
Calaveras	9	1	0	3.5	F
Colusa	0	0	0	0.0	A
Contra Costa	11	0	0	3.7	F
El Dorado	49	6	0	19.3	F
Fresno	129	17	1	52.2	F
Glenn	0	0	0	0.0	A
Humboldt	0	0	0	0.0	A
Imperial	41	3	0	15.2	F
Inyo	17	0	0	5.7	F
Kern	196	43	1	87.5	F
Kings	57	3	0	20.5	F
Lake	0	0	0	0.0	A
Los Angeles	182	87	16	114.8	F
Madera	58	6	0	22.3	F
Marin	0	0	0	0.0	A
Mariposa	44	8	0	18.7	F
Mendocino	0	0	0	0.0	A
Merced	47	3	0	17.2	F
Mono	DNC	DNC	DNC	DNC	DNC
Monterey	0	0	0	0.0	A
Napa	INC	INC	INC	INC	INC
Nevada	58	8	1	24.0	F
Orange	36	10	2	18.3	F
Placer	76	8	0	29.3	F
Plumas	DNC	DNC	DNC	DNC	DNC
Riverside	229	90	10	128.0	F
Sacramento	48	3	0	17.5	F
San Benito	3	0	0	1.0	C
San Bernardino	195	175	34	175.2	F
San Diego	68	5	0	25.2	F
San Francisco	0	0	0	0.0	A
San Joaquin	7	0	1	3.0	D
San Luis Obispo	30	0	1	10.7	F
San Mateo	1	0	0	0.3	B
Santa Barbara	6	1	0	2.5	D
Santa Clara	14	1	0	5.2	F

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Alameda	10	10	1	0	9.0	F	9.4	Fail
Amador	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Butte	23	22	2	1	20.8	F	11.6	Fail
Calaveras	14	16	0	0	12.7	F	9.0	Pass
Colusa	19	27	0	0	19.8	F	10.5	Fail
Contra Costa	9	11	0	0	8.5	F	10.0	Fail
El Dorado	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fresno	90	43	5	0	54.8	F	17.5	Fail
Glenn	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Humboldt	2	0	0	0	0.7	B	7.4	Pass
Imperial	18	2	0	0	7.0	F	11.1	Fail
Inyo	38	32	8	6	39.0	F	8.8	Pass
Kern	135	31	2	0	61.8	F	18.8	Fail
Kings	94	23	0	0	42.8	F	16.6	Fail
Lake	1	4	0	0	2.3	D	6.6	Pass
Los Angeles	42	12	1	0	20.7	F	13.4	Fail
Madera	33	21	1	0	22.2	F	13.2	Fail
Marin	4	4	1	0	4.0	F	7.5	Pass
Mariposa	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Mendocino	17	12	1	2	14.0	F	11.1	Fail
Merced	27	16	0	0	17.0	F	12.3	Fail
Mono	21	29	10	18	43.2	F	19.5	Fail
Monterey	4	9	2	0	7.2	F	6.9	Pass
Napa	INC	INC	INC	INC	INC	INC	INC	INC
Nevada	14	27	4	0	20.8	F	8.9	Pass
Orange	20	2	0	0	7.7	F	11.2	Fail
Placer	21	26	3	0	22.0	F	10.9	Fail
Plumas	28	29	1	1	25.3	F	17.0	Fail
Riverside	34	10	0	0	16.3	F	13.6	Fail
Sacramento	29	23	0	1	22.0	F	11.7	Fail
San Benito	6	8	0	0	6.0	F	6.5	Pass
San Bernardino	33	8	0	0	15.0	F	14.0	Fail
San Diego	15	10	0	0	10.0	F	10.0	Fail
San Francisco	3	5	0	0	3.5	F	8.2	Pass
San Joaquin	31	16	0	0	18.3	F	12.3	Fail
San Luis Obispo	5	8	2	0	7.0	F	8.7	Pass
San Mateo	4	5	0	0	3.8	F	7.6	Pass
Santa Barbara	7	3	0	0	3.8	F	8.0	Pass
Santa Clara	14	8	0	0	8.7	F	10.7	Fail

CALIFORNIA (cont.)

American Lung Association in California

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Santa Cruz	0	0	0	0.0	A
Shasta	16	0	0	5.3	F
Siskiyou	0	0	0	0.0	A
Solano	6	0	0	2.0	C
Sonoma	0	0	0	0.0	A
Stanislaus	53	4	0	19.7	F
Sutter	22	3	0	8.8	F
Tehama	33	1	0	11.5	F
Tulare	242	42	2	103.0	F
Tuolumne	8	0	0	2.7	D
Ventura	39	3	0	14.5	F
Yolo	7	0	0	2.3	D

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Santa Cruz	6	10	2	2	10.0	F	7.2	Pass
Shasta	11	17	2	0	13.5	F	9.3	Fail
Siskiyou	19	37	2	2	27.8	F	11.6	Fail
Solano	6	5	1	0	5.2	F	9.4	Fail
Sonoma	1	6	0	0	3.3	F	7.3	Pass
Stanislaus	44	19	0	0	24.2	F	14.3	Fail
Sutter	24	19	1	1	19.0	F	13.8	Fail
Tehama	17	36	0	0	23.7	F	9.9	Fail
Tulare	70	21	1	1	35.3	F	18.4	Fail
Tuolumne	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Ventura	5	2	0	0	2.7	D	7.8	Pass
Yolo	3	1	0	0	1.5	C	INC	INC

CALIFORNIA

American Lung Association in California

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Alameda	1,628,997	317,744	256,384	17,813	113,694	61,125	532	92,276	18,379	161,918	1,160,476
Amador	41,412	6,344	11,565	356	3,114	2,016	14	3,239	278	3,767	10,229
Butte	207,303	41,519	38,407	2,328	14,390	7,874	68	12,254	2,266	37,152	66,108
Calaveras	46,563	8,055	13,479	452	3,432	2,279	15	3,687	349	5,561	10,460
Colusa	21,914	5,777	3,528	324	1,403	773	7	1,185	216	2,324	14,775
Contra Costa	1,156,966	250,739	200,789	14,057	79,110	44,885	378	68,482	11,763	99,767	696,393
El Dorado	192,646	37,225	45,461	2,087	13,742	8,603	63	13,564	1,634	14,477	47,548
Fresno	1,015,190	280,680	130,958	15,735	63,330	32,520	332	48,812	10,780	185,876	744,400
Glenn	28,339	7,559	4,881	424	1,812	1,022	9	1,582	266	3,933	14,584
Humboldt	135,010	24,999	26,988	1,401	9,586	5,409	44	8,450	1,470	23,910	37,726
Imperial	178,713	50,235	24,582	2,816	11,096	5,791	59	8,774	1,732	36,354	162,416
Inyo	18,718	3,776	4,628	212	1,321	828	6	1,323	158	2,073	7,634
Kern	916,108	260,354	107,854	14,596	56,417	28,379	300	42,186	9,535	158,995	637,251
Kings	152,981	40,804	16,689	2,288	9,610	4,654	51	6,861	1,477	24,576	108,252
Lake	68,191	14,853	16,330	833	4,714	2,953	22	4,707	566	11,556	23,326
Los Angeles	9,721,138	1,983,781	1,479,466	111,215	670,547	358,801	3,176	539,981	107,753	1,328,547	7,271,416
Madera	160,256	43,366	23,312	2,431	10,123	5,401	52	8,203	1,747	33,721	110,534
Marin	256,018	48,302	62,666	2,708	18,430	11,802	84	18,615	2,089	19,345	77,539
Mariposa	17,020	2,983	5,130	167	1,252	838	6	1,367	127	2,555	3,975
Mendocino	89,783	18,717	22,108	1,049	6,280	3,937	29	6,299	783	15,657	33,940
Merced	290,014	82,915	34,018	4,648	17,811	8,934	95	13,287	3,084	53,454	220,343
Mono	12,978	2,196	2,396	123	941	534	4	815	128	1,319	4,516
Monterey	432,858	109,977	65,801	6,166	27,993	15,073	142	22,934	4,352	50,699	311,103
Napa	134,300	25,799	28,650	1,446	9,525	5,668	44	8,862	1,280	11,343	67,186
Nevada	102,293	17,130	30,149	960	7,586	5,029	33	8,164	814	10,683	16,775
Orange	3,151,184	654,517	516,335	36,693	217,255	120,144	1,030	182,022	33,090	308,990	1,953,645
Placer	417,772	90,179	86,295	5,056	28,774	17,174	136	26,814	3,923	25,827	132,175
Plumas	19,351	3,270	6,188	183	1,439	985	6	1,617	144	2,416	3,496
Riverside	2,473,902	593,553	378,953	33,276	163,108	88,107	809	133,640	25,846	264,935	1,699,282
Sacramento	1,584,169	359,154	243,730	20,135	106,190	57,046	517	86,433	17,173	190,656	927,532
San Benito	67,579	16,896	9,120	947	4,385	2,309	22	3,450	698	4,842	47,735
San Bernardino	2,193,656	557,742	273,519	31,268	141,025	72,078	718	107,038	23,861	291,258	1,652,061
San Diego	3,276,208	679,626	507,032	38,101	224,682	119,040	1,073	180,364	35,634	338,482	1,854,933
San Francisco	808,437	110,700	147,446	6,206	60,521	32,773	265	50,160	9,353	83,231	502,155
San Joaquin	793,229	207,198	106,871	11,616	50,666	26,579	259	39,844	8,355	96,295	576,788
San Luis Obispo	282,013	47,941	63,001	2,688	20,460	11,858	92	18,774	2,828	31,956	92,649
San Mateo	729,181	140,498	133,557	7,877	51,381	29,161	238	44,709	7,442	52,227	461,508
Santa Barbara	443,837	97,405	74,086	5,461	29,989	16,022	145	24,676	4,849	59,962	256,131
Santa Clara	1,870,945	380,160	282,817	21,312	129,162	68,951	613	103,675	20,055	137,728	1,341,700

CALIFORNIA (CONT.)

American Lung Association in California

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Santa Cruz	264,370	47,728	50,619	2,676	18,872	10,592	86	16,395	2,851	31,936	116,417
Shasta	180,930	38,832	39,122	2,177	12,478	7,460	59	11,762	1,667	24,791	41,003
Siskiyou	43,660	8,686	12,137	487	3,109	2,033	14	3,299	340	6,823	11,429
Solano	448,747	97,156	79,185	5,447	30,631	17,163	147	26,368	4,492	43,957	294,341
Sonoma	482,650	90,147	105,606	5,054	34,475	20,608	158	32,317	4,623	42,504	189,983
Stanislaus	551,275	145,893	76,250	8,179	35,065	18,489	180	27,844	5,745	81,730	347,261
Sutter	98,503	24,603	16,209	1,379	6,427	3,555	32	5,451	986	13,784	56,835
Tehama	65,245	15,465	13,322	867	4,371	2,606	21	4,084	581	9,732	23,213
Tulare	477,544	141,291	56,443	7,921	28,949	14,655	156	21,831	5,048	86,096	353,320
Tuolumne	54,531	9,386	15,331	526	4,005	2,585	18	4,188	418	7,014	11,560
Ventura	832,605	179,928	145,732	10,087	56,931	32,146	272	49,191	8,332	78,211	474,612
Yolo	222,115	43,393	29,906	2,433	15,313	7,468	72	11,225	2,939	33,935	124,403

COLORADO

American Lung Association in Colorado

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Adams	45	1	0	15.5	F
Arapahoe	55	5	0	20.8	F
Archuleta	0	0	0	0.0	A
Boulder	47	2	0	16.7	F
Clear Creek	18	0	0	6.0	F
Delta	0	0	0	0.0	A
Denver	43	2	0	15.3	F
Douglas	63	10	0	26.0	F
El Paso	36	1	0	12.5	F
Garfield	3	0	0	1.0	C
Gilpin	31	1	0	10.8	F
Gunnison	3	0	0	1.0	C
Jackson	INC	INC	INC	INC	INC
Jefferson	97	16	0	40.3	F
La Plata	4	0	0	1.3	C
Larimer	47	3	0	17.2	F
Mesa	3	0	0	1.0	C
Montezuma	4	0	0	1.3	C
Pueblo	DNC	DNC	DNC	DNC	DNC
Rio Blanco	6	0	0	2.0	C
Weld	47	1	0	16.2	F

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Adams	4	1	0	0	1.8	C	INC	INC
Arapahoe	1	0	0	0	0.3	B	6.1	Pass
Archuleta	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Boulder	20	3	0	0	8.2	F	8.7	Pass
Clear Creek	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Delta	2	0	0	0	0.7	B	INC	INC
Denver	19	2	0	0	7.3	F	9.3	Fail
Douglas	7	2	0	0	3.3	F	6.7	Pass
El Paso	1	0	0	0	0.3	B	5.5	Pass
Garfield	INC	INC	INC	INC	INC	INC	INC	INC
Gilpin	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Gunnison	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jackson	INC	INC	INC	INC	INC	INC	INC	INC
Jefferson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
La Plata	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Larimer	14	1	0	0	5.2	F	7.7	Pass
Mesa	3	0	0	0	1.0	C	5.8	Pass
Montezuma	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Pueblo	1	0	0	0	0.3	B	INC	INC
Rio Blanco	4	1	0	0	1.8	C	8.5	Pass
Weld	14	0	0	0	4.7	F	8.8	Pass

COLORADO

American Lung Association in Colorado

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Adams	527,575	129,498	59,768	9,031	43,723	18,837	188	24,545	5,839	53,153	280,694
Arapahoe	655,808	145,482	95,751	10,146	55,722	26,112	234	34,469	7,031	52,215	280,118
Archuleta	14,003	2,383	3,957	166	1,238	777	5	1,064	104	1,362	3,305
Boulder	327,468	56,615	54,329	3,948	29,566	14,024	117	18,567	3,641	37,074	75,603
Clear Creek	9,355	1,267	2,152	88	869	490	3	662	81	691	1,281
Delta	31,602	6,047	8,826	422	2,729	1,692	11	2,317	239	4,549	6,180
Denver	713,252	128,348	89,001	8,951	64,512	26,720	255	34,711	9,174	83,390	321,565
Douglas	375,988	86,913	52,679	6,061	31,439	15,199	134	20,091	3,763	11,794	78,160
El Paso	740,567	169,993	104,035	11,855	62,477	28,420	265	37,402	7,787	61,445	244,184
Garfield	62,271	14,930	9,355	1,041	5,155	2,493	22	3,304	605	4,894	21,196
Gilpin	5,891	809	1,211	56	546	305	2	410	53	373	870
Gunnison	17,267	2,715	2,528	189	1,596	710	6	931	194	1,578	2,466
Jackson	1,302	231	343	16	114	70	0	96	10	175	218
Jefferson	576,143	105,195	103,790	7,336	51,176	25,609	206	34,129	5,903	37,513	133,357
La Plata	56,607	9,781	11,791	682	5,063	2,697	20	3,623	553	6,407	12,285
Larimer	366,778	66,337	64,064	4,626	32,806	15,663	131	20,787	4,126	39,357	70,080
Mesa	158,636	32,131	33,488	2,241	13,680	7,342	57	9,887	1,515	16,577	31,437
Montezuma	26,468	5,503	6,481	384	2,250	1,318	9	1,793	220	3,975	7,549
Pueblo	169,544	36,892	32,968	2,573	14,366	7,539	61	10,117	1,623	24,790	83,714
Rio Blanco	6,569	1,541	1,205	107	545	283	2	379	59	634	1,146
Weld	350,176	88,411	45,390	6,166	28,660	12,959	125	17,020	3,699	31,318	128,291

CONNECTICUT

American Lung Association in Connecticut

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Fairfield	41	8	0	17.7	F
Hartford	5	0	0	1.7	C
Litchfield	4	0	0	1.3	C
Middlesex	18	1	0	6.5	F
New Haven	28	3	0	10.8	F
New London	13	1	0	4.8	F
Tolland	3	0	0	1.0	C
Windham	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Fairfield	5	0	0	0	1.7	C	8.0	Pass
Hartford	2	0	0	0	0.7	B	7.5	Pass
Litchfield	2	0	0	0	0.7	B	5.1	Pass
Middlesex	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
New Haven	3	0	0	0	1.0	C	8.2	Pass
New London	1	0	0	0	0.3	B	6.9	Pass
Tolland	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Windham	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

CONNECTICUT

American Lung Association in Connecticut

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Fairfield	959,768	210,680	158,603	17,359	93,497	42,247	452	58,760	9,266	85,452	386,212
Hartford	896,854	186,592	158,512	15,374	88,532	40,128	422	55,990	8,841	92,542	371,285
Litchfield	185,000	32,664	42,169	2,691	18,765	9,618	87	13,867	1,527	15,713	25,753
Middlesex	164,759	27,712	35,695	2,283	16,944	8,368	78	11,953	1,495	10,537	29,067
New Haven	863,700	172,492	156,201	14,212	86,112	39,220	407	54,808	8,747	100,433	345,820
New London	268,805	51,417	51,843	4,236	27,014	12,615	127	17,760	2,473	23,102	69,656
Tolland	150,293	25,624	25,398	2,111	15,615	6,664	71	9,143	1,633	15,039	26,007
Windham	116,418	22,529	20,814	1,856	11,700	5,348	55	7,471	1,121	13,043	21,471

DELAWARE

American Lung Association in Delaware

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Kent	2	0	0	0.7	B
New Castle	4	0	0	1.3	C
Sussex	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Kent	0	0	0	0	0.0	A	INC	INC
New Castle	2	0	0	0	0.7	B	INC	INC
Sussex	0	0	0	0	0.0	A	INC	INC

DELAWARE

American Lung Association in Delaware

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Kent	186,946	42,496	34,393	2,964	14,126	9,755	87	12,717	2,083	19,204	78,595
New Castle	575,494	121,047	98,720	8,442	44,506	30,283	267	38,738	6,576	56,547	265,939
Sussex	255,956	44,584	78,731	3,109	20,823	16,658	119	24,172	2,030	24,092	62,884

DISTRICT OF COLUMBIA

American Lung Association in the District of Columbia

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
District of Columbia	9	0	0	3.0	D

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
District of Columbia	2	2	0	0	1.7	C	8.6	Pass

DISTRICT OF COLUMBIA

American Lung Association in the District of Columbia

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
District of Columbia	671,803	124,475	87,260	12,031	61,433	21,294	257	34,339	8,001	91,474	419,653

FLORIDA

American Lung Association in Florida

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Alachua	0	0	0	0.0	A	1	0	0	0	0.3	B	7.1	Pass
Baker	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Bay	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Brevard	0	0	0	0.0	A	0	0	0	0	0.0	A	7.9	Pass
Broward	0	0	0	0.0	A	3	0	0	0	1.0	C	9.4	Fail
Collier	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Columbia	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Duval	0	0	0	0.0	A	1	0	0	0	0.3	B	8.7	Pass
Escambia	1	0	0	0.3	B	0	0	0	0	0.0	A	9.5	Fail
Flagler	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Highlands	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hillsborough	4	0	0	1.3	C	1	0	0	0	0.3	B	8.3	Pass
Holmes	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Indian River	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lake	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lee	0	0	0	0.0	A	0	0	0	0	0.0	A	INC	INC
Leon	0	0	0	0.0	A	1	0	0	0	0.3	B	7.2	Pass
Liberty	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Manatee	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Marion	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Martin	0	0	0	0.0	A	INC	INC	INC	INC	INC	INC	INC	INC
Miami-Dade	1	0	0	0.3	B	1	0	0	0	0.3	B	7.1	Pass
Okaloosa	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Orange	0	0	0	0.0	A	INC	INC	INC	INC	INC	INC	INC	INC
Osceola	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Palm Beach	0	0	0	0.0	A	0	0	0	0	0.0	A	6.7	Pass
Pasco	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Pinellas	0	0	0	0.0	A	0	0	0	0	0.0	A	7.7	Pass
Polk	0	0	0	0.0	A	0	0	0	0	0.0	A	8.3	Pass
St. Lucie	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Santa Rosa	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sarasota	0	0	0	0.0	A	0	0	0	0	0.0	A	7.9	Pass
Seminole	0	0	0	0.0	A	0	0	0	0	0.0	A	7.5	Pass
Volusia	0	0	0	0.0	A	0	0	0	0	0.0	A	8.3	Pass
Wakulla	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

FLORIDA

American Lung Association in Florida

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Alachua	284,030	49,898	44,121	2,616	21,753	13,726	138	17,351	3,918	50,816	114,238
Baker	27,803	6,840	4,208	359	1,993	1,357	14	1,802	277	3,338	5,474
Bay	185,134	38,526	34,226	2,020	13,934	10,017	90	13,635	1,847	21,668	46,818
Brevard	630,693	112,879	155,522	5,918	49,015	38,822	307	54,919	5,613	62,175	175,373
Broward	1,947,026	400,094	353,019	20,975	147,139	105,037	949	142,577	20,413	257,252	1,304,281
Collier	397,994	64,531	133,653	3,383	31,150	27,845	194	40,966	3,004	40,381	152,115
Columbia	71,908	15,697	14,660	823	5,314	3,951	35	5,447	647	12,901	20,246
Duval	1,016,536	225,778	156,979	11,836	74,732	50,012	495	65,693	11,599	137,467	504,180
Escambia	324,878	67,241	58,634	3,525	24,271	16,963	158	22,718	3,427	50,147	118,346
Flagler	126,705	20,282	39,760	1,063	10,030	8,757	62	12,816	997	11,424	33,255
Highlands	105,618	17,481	38,272	916	8,170	7,551	51	11,206	774	16,289	37,666
Hillsborough	1,513,301	325,426	229,110	17,060	112,526	74,953	738	98,326	17,441	191,075	816,965
Holmes	19,651	4,018	3,985	211	1,482	1,098	10	1,513	163	3,513	2,840
Indian River	167,352	24,708	58,848	1,295	13,339	12,130	81	17,953	1,226	19,060	43,332
Lake	410,139	77,248	109,935	4,050	31,281	25,571	200	36,522	3,688	39,355	140,918
Lee	822,453	138,943	240,873	7,284	64,093	53,904	401	77,740	7,075	89,587	294,650
Leon	297,369	54,306	44,317	2,847	22,631	14,190	144	17,893	4,209	52,424	134,538
Liberty	7,603	1,314	1,283	69	595	404	4	535	59	1,332	2,138
Manatee	429,125	73,474	124,122	3,852	33,470	28,175	209	40,693	3,614	42,580	128,699
Marion	396,415	73,553	114,887	3,856	30,234	25,497	193	36,793	3,411	60,464	130,118
Martin	162,006	25,527	52,963	1,338	12,814	11,343	79	16,658	1,163	15,939	37,104
Miami-Dade	2,673,837	528,913	459,733	27,728	204,211	142,732	1,303	191,980	28,619	381,423	2,306,084
Okaloosa	216,482	48,138	36,231	2,524	15,879	10,895	106	14,473	2,208	16,979	61,045
Orange	1,452,726	306,733	191,501	16,080	108,509	68,894	708	88,165	17,894	178,037	892,056
Osceola	422,545	100,693	56,675	5,279	30,543	19,822	206	25,685	4,873	54,089	304,240
Palm Beach	1,518,477	281,868	382,647	14,777	116,433	92,613	739	130,996	14,094	165,851	723,976
Pasco	608,794	122,396	134,246	6,417	46,007	35,067	297	48,846	5,958	65,148	190,111
Pinellas	961,739	146,541	256,228	7,682	77,065	62,175	468	88,538	8,828	117,299	261,621
Polk	787,404	171,779	154,640	9,005	57,931	42,020	384	57,206	8,240	120,353	376,497
St. Lucie	358,704	69,878	88,558	3,663	27,224	21,605	175	30,543	3,282	47,534	170,061
Santa Rosa	198,268	42,995	33,403	2,254	14,773	10,324	97	13,881	1,937	18,064	38,020
Sarasota	462,286	63,491	174,368	3,329	37,214	34,842	225	52,018	3,251	38,638	84,169
Seminole	478,772	97,847	80,170	5,130	36,112	24,846	233	33,118	5,367	52,808	208,930
Volusia	579,192	100,335	147,434	5,260	45,154	35,926	282	50,847	5,282	66,107	182,441
Wakulla	35,178	7,267	5,859	381	2,664	1,858	17	2,499	322	3,771	7,545

GEORGIA

American Lung Association in Georgia

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Bibb	1	0	0	0.3	B	1	0	0	0	0.3	B	8.8	Pass
Chatham	0	0	0	0.0	A	1	0	0	0	0.3	B	INC	INC
Chattooga	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clarke	0	0	0	0.0	A	1	0	0	0	0.3	B	9.2	Fail
Clayton	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.4	Pass
Cobb	1	0	0	0.3	B	0	0	0	0	0.0	A	8.4	Pass
Coffee	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	6.9	Pass
Columbia	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dawson	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
DeKalb	4	0	0	1.3	C	1	0	0	0	0.3	B	9.0	Pass
Dougherty	DNC	DNC	DNC	DNC	DNC	7	0	0	0	2.3	D	9.2	Fail
Douglas	3	0	0	1.0	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fulton	4	1	0	1.8	C	0	0	0	0	0.0	A	9.4	Fail
Glynn	0	0	0	0.0	A	1	0	0	0	0.3	B	8.1	Pass
Gwinnett	2	0	0	0.7	B	1	0	0	0	0.3	B	8.8	Pass
Hall	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.8	Pass
Henry	4	0	0	1.3	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Houston	DNC	DNC	DNC	DNC	DNC	6	0	0	0	2.0	C	9.1	Fail
Lowndes	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	8.6	Pass
Murray	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Muscogee	0	0	0	0.0	A	1	1	0	0	0.8	B	8.3	Pass
Pike	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Richmond	0	0	0	0.0	A	8	0	0	0	2.7	D	10.4	Fail
Rockdale	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sumter	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Walker	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	INC	INC
Washington	DNC	DNC	DNC	DNC	DNC	8	0	0	0	2.7	D	10.2	Fail

GEORGIA

American Lung Association in Georgia

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Bibb	156,197	37,771	25,944	2,937	11,417	8,796	81	11,315	1,773	34,064	100,804
Chatham	301,107	61,340	51,272	4,770	23,111	17,408	158	22,266	3,634	45,884	159,245
Chattooga	24,936	5,468	4,712	425	1,879	1,527	13	1,991	231	4,271	4,530
Clarke	129,875	21,414	16,209	1,665	10,420	6,522	68	7,908	2,052	31,580	57,719
Clayton	296,564	79,236	32,248	6,162	20,870	14,342	154	17,901	3,731	42,575	272,834
Cobb	771,952	171,337	107,063	13,324	57,771	42,162	405	53,500	9,147	61,108	389,143
Coffee	43,172	10,514	6,239	818	3,144	2,324	23	2,959	438	7,959	18,745
Columbia	162,419	39,980	24,608	3,109	11,792	8,875	85	11,351	1,816	11,298	57,552
Dawson	30,138	5,971	6,092	464	2,334	1,935	16	2,533	298	2,398	3,406
DeKalb	762,820	169,594	107,083	13,188	57,071	41,147	398	52,038	9,542	101,463	539,430
Dougherty	82,966	19,939	14,368	1,551	6,079	4,734	43	6,106	985	22,306	63,628
Douglas	147,316	37,017	18,212	2,879	10,601	7,683	77	9,733	1,737	14,898	99,836
Fulton	1,074,634	221,562	137,490	17,229	81,983	57,034	564	71,427	13,853	133,088	663,459
Glynn	85,079	17,297	19,505	1,345	6,559	5,693	44	7,527	857	11,354	30,985
Gwinnett	975,353	251,067	111,705	19,524	69,571	49,219	512	61,938	11,341	86,107	663,631
Hall	212,692	50,422	34,227	3,921	15,636	12,068	112	15,533	2,251	24,679	88,201
Henry	248,364	61,600	31,151	4,790	17,951	13,092	130	16,612	2,949	19,857	166,174
Houston	169,631	42,925	23,249	3,338	12,191	8,880	89	11,261	1,962	17,991	80,127
Lowndes	119,739	29,115	15,779	2,264	8,717	5,974	63	7,448	1,523	17,678	57,957
Murray	40,472	9,500	6,416	739	2,984	2,316	21	2,985	428	5,332	8,024
Muscogee	202,616	50,009	30,077	3,889	14,696	10,794	106	13,719	2,368	35,163	125,622
Pike	19,990	4,694	3,217	365	1,474	1,161	11	1,501	213	1,709	2,663
Richmond	206,640	46,848	31,544	3,643	15,388	11,253	108	14,284	2,421	35,823	140,119
Rockdale	94,984	22,432	15,005	1,744	6,989	5,463	49	7,054	1,053	10,561	71,862
Sumter	28,877	6,509	5,166	506	2,158	1,685	15	2,176	327	6,101	17,566
Walker	68,915	14,578	13,447	1,134	5,246	4,305	36	5,623	693	9,937	7,217
Washington	19,738	4,260	3,543	331	1,493	1,192	10	1,547	178	3,949	11,433

HAWAII

American Lung Association in Hawaii

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Hawaii	DNC	DNC	DNC	DNC	DNC
Honolulu	0	0	0	0.0	A
Kauai	DNC	DNC	DNC	DNC	DNC
Maui	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Hawaii	0	0	0	0	0.0	A	3.4	Pass
Honolulu	0	0	0	0	0.0	A	3.7	Pass
Kauai	0	0	0	0	0.0	A	INC	INC
Maui	0	0	0	0	0.0	A	4.0	Pass

HAWAII

American Lung Association in Hawaii

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Hawaii	206,315	43,255	48,400	3,999	14,591	6,144	72	12,969	2,087	29,609	143,863
Honolulu	995,638	203,999	195,377	18,860	71,758	27,126	350	55,959	10,869	89,980	821,881
Kauai	73,810	15,655	16,582	1,447	5,216	2,160	26	4,534	751	6,620	52,434
Maui	164,351	34,415	33,977	3,182	11,699	4,714	58	9,775	1,728	14,663	115,372

IDAHO

American Lung Association in Idaho

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Ada	16	0	0	5.3	F
Bannock	3	0	0	1.0	C
Benewah	DNC	DNC	DNC	DNC	DNC
Butte	2	0	0	0.7	B
Canyon	DNC	DNC	DNC	DNC	DNC
Franklin	DNC	DNC	DNC	DNC	DNC
Idaho	3	0	0	1.0	C
Jerome	DNC	DNC	DNC	DNC	DNC
Lemhi	DNC	DNC	DNC	DNC	DNC
Shoshone	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Ada	6	1	0	0	2.5	D	8.1	Pass
Bannock	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Benewah	14	15	0	1	13.0	F	10.2	Fail
Butte	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Canyon	20	8	0	0	10.7	F	INC	INC
Franklin	8	1	0	0	3.2	D	6.6	Pass
Idaho	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jerome	INC	INC	INC	INC	INC	INC	INC	INC
Lemhi	23	11	0	0	13.2	F	11.3	Fail
Shoshone	12	12	3	1	12.8	F	10.7	Fail

IDAHO

American Lung Association in Idaho

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Ada	518,907	112,845	84,697	7,870	45,047	23,952	208	33,844	6,135	40,623	87,933
Bannock	89,517	22,379	13,707	1,561	7,480	3,864	36	5,397	1,082	11,147	15,742
Benewah	10,370	2,335	2,420	163	872	552	4	821	91	1,483	1,654
Butte	2,684	602	692	42	225	147	1	220	25	399	268
Canyon	251,065	66,307	36,630	4,624	20,568	10,639	100	14,886	2,963	25,965	76,931
Franklin	15,189	4,579	2,245	319	1,177	628	6	889	162	1,203	1,462
Idaho	17,593	3,411	5,107	238	1,527	1,037	7	1,566	136	2,161	1,769
Jerome	25,311	7,425	3,420	518	1,992	1,024	10	1,430	271	2,924	10,549
Lemhi	8,240	1,455	2,589	101	728	508	3	772	68	1,146	586
Shoshone	14,012	2,955	3,307	206	1,203	751	6	1,113	129	1,834	1,349

ILLINOIS

American Lung Association in Illinois

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Adams	0	0	0	0.0	A
Champaign	3	0	0	1.0	C
Clark	1	0	0	0.3	B
Cook	37	6	0	15.3	F
DuPage	6	1	0	2.5	D
Effingham	0	0	0	0.0	A
Hamilton	1	0	0	0.3	B
Jersey	8	0	0	2.7	D
Jo Daviess	0	0	0	0.0	A
Kane	9	1	0	3.5	F
Lake	21	2	0	8.0	F
McHenry	13	0	0	4.3	F
McLean	5	0	0	1.7	C
Macon	2	0	0	0.7	B
Macoupin	2	0	0	0.7	B
Madison	18	0	0	6.0	F
Peoria	2	0	0	0.7	B
Randolph	3	0	0	1.0	C
Rock Island	2	0	0	0.7	B
St. Clair	2	1	0	1.2	C
Sangamon	3	0	0	1.0	C
Will	6	0	0	2.0	C
Winnebago	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Adams	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Champaign	0	0	0	0	0.0	A	7.8	Pass
Clark	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cook	4	0	0	0	1.3	C	10.5	Fail
DuPage	0	0	0	0	0.0	A	9.5	Fail
Effingham	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hamilton	2	0	0	0	0.7	B	8.8	Pass
Jersey	0	0	0	0	0.0	A	8.0	Pass
Jo Daviess	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Kane	1	0	0	0	0.3	B	9.2	Fail
Lake	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
McHenry	0	0	0	0	0.0	A	8.9	Pass
McLean	1	0	0	0	0.3	B	8.9	Pass
Macon	3	0	0	0	1.0	C	9.2	Fail
Macoupin	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Madison	0	0	0	0	0.0	A	10.0	Fail
Peoria	1	0	0	0	0.3	B	INC	INC
Randolph	2	0	0	0	0.7	B	8.2	Pass
Rock Island	2	0	0	0	0.7	B	8.8	Pass
St. Clair	0	0	0	0	0.0	A	10.0	Fail
Sangamon	1	0	0	0	0.3	B	8.3	Pass
Will	1	1	0	0	0.8	B	9.7	Fail
Winnebago	0	0	0	0	0.0	A	9.1	Fail

ILLINOIS

American Lung Association in Illinois

	AT-RISK GROUPS											
				Lung Diseases								
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Adams	64,725	14,459	13,667	647	4,376	3,176	34	4,769	578	8,475	6,004
Champaign	206,542	38,655	29,630	1,730	14,952	8,420	110	11,806	2,596	36,364	72,375
Clark	15,229	3,419	3,065	153	1,034	745	8	1,116	130	1,703	634
Cook	5,109,292	1,069,611	826,245	47,864	358,748	226,834	2,710	328,733	55,496	688,627	3,010,470
DuPage	920,901	200,390	162,203	8,967	63,707	42,687	489	62,813	8,957	61,619	330,087
Effingham	34,325	8,121	6,487	363	2,300	1,603	18	2,383	301	3,133	1,617
Hamilton	7,984	1,803	1,769	81	536	402	4	608	68	1,058	397
Jersey	21,246	4,231	4,406	189	1,490	1,072	11	1,606	191	2,057	1,028
Jo Daviess	21,758	3,873	6,571	173	1,513	1,309	12	2,041	152	1,828	1,344
Kane	514,182	121,549	80,550	5,439	34,948	22,636	273	32,996	5,006	41,027	228,424
Lake	709,150	162,159	113,993	7,256	48,640	31,705	377	46,297	6,769	56,275	294,738
McHenry	311,747	69,845	51,959	3,126	21,493	14,329	166	21,043	2,901	18,106	67,763
McLean	171,141	35,679	25,332	1,597	12,065	7,188	91	10,246	2,004	18,099	37,968
Macon	101,483	22,715	21,571	1,016	6,852	4,980	54	7,483	964	14,579	26,177
Macoupin	44,245	9,062	9,729	406	3,064	2,275	24	3,434	388	5,241	1,952
Madison	263,864	55,509	49,333	2,484	18,345	12,503	140	18,483	2,605	31,585	44,211
Peoria	178,383	42,081	33,209	1,883	11,959	8,158	95	12,070	1,757	23,909	57,290
Randolph	30,068	5,954	6,277	266	2,109	1,506	16	2,253	235	3,999	4,216
Rock Island	141,527	31,482	29,223	1,409	9,594	6,846	75	10,241	1,311	20,347	43,921
St. Clair	252,671	57,904	44,214	2,591	17,205	11,532	134	16,972	2,499	39,066	100,166
Sangamon	194,534	42,185	37,984	1,888	13,365	9,345	103	13,905	1,882	21,500	41,823
Will	696,757	162,744	102,286	7,283	47,758	30,272	370	43,851	6,936	48,828	279,060
Winnebago	282,188	65,462	53,119	2,929	19,035	13,185	150	19,574	2,681	42,830	97,719

INDIANA

American Lung Association in Indiana

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Allen	2	0	0	0.7	B	INC	INC	INC	INC	INC	INC	INC	INC
Bartholomew	1	0	0	0.3	B	0	0	0	0	0.0	A	7.0	Pass
Boone	4	0	0	1.3	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Brown	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Carroll	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clark	1	0	0	0.3	B	0	0	0	0	0.0	A	9.9	Fail
Delaware	1	0	0	0.3	B	0	0	0	0	0.0	A	8.1	Pass
Dubois	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.8	Pass
Elkhart	0	0	0	0.0	A	3	2	0	0	2.0	C	8.4	Pass
Floyd	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Greene	2	0	0	0.7	B	0	0	0	0	0.0	A	7.7	Pass
Hamilton	0	0	0	0.0	A	0	0	0	0	0.0	A	9.8	Fail
Hendricks	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Henry	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	7.5	Pass
Howard	7	0	0	2.3	D	0	0	0	0	0.0	A	7.4	Pass
Knox	3	0	0	1.0	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lake	13	0	0	4.3	F	3	1	0	0	1.5	C	9.8	Fail
LaPorte	13	1	0	4.8	F	1	0	0	0	0.3	B	8.1	Pass
Madison	4	0	0	1.3	C	0	0	0	0	0.0	A	8.9	Pass
Marion	6	0	0	2.0	C	18	1	0	0	6.5	F	11.9	Fail
Monroe	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	7.7	Pass
Perry	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Porter	13	1	0	4.8	F	2	1	0	0	1.2	C	8.3	Pass
Posey	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. Joseph	8	0	0	2.7	D	3	1	0	0	1.5	C	9.6	Fail
Shelby	3	0	0	1.0	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Spencer	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.2	Pass
Sullivan	DNC	DNC	DNC	DNC	DNC	INC	INC	INC	INC	INC	INC	INC	INC
Tippecanoe	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.4	Pass
Vanderburgh	1	0	0	0.3	B	2	0	0	0	0.7	B	9.2	Fail
Vigo	1	0	0	0.3	B	2	0	0	0	0.7	B	8.7	Pass
Wabash	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Warrick	4	0	0	1.3	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Whitley	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	7.6	Pass

INDIANA

American Lung Association in Indiana

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Allen	391,449	98,300	61,511	7,919	32,208	24,903	243	29,388	4,619	44,410	111,778
Bartholomew	83,540	20,017	14,333	1,613	6,982	5,573	52	6,660	914	10,442	17,158
Boone	74,164	18,612	11,149	1,499	6,153	4,825	46	5,630	840	3,825	9,370
Brown	15,570	2,569	4,151	207	1,433	1,357	10	1,720	132	1,489	817
Carroll	20,555	4,450	4,261	358	1,774	1,531	13	1,879	204	2,106	1,517
Clark	124,237	26,897	21,138	2,167	10,737	8,549	77	10,131	1,453	11,755	23,311
Delaware	112,031	19,940	19,786	1,606	10,043	7,614	69	9,055	1,526	19,758	15,915
Dubois	43,632	10,501	8,311	846	3,653	3,088	27	3,753	429	3,606	4,991
Elkhart	206,890	55,712	32,600	4,488	16,634	13,080	129	15,499	2,294	26,704	56,372
Floyd	80,714	18,008	14,236	1,451	6,917	5,609	50	6,698	916	7,971	10,939
Greene	31,006	6,620	6,292	533	2,691	2,311	19	2,821	312	3,888	1,371
Hamilton	364,921	91,292	50,946	7,354	30,351	23,279	226	26,804	4,365	16,387	70,371
Hendricks	182,534	44,078	27,569	3,551	15,306	11,877	114	13,852	2,103	9,627	38,872
Henry	48,915	9,874	9,695	795	4,300	3,603	31	4,374	468	6,269	3,487
Howard	83,574	18,907	16,784	1,523	7,095	5,983	52	7,336	905	12,517	13,852
Knox	35,789	7,543	6,755	608	3,093	2,497	22	3,020	383	4,988	3,075
Lake	499,689	115,108	89,342	9,273	42,353	34,469	310	41,363	5,664	72,873	237,682
LaPorte	111,675	23,491	21,770	1,892	9,691	8,037	70	9,758	1,095	16,055	24,466
Madison	131,744	27,971	24,977	2,253	11,416	9,397	82	11,354	1,414	18,875	21,630
Marion	969,466	236,984	130,896	19,091	80,519	58,634	601	67,253	12,627	149,846	466,850
Monroe	139,745	21,738	20,670	1,751	12,799	8,716	87	10,011	2,135	23,312	24,516
Perry	19,183	3,924	3,737	316	1,678	1,389	12	1,683	174	2,903	1,363
Porter	174,791	36,937	32,087	2,976	15,184	12,375	109	14,854	1,993	15,180	33,390
Posey	25,063	5,398	5,294	435	2,165	1,878	16	2,313	245	2,416	1,146
St. Joseph	272,234	62,509	46,096	5,036	22,974	17,899	169	21,328	3,302	34,388	80,457
Shelby	44,991	9,970	8,422	803	3,870	3,236	28	3,900	469	6,233	4,187
Spencer	19,967	4,301	4,170	346	1,728	1,503	12	1,845	195	1,850	1,203
Sullivan	20,670	3,804	3,950	306	1,856	1,510	13	1,815	195	2,339	1,817
Tippecanoe	188,717	37,701	23,524	3,037	16,416	10,814	118	12,148	2,653	33,200	49,312
Vanderburgh	179,744	38,508	32,983	3,102	15,475	12,384	111	14,915	2,111	26,687	32,718
Vigo	106,006	21,496	18,416	1,732	9,228	7,073	66	8,428	1,269	17,975	15,681
Wabash	30,828	6,430	6,807	518	2,676	2,331	19	2,896	316	3,400	1,932
Warrick	65,185	14,899	12,147	1,200	5,543	4,605	40	5,561	706	4,762	5,915
Whitley	34,627	7,872	6,727	634	2,950	2,495	22	3,034	352	3,085	1,901

IOWA

American Lung Association in Iowa

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Black Hawk	DNC	DNC	DNC	DNC	DNC
Bremer	0	0	0	0.0	A
Clinton	0	0	0	0.0	A
Harrison	0	0	0	0.0	A
Johnson	DNC	DNC	DNC	DNC	DNC
Lee	DNC	DNC	DNC	DNC	DNC
Linn	1	0	0	0.3	B
Montgomery	0	0	0	0.0	A
Muscatine	DNC	DNC	DNC	DNC	DNC
Palo Alto	0	0	0	0.0	A
Polk	0	0	0	0.0	A
Pottawattamie	DNC	DNC	DNC	DNC	DNC
Scott	0	0	0	0.0	A
Van Buren	0	0	0	0.0	A
Woodbury	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Black Hawk	0	0	0	0	0.0	A	7.9	Pass
Bremer	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clinton	0	0	0	0	0.0	A	8.6	Pass
Harrison	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Johnson	1	0	0	0	0.3	B	7.8	Pass
Lee	0	0	0	0	0.0	A	8.2	Pass
Linn	0	0	0	0	0.0	A	8.1	Pass
Montgomery	0	0	0	0	0.0	A	6.7	Pass
Muscatine	1	0	0	0	0.3	B	8.1	Pass
Palo Alto	0	1	0	0	0.5	B	7.0	Pass
Polk	1	2	0	0	1.3	C	7.6	Pass
Pottawattamie	1	0	0	0	0.3	B	8.2	Pass
Scott	0	1	0	0	0.5	B	8.4	Pass
Van Buren	0	0	0	0	0.0	A	7.1	Pass
Woodbury	0	1	0	0	0.5	B	7.9	Pass

IOWA

American Lung Association in Iowa

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Black Hawk	130,274	28,109	23,309	1,618	9,907	6,389	73	8,572	1,649	20,825	26,901
Bremer	25,259	5,657	5,007	326	1,897	1,313	14	1,777	288	1,582	1,560
Clinton	46,344	10,564	9,568	608	3,476	2,533	26	3,426	474	6,077	4,644
Harrison	14,658	3,404	2,950	196	1,097	800	8	1,078	144	1,323	677
Johnson	156,420	29,763	21,146	1,713	12,378	6,850	88	8,932	2,370	22,481	36,791
Lee	32,840	6,936	7,258	399	2,507	1,858	19	2,528	322	4,255	3,171
Linn	229,033	50,945	40,117	2,932	17,394	11,568	129	15,405	2,698	20,251	37,083
Montgomery	10,205	2,283	2,273	131	766	576	6	785	100	1,119	738
Muscatine	42,377	10,118	7,753	582	3,146	2,168	24	2,903	452	5,116	10,397
Palo Alto	8,764	2,000	2,045	115	650	492	5	677	82	950	701
Polk	501,089	119,897	71,143	6,901	37,484	23,028	283	30,097	6,223	50,460	124,112
Pottawattamie	93,173	21,190	17,613	1,220	7,014	4,872	53	6,536	1,014	10,637	13,487
Scott	173,924	39,971	30,798	2,301	13,076	8,792	98	11,730	2,013	20,116	37,807
Van Buren	7,256	1,700	1,689	98	535	412	4	566	66	928	295
Woodbury	105,671	26,989	16,730	1,553	7,697	4,972	60	6,587	1,206	13,386	33,521

KANSAS

American Lung Association in Kansas

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Johnson	2	0	0	0.7	B
Leavenworth	2	0	0	0.7	B
Neosho	0	0	0	0.0	A
Sedgwick	6	0	0	2.0	C
Shawnee	0	1	0	0.5	B
Sumner	3	0	0	1.0	C
Trego	0	0	0	0.0	A
Wyandotte	6	0	0	2.0	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Johnson	4	0	0	0	1.3	C	8.9	Pass
Leavenworth	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Neosho	4	0	0	0	1.3	C	9.6	Fail
Sedgwick	5	0	0	0	1.7	C	INC	INC
Shawnee	5	2	0	0	2.7	D	INC	INC
Sumner	5	0	0	0	1.7	C	9.8	Fail
Trego	3	0	0	0	1.0	C	INC	INC
Wyandotte	8	0	0	0	2.7	D	10.8	Fail

KANSAS

American Lung Association in Kansas

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Johnson	619,195	143,498	100,187	10,740	51,180	32,927	293	41,169	7,421	33,349	134,610
Leavenworth	82,892	19,484	13,283	1,458	6,829	4,367	39	5,458	865	7,294	17,703
Neosho	15,606	3,770	3,196	282	1,249	885	7	1,156	161	2,360	1,871
Sedgwick	525,525	129,479	84,157	9,691	42,704	27,045	249	33,936	6,279	81,103	176,172
Shawnee	177,480	40,538	34,574	3,034	14,540	9,993	84	12,899	2,006	23,618	48,797
Sumner	22,473	5,421	4,529	406	1,798	1,282	11	1,667	227	2,905	2,640
Trego	2,752	506	737	38	232	184	1	248	25	295	172
Wyandotte	165,746	44,564	22,803	3,335	13,157	8,045	78	9,882	1,981	25,639	101,273

KENTUCKY

American Lung Association in Kentucky

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Bell	0	0	0	0.0	A
Boone	0	0	0	0.0	A
Boyd	0	0	0	0.0	A
Bullitt	3	0	0	1.0	C
Campbell	2	0	0	0.7	B
Carter	0	0	0	0.0	A
Christian	0	0	0	0.0	A
Daviess	1	0	0	0.3	B
Edmonson	0	0	0	0.0	A
Fayette	0	0	0	0.0	A
Greenup	0	0	0	0.0	A
Hancock	1	0	0	0.3	B
Hardin	1	0	0	0.3	B
Jefferson	15	0	0	5.0	F
Jessamine	1	0	0	0.3	B
Livingston	3	0	0	1.0	C
McCracken	2	0	0	0.7	B
Morgan	0	0	0	0.0	A
Oldham	3	0	0	1.0	C
Perry	0	0	0	0.0	A
Pike	0	0	0	0.0	A
Pulaski	0	0	0	0.0	A
Simpson	0	0	0	0.0	A
Trigg	0	0	0	0.0	A
Warren	0	0	0	0.0	A
Washington	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Bell	2	0	0	0	0.7	B	9.3	Fail
Boone	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Boyd	1	0	0	0	0.3	B	8.0	Pass
Bullitt	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Campbell	0	0	0	0	0.0	A	7.8	Pass
Carter	0	0	0	0	0.0	A	6.2	Pass
Christian	0	0	0	0	0.0	A	9.2	Fail
Daviess	0	0	0	0	0.0	A	9.0	Pass
Edmonson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fayette	1	0	0	0	0.3	B	8.2	Pass
Greenup	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hancock	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hardin	0	0	0	0	0.0	A	7.9	Pass
Jefferson	5	0	0	0	1.7	C	10.2	Fail
Jessamine	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Livingston	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
McCracken	4	0	0	0	1.3	C	INC	INC
Morgan	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Oldham	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Perry	1	2	0	0	1.3	C	8.0	Pass
Pike	0	1	0	0	0.5	B	7.2	Pass
Pulaski	1	0	0	0	0.3	B	8.0	Pass
Simpson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Trigg	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Warren	2	0	0	0	0.7	B	8.1	Pass
Washington	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

KENTUCKY

American Lung Association in Kentucky

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Bell	23,568	5,094	4,658	482	1,997	2,285	18	2,427	246	6,953	1,642
Boone	139,093	34,961	20,899	3,308	11,400	12,053	108	12,441	1,583	10,120	20,466
Boyd	48,110	10,247	9,778	970	4,087	4,697	37	5,010	490	8,437	3,576
Bullitt	83,836	17,587	14,757	1,664	7,214	7,997	65	8,335	946	7,813	6,235
Campbell	93,300	18,932	16,491	1,792	8,100	8,623	72	9,065	1,108	8,673	7,807
Carter	26,395	5,867	5,326	555	2,215	2,567	20	2,735	278	5,010	987
Christian	73,037	20,214	9,345	1,913	5,818	5,148	57	5,403	818	12,282	25,652
Daviess	103,222	24,845	18,651	2,351	8,503	9,319	80	9,875	1,146	13,143	13,602
Edmonson	12,269	2,167	2,632	205	1,090	1,285	9	1,364	133	2,048	610
Fayette	320,347	65,298	48,688	6,179	27,993	27,129	247	28,290	4,335	45,848	98,147
Greenup	35,403	7,447	7,936	705	2,998	3,595	27	3,877	363	5,599	1,573
Hancock	9,021	2,149	1,689	203	744	849	7	897	94	1,248	437
Hardin	111,862	27,467	17,042	2,599	9,237	9,628	87	9,981	1,283	13,692	27,487
Jefferson	773,399	168,669	136,238	15,961	65,812	70,103	596	73,934	9,286	115,319	276,472
Jessamine	54,254	12,665	9,120	1,199	4,533	4,876	42	5,102	639	6,479	6,968
Livingston	8,963	1,822	2,023	172	766	943	7	1,009	86	1,300	557
McCracken	67,490	14,525	14,208	1,375	5,703	6,584	52	7,075	736	10,063	11,888
Morgan	14,120	2,475	2,495	234	1,271	1,360	11	1,418	125	3,042	1,204
Oldham	69,431	16,955	10,199	1,604	5,754	6,179	54	6,318	719	2,836	8,514
Perry	27,361	6,324	5,023	598	2,282	2,587	21	2,721	293	7,200	1,384
Pike	56,286	11,431	11,475	1,082	4,845	5,637	43	5,981	587	13,778	1,904
Pulaski	65,795	14,309	13,038	1,354	5,564	6,437	51	6,824	697	12,116	4,250
Simpson	19,949	4,572	3,405	433	1,675	1,821	15	1,904	218	3,011	3,059
Trigg	14,332	3,096	3,336	293	1,201	1,499	11	1,618	134	1,971	1,777
Warren	139,843	32,338	19,008	3,060	11,840	11,225	108	11,593	1,871	24,613	33,495
Washington	12,061	2,728	2,366	258	1,009	1,169	9	1,239	122	1,710	1,422

LOUISIANA

American Lung Association in Louisiana

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Ascension Parish	1	1	0	0.8	B
Bossier Parish	0	0	0	0.0	A
Caddo Parish	1	0	0	0.3	B
Calcasieu Parish	0	1	0	0.5	B
East Baton Rouge Parish	5	1	0	2.2	D
Iberville Parish	12	1	0	4.5	F
Jefferson Parish	2	0	0	0.7	B
Lafayette Parish	1	0	0	0.3	B
Lafourche Parish	1	0	0	0.3	B
Livingston Parish	1	0	0	0.3	B
Orleans Parish	DNC	DNC	DNC	DNC	DNC
Ouachita Parish	0	0	0	0.0	A
Pointe Coupee Parish	1	0	0	0.3	B
Rapides Parish	DNC	DNC	DNC	DNC	DNC
St. Bernard Parish	1	0	0	0.3	B
St. James Parish	0	0	0	0.0	A
St. John the Baptist Parish	1	0	0	0.3	B
St. Martin Parish	0	0	0	0.0	A
St. Tammany Parish	0	0	0	0.0	A
Tangipahoa Parish	DNC	DNC	DNC	DNC	DNC
Terrebonne Parish	DNC	DNC	DNC	DNC	DNC
West Baton Rouge Parish	8	0	0	2.7	D

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Ascension Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Bossier Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Caddo Parish	1	0	0	0	0.3	B	9.6	Fail
Calcasieu Parish	0	0	0	0	0.0	A	7.4	Pass
East Baton Rouge Parish	3	0	0	0	1.0	C	8.5	Pass
Iberville Parish	0	0	0	0	0.0	A	7.7	Pass
Jefferson Parish	0	0	0	0	0.0	A	7.7	Pass
Lafayette Parish	2	0	0	0	0.7	B	7.9	Pass
Lafourche Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Livingston Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Orleans Parish	0	0	0	0	0.0	A	7.8	Pass
Ouachita Parish	2	0	0	0	0.7	B	7.5	Pass
Pointe Coupee Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rapides Parish	2	0	0	0	0.7	B	7.4	Pass
St. Bernard Parish	0	0	0	0	0.0	A	8.0	Pass
St. James Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. John the Baptist Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. Martin Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. Tammany Parish	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Tangipahoa Parish	0	0	0	0	0.0	A	7.5	Pass
Terrebonne Parish	0	0	0	0	0.0	A	7.2	Pass
West Baton Rouge Parish	2	0	0	0	0.7	B	8.8	Pass

LOUISIANA

American Lung Association in Louisiana

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Ascension Parish	130,458	33,911	17,289	2,967	9,549	8,386	71	10,278	1,634	13,406	44,757
Bossier Parish	129,276	31,668	20,412	2,771	9,653	8,680	70	10,824	1,579	16,634	46,179
Caddo Parish	229,025	53,220	43,618	4,657	17,470	16,699	124	21,326	2,722	49,858	129,755
Calcasieu Parish	202,418	49,651	33,316	4,345	15,142	13,916	110	17,469	2,390	32,866	66,296
East Baton Rouge Parish	450,544	99,672	70,362	8,722	34,559	30,019	244	37,121	6,255	80,321	255,044
Iberville Parish	29,506	5,966	5,188	522	2,336	2,168	16	2,727	344	5,105	15,327
Jefferson Parish	425,884	93,329	81,175	8,167	33,072	31,663	231	40,375	4,956	63,585	210,888
Lafayette Parish	247,866	58,966	37,333	5,160	18,670	16,565	135	20,512	3,148	41,649	89,147
Lafourche Parish	95,870	21,519	16,222	1,883	7,382	6,859	52	8,622	1,126	16,245	23,090
Livingston Parish	148,425	37,434	20,946	3,276	10,976	9,711	81	11,970	1,865	19,692	24,905
Orleans Parish	369,749	71,513	64,471	6,258	29,495	26,678	199	33,401	5,151	80,328	252,296
Ouachita Parish	157,702	38,128	25,497	3,336	11,841	10,779	85	13,487	1,970	35,808	67,396
Pointe Coupee Parish	20,151	4,251	4,522	372	1,589	1,613	11	2,100	209	3,411	7,902
Rapides Parish	127,189	31,415	21,957	2,749	9,509	8,914	69	11,271	1,471	23,295	50,163
St. Bernard Parish	44,479	11,352	5,942	993	3,272	2,850	24	3,489	579	9,882	18,289
St. James Parish	19,423	4,259	3,824	373	1,510	1,467	11	1,880	213	3,051	9,757
St. John the Baptist Parish	39,864	9,433	6,361	825	3,023	2,800	22	3,504	467	6,207	27,635
St. Martin Parish	51,236	12,263	8,785	1,073	3,874	3,648	28	4,607	583	9,246	18,148
St. Tammany Parish	273,263	63,664	51,114	5,571	20,871	20,143	148	25,701	3,068	29,091	67,025
Tangipahoa Parish	137,048	33,168	21,319	2,902	10,269	9,180	74	11,419	1,728	25,934	52,094
Terrebonne Parish	104,786	25,776	16,865	2,256	7,842	7,250	57	9,089	1,206	17,009	35,573
West Baton Rouge Parish	28,034	6,927	4,202	606	2,087	1,862	15	2,309	339	3,313	13,125

MAINE

American Lung Association in Maine

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Androscoggin	0	0	0	0.0	A
Aroostook	0	0	0	0.0	A
Cumberland	5	0	0	1.7	C
Hancock	5	0	0	1.7	C
Kennebec	0	0	0	0.0	A
Knox	2	0	0	0.7	B
Oxford	0	0	0	0.0	A
Penobscot	0	0	0	0.0	A
Sagadahoc	INC	INC	INC	INC	INC
Washington	0	0	0	0.0	A
York	5	0	0	1.7	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Androscoggin	0	0	0	0	0.0	A	5.3	Pass
Aroostook	0	2	0	0	1.0	C	5.4	Pass
Cumberland	0	0	0	0	0.0	A	6.5	Pass
Hancock	0	0	0	0	0.0	A	3.2	Pass
Kennebec	0	0	0	0	0.0	A	5.6	Pass
Knox	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Oxford	1	0	0	0	0.3	B	INC	INC
Penobscot	0	0	0	0	0.0	A	4.5	Pass
Sagadahoc	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Washington	INC	INC	INC	INC	INC	INC	INC	INC
York	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

MAINE

American Lung Association in Maine

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Androscoggin	113,023	23,100	21,420	1,549	12,024	7,533	72	9,134	1,050	13,750	12,530
Aroostook	67,255	12,410	17,388	832	7,122	5,180	43	6,620	504	10,138	4,589
Cumberland	307,451	54,845	63,488	3,677	33,640	21,495	197	26,312	2,915	19,827	33,442
Hancock	56,701	9,116	15,289	611	6,180	4,470	36	5,725	451	6,064	3,476
Kennebec	125,540	23,414	26,937	1,570	13,521	8,940	80	11,049	1,099	14,916	7,937
Knox	41,164	6,899	11,596	463	4,426	3,279	26	4,239	306	4,194	2,224
Oxford	59,495	10,329	14,187	692	6,440	4,515	38	5,675	474	7,462	3,137
Penobscot	153,704	26,696	31,303	1,790	16,927	10,804	98	13,185	1,419	21,623	10,868
Sagadahoc	37,393	6,618	9,242	444	4,024	2,825	24	3,574	303	3,424	2,229
Washington	31,437	5,811	8,278	390	3,323	2,428	20	3,114	239	4,781	3,579
York	216,732	38,100	48,522	2,554	23,584	15,815	139	19,649	1,868	18,069	14,944

MARYLAND

American Lung Association in Maryland

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Anne Arundel	3	0	0	1.0	C
Baltimore	13	0	0	4.3	F
Calvert	1	0	0	0.3	B
Carroll	2	0	0	0.7	B
Cecil	4	0	0	1.3	C
Charles	1	0	0	0.3	B
Dorchester	1	0	0	0.3	B
Frederick	2	0	0	0.7	B
Garrett	0	0	0	0.0	A
Harford	10	0	0	3.3	F
Howard	DNC	DNC	DNC	DNC	DNC
Kent	1	0	0	0.3	B
Montgomery	4	0	0	1.3	C
Prince George's	7	0	0	2.3	D
Washington	1	0	0	0.3	B
Baltimore City	2	0	0	0.7	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Anne Arundel	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Baltimore	1	0	0	0	0.3	B	7.7	Pass
Calvert	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Carroll	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cecil	1	0	0	0	0.3	B	6.8	Pass
Charles	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dorchester	0	0	0	0	0.0	A	5.9	Pass
Frederick	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Garrett	0	0	0	0	0.0	A	5.2	Pass
Harford	0	0	0	0	0.0	A	6.7	Pass
Howard	0	0	0	0	0.0	A	6.9	Pass
Kent	0	0	0	0	0.0	A	5.5	Pass
Montgomery	0	0	0	0	0.0	A	6.8	Pass
Prince George's	0	0	0	0	0.0	A	5.9	Pass
Washington	0	0	0	0	0.0	A	6.8	Pass
Baltimore City	0	0	0	0	0.0	A	INC	INC

MARYLAND

American Lung Association in Maryland

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Anne Arundel	593,286	131,687	96,019	7,905	48,336	22,805	263	35,850	6,490	37,624	214,779
Baltimore	846,161	181,618	156,497	10,903	69,383	34,333	374	54,536	9,486	91,009	397,145
Calvert	94,573	21,572	15,601	1,295	7,665	3,719	42	5,875	965	5,011	23,226
Carroll	175,305	38,034	31,678	2,283	14,391	7,200	78	11,447	1,742	9,468	23,672
Cecil	104,942	23,049	18,175	1,384	8,592	4,232	47	6,707	1,077	9,831	18,044
Charles	170,102	40,211	23,629	2,414	13,679	6,263	75	9,766	1,891	13,513	114,113
Dorchester	32,726	6,827	7,560	410	2,699	1,495	14	2,424	320	4,893	12,498
Frederick	287,079	66,036	44,554	3,964	23,178	10,854	127	17,028	3,138	15,874	93,153
Garrett	28,579	5,028	6,899	302	2,458	1,373	13	2,228	261	4,238	1,160
Harford	263,867	58,154	46,276	3,491	21,553	10,611	117	16,820	2,749	19,117	70,778
Howard	335,411	78,927	51,753	4,738	26,918	12,676	149	19,905	3,699	18,867	175,959
Kent	19,320	2,914	5,440	175	1,699	988	9	1,618	182	2,181	4,279
Montgomery	1,052,521	236,869	181,307	14,219	85,450	41,788	467	66,156	11,405	82,175	616,751
Prince George's	946,971	205,699	144,490	12,348	77,766	35,938	420	56,220	10,762	101,043	839,127
Washington	155,590	33,475	28,379	2,010	12,776	6,346	69	10,081	1,521	17,387	39,317
Baltimore City	569,931	115,806	89,369	6,952	47,350	21,200	252	33,010	7,458	104,408	414,722

MASSACHUSETTS

American Lung Association in Massachusetts

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Barnstable	5	0	0	1.7	C
Berkshire	0	0	0	0.0	A
Bristol	6	0	0	2.0	C
Dukes	2	0	0	0.7	B
Essex	4	0	0	1.3	C
Franklin	0	0	0	0.0	A
Hampden	2	0	0	0.7	B
Hampshire	0	0	0	0.0	A
Middlesex	0	0	0	0.0	A
Norfolk	3	0	0	1.0	C
Plymouth	1	0	0	0.3	B
Suffolk	3	0	0	1.0	C
Worcester	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Barnstable	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Berkshire	1	0	0	0	0.3	B	7.5	Pass
Bristol	0	0	0	0	0.0	A	6.4	Pass
Dukes	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Essex	2	0	0	0	0.7	B	6.3	Pass
Franklin	1	0	0	0	0.3	B	7.8	Pass
Hampden	1	0	0	0	0.3	B	6.5	Pass
Hampshire	0	0	0	0	0.0	A	6.3	Pass
Middlesex	1	1	0	0	0.8	B	6.6	Pass
Norfolk	1	0	0	0	0.3	B	INC	INC
Plymouth	1	0	0	0	0.3	B	8.2	Pass
Suffolk	2	0	0	0	0.7	B	7.9	Pass
Worcester	2	0	0	0	0.7	B	8.6	Pass

MASSACHUSETTS

American Lung Association in Massachusetts

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Barnstable	232,457	32,137	77,146	3,277	22,146	14,526	125	23,491	1,512	17,549	25,813
Berkshire	127,859	20,248	32,606	2,065	12,088	6,976	69	10,967	1,053	14,737	16,838
Bristol	580,068	117,179	104,271	11,949	52,823	26,784	311	40,720	5,406	64,988	121,274
Dukes	20,868	3,609	5,636	368	1,932	1,165	11	1,849	152	1,711	2,822
Essex	806,765	166,061	149,634	16,934	72,965	37,457	433	57,146	7,411	77,346	266,682
Franklin	70,894	11,639	17,667	1,187	6,663	3,815	38	5,986	587	9,425	7,498
Hampden	461,041	95,712	84,145	9,760	41,572	21,060	247	32,019	4,395	75,753	185,723
Hampshire	162,588	22,516	31,356	2,296	15,890	7,767	87	11,695	1,951	16,278	28,419
Middlesex	1,617,105	311,444	267,823	31,758	149,259	72,089	867	108,102	16,367	127,726	499,045
Norfolk	725,531	146,795	130,151	14,969	66,024	33,389	389	50,726	6,913	46,348	208,840
Plymouth	533,069	108,719	106,110	11,086	48,237	25,667	286	39,532	4,571	40,237	108,224
Suffolk	766,381	123,201	103,234	12,563	73,761	31,570	411	45,574	9,743	118,607	424,586
Worcester	862,927	175,286	148,313	17,874	78,607	39,152	463	59,222	8,062	88,902	225,839

MICHIGAN

American Lung Association in Michigan

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Allegan	18	2	0	7.0	F
Bay	DNC	DNC	DNC	DNC	DNC
Benzie	3	2	0	2.0	C
Berrien	14	1	0	5.2	F
Cass	8	0	0	2.7	D
Clinton	0	0	0	0.0	A
Genesee	6	0	0	2.0	C
Huron	10	0	0	3.3	F
Ingham	0	0	0	0.0	A
Kalamazoo	6	0	0	2.0	C
Kent	13	0	0	4.3	F
Lenawee	2	0	0	0.7	B
Macomb	17	0	0	5.7	F
Manistee	5	1	0	2.2	D
Mason	5	2	0	2.7	D
Missaukee	2	0	0	0.7	B
Muskegon	19	2	0	7.3	F
Oakland	7	0	0	2.3	D
Ottawa	11	2	0	4.7	F
St. Clair	9	0	0	3.0	D
Schoolcraft	6	0	0	2.0	C
Tuscola	4	0	0	1.3	C
Washtenaw	6	0	0	2.0	C
Wayne	13	0	0	4.3	F
Wexford	5	0	0	1.7	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Allegan	2	0	0	0	0.7	B	6.6	Pass
Bay	0	0	0	0	0.0	A	5.8	Pass
Benzie	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Berrien	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cass	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clinton	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Genesee	0	0	0	0	0.0	A	7.2	Pass
Huron	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Ingham	0	0	0	0	0.0	A	8.5	Pass
Kalamazoo	3	0	0	0	1.0	C	9.5	Fail
Kent	1	0	0	0	0.3	B	9.2	Fail
Lenawee	0	0	0	0	0.0	A	8.3	Pass
Macomb	0	0	0	0	0.0	A	8.2	Pass
Manistee	0	0	0	0	0.0	A	INC	INC
Mason	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Missaukee	1	0	0	0	0.3	B	8.6	Pass
Muskegon	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Oakland	0	0	0	0	0.0	A	7.5	Pass
Ottawa	1	0	0	0	0.3	B	8.8	Pass
St. Clair	1	0	0	0	0.3	B	8.2	Pass
Schoolcraft	1	0	0	0	0.3	B	INC	INC
Tuscola	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Washtenaw	0	1	0	0	0.5	B	8.7	Pass
Wayne	16	1	0	0	5.8	F	11.7	Fail
Wexford	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

MICHIGAN

American Lung Association in Michigan

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Allegan	121,210	27,916	22,321	1,903	11,192	8,463	63	9,208	1,142	11,735	15,220
Bay	102,821	19,888	22,545	1,356	9,868	7,739	54	8,633	967	14,566	11,234
Benzie	18,297	3,096	5,173	211	1,779	1,530	10	1,780	146	1,784	1,217
Berrien	152,900	32,253	32,959	2,198	14,350	11,270	80	12,585	1,430	22,507	38,621
Cass	51,403	10,306	11,691	702	4,879	3,947	27	4,426	451	6,135	7,262
Clinton	79,748	16,859	15,216	1,149	7,539	5,705	42	6,223	783	7,186	8,829
Genesee	401,983	88,038	76,263	6,001	37,618	28,412	210	31,035	4,023	65,211	114,049
Huron	31,248	5,897	8,453	402	2,973	2,552	16	2,952	237	3,693	1,690
Ingham	284,108	54,661	42,120	3,726	27,789	17,815	148	18,770	3,642	43,468	88,576
Kalamazoo	261,173	55,106	42,658	3,756	24,836	16,777	137	18,006	3,090	30,887	62,314
Kent	659,083	152,891	99,559	10,421	61,227	41,786	345	44,247	7,363	69,096	182,680
Lenawee	98,567	20,028	20,079	1,365	9,381	7,198	52	7,939	909	10,923	13,897
Macomb	874,195	178,925	160,576	12,196	83,569	62,383	457	67,466	8,869	84,662	212,941
Manistee	25,287	4,182	7,105	285	2,472	2,106	13	2,448	184	3,115	2,905
Mason	29,409	5,737	7,700	391	2,780	2,332	15	2,693	246	2,972	2,801
Missaukee	15,213	3,355	3,316	229	1,409	1,125	8	1,260	129	2,007	1,028
Muskegon	176,565	39,087	32,519	2,664	16,491	12,226	92	13,316	1,720	24,813	43,141
Oakland	1,269,431	253,891	235,012	17,305	122,037	90,941	664	98,428	12,823	102,636	375,252
Ottawa	300,873	68,537	50,139	4,672	27,970	19,565	157	21,072	3,285	23,817	51,434
St. Clair	160,151	32,199	32,875	2,195	15,298	12,043	84	13,230	1,450	20,337	15,080
Schoolcraft	8,188	1,468	2,341	100	786	700	4	813	59	1,033	1,247
Tuscola	52,945	10,583	11,581	721	5,043	4,030	28	4,484	462	6,411	3,975
Washtenaw	366,376	65,770	58,334	4,483	36,340	24,043	192	25,515	4,495	47,071	111,784
Wayne	1,757,043	411,933	292,355	28,078	162,092	116,989	918	125,499	18,599	369,107	896,409
Wexford	34,196	7,695	7,186	524	3,154	2,477	18	2,761	307	4,311	2,262

MINNESOTA

American Lung Association in Minnesota

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Anoka	3	0	0	1.0	C
Becker	1	0	0	0.3	B
Beltrami	DNC	DNC	DNC	DNC	DNC
Carlton	0	0	0	0.0	A
Cass	DNC	DNC	DNC	DNC	DNC
Cook	DNC	DNC	DNC	DNC	DNC
Crow Wing	0	0	0	0.0	A
Dakota	DNC	DNC	DNC	DNC	DNC
Goodhue	0	0	0	0.0	A
Hennepin	0	0	0	0.0	A
Lake	0	0	0	0.0	A
Lyon	0	0	0	0.0	A
Mille Lacs	0	0	0	0.0	A
Olmsted	0	0	0	0.0	A
Ramsey	DNC	DNC	DNC	DNC	DNC
St. Louis	0	0	0	0.0	A
Scott	0	0	0	0.0	A
Stearns	0	0	0	0.0	A
Washington	1	0	0	0.3	B
Wright	2	0	0	0.7	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Anoka	2	2	0	0	1.7	C	6.6	Pass
Becker	7	5	0	0	4.8	F	7.2	Pass
Beltrami	5	3	1	0	3.8	F	6.2	Pass
Carlton	4	0	0	0	1.3	C	2.2	Pass
Cass	6	4	1	0	4.7	F	7.8	Pass
Cook	3	1	0	0	1.5	C	2.3	Pass
Crow Wing	2	2	1	0	2.3	D	5.5	Pass
Dakota	2	2	0	0	1.7	C	7.4	Pass
Goodhue	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hennepin	1	4	0	0	2.3	D	8.0	Pass
Lake	3	1	0	0	1.5	C	4.7	Pass
Lyon	3	4	0	0	3.0	D	6.4	Pass
Mille Lacs	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Olmsted	4	0	0	0	1.3	C	6.0	Pass
Ramsey	3	1	0	0	1.5	C	7.2	Pass
St. Louis	7	2	0	0	3.3	F	5.1	Pass
Scott	1	0	0	0	0.3	B	6.4	Pass
Stearns	3	2	1	0	2.7	D	INC	INC
Washington	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wright	2	2	0	0	1.7	C	7.0	Pass

MINNESOTA

American Lung Association in Minnesota

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Anoka	368,864	86,409	57,364	4,730	28,267	14,698	184	22,419	4,068	27,085	88,413
Becker	35,371	8,259	8,043	452	2,628	1,604	18	2,610	328	3,430	4,913
Beltrami	46,799	11,485	8,161	629	3,510	1,828	23	2,863	523	7,697	13,415
Carlton	36,708	7,982	6,813	437	2,841	1,576	18	2,466	347	3,580	4,570
Cass	31,274	6,318	8,455	346	2,381	1,584	16	2,630	254	4,265	5,251
Cook	5,708	840	1,770	46	461	315	3	530	50	519	887
Crow Wing	67,948	13,784	16,717	754	5,228	3,265	34	5,345	625	7,126	3,852
Dakota	443,341	105,016	71,368	5,748	33,780	17,711	221	27,197	4,935	26,859	112,282
Goodhue	48,013	10,475	9,973	573	3,677	2,144	24	3,419	474	4,249	4,269
Hennepin	1,260,121	268,313	199,163	14,686	99,504	49,745	627	75,956	15,414	133,681	412,914
Lake	10,939	2,094	3,040	115	843	561	5	935	91	906	603
Lyon	25,262	6,648	4,491	364	1,841	1,002	13	1,576	268	2,764	4,646
Mille Lacs	27,280	6,327	4,977	346	2,072	1,156	14	1,808	273	2,925	3,168
Olmsted	164,020	38,819	27,896	2,125	12,466	6,516	82	10,122	1,922	14,379	37,203
Ramsey	536,413	122,516	86,061	6,706	41,449	20,754	267	31,909	6,577	72,217	217,824
St. Louis	199,532	36,655	42,746	2,006	16,001	8,977	99	14,344	2,212	28,093	18,769
Scott	154,520	39,589	19,466	2,167	11,624	5,758	77	8,525	1,762	6,968	35,095
Stearns	160,405	37,290	26,178	2,041	12,310	6,218	80	9,597	1,855	17,033	29,085
Washington	275,912	65,515	46,258	3,586	20,933	11,271	137	17,410	2,961	15,451	58,284
Wright	148,003	39,864	20,431	2,182	10,871	5,531	74	8,335	1,608	7,779	14,969

MISSISSIPPI

American Lung Association in Mississippi

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Bolivar	0	0	0	0.0	A
DeSoto	7	0	0	2.3	D
Forrest	DNC	DNC	DNC	DNC	DNC
Hancock	0	0	0	0.0	A
Harrison	1	0	0	0.3	B
Hinds	0	0	0	0.0	A
Jackson	1	0	0	0.3	B
Lauderdale	0	0	0	0.0	A
Lee	0	0	0	0.0	A
Yalobusha	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Bolivar	0	0	0	0	0.0	A	8.5	Pass
DeSoto	0	0	0	0	0.0	A	8.7	Pass
Forrest	1	0	0	0	0.3	B	9.9	Fail
Hancock	0	0	0	0	0.0	A	8.5	Pass
Harrison	0	0	0	0	0.0	A	9.1	Fail
Hinds	3	0	0	0	1.0	C	10.1	Fail
Jackson	0	0	0	0	0.0	A	8.2	Pass
Lauderdale	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lee	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Yalobusha	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

MISSISSIPPI

American Lung Association in Mississippi

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Bolivar	29,370	7,161	5,107	496	2,082	2,338	18	2,702	339	8,072	19,823
DeSoto	191,723	47,568	26,285	3,295	13,597	14,787	116	16,384	2,371	18,722	81,596
Forrest	78,110	17,517	11,094	1,213	5,658	5,838	47	6,395	1,114	16,194	33,442
Hancock	46,094	8,670	10,440	601	3,521	4,286	28	5,178	465	6,839	7,350
Harrison	211,044	49,090	35,506	3,400	15,214	17,034	128	19,518	2,441	39,771	79,506
Hinds	217,730	50,312	35,896	3,485	15,698	17,295	131	19,689	2,743	47,221	166,817
Jackson	144,975	32,676	25,141	2,263	10,570	12,018	88	13,854	1,647	22,460	48,017
Lauderdale	70,904	16,522	13,237	1,144	5,103	5,865	43	6,868	770	16,097	34,841
Lee	82,959	20,580	12,970	1,426	5,870	6,532	50	7,414	968	11,046	30,562
Yalobusha	12,364	2,692	2,678	186	908	1,090	7	1,313	125	2,176	5,234

MISSOURI

American Lung Association in Missouri

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Andrew	1	0	0	0.3	B
Boone	0	0	0	0.0	A
Buchanan	DNC	DNC	DNC	DNC	DNC
Callaway	0	0	0	0.0	A
Cass	2	0	0	0.7	B
Cedar	0	0	0	0.0	A
Clay	9	0	0	3.0	D
Clinton	1	0	0	0.3	B
Greene	0	0	0	0.0	A
Jackson	DNC	DNC	DNC	DNC	DNC
Jasper	1	0	0	0.3	B
Jefferson	8	0	0	2.7	D
Lincoln	2	0	0	0.7	B
Monroe	0	0	0	0.0	A
Perry	2	0	0	0.7	B
St. Charles	13	0	0	4.3	F
Ste. Genevieve	0	0	0	0.0	A
St. Louis	9	0	0	3.0	D
St. Louis City	4	1	0	1.8	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Andrew	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Boone	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Buchanan	4	0	0	0	1.3	C	8.1	Pass
Callaway	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cass	1	0	0	0	0.3	B	6.3	Pass
Cedar	0	0	0	0	0.0	A	6.7	Pass
Clay	0	0	0	0	0.0	A	6.0	Pass
Clinton	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Greene	1	0	0	0	0.3	B	INC	INC
Jackson	7	1	0	0	2.8	D	7.9	Pass
Jasper	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jefferson	1	1	0	0	0.8	B	8.0	Pass
Lincoln	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Monroe	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Perry	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. Charles	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Ste. Genevieve	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
St. Louis	2	0	0	0	0.7	B	7.0	Pass
St. Louis City	6	1	0	0	2.5	D	8.9	Pass

MISSOURI

American Lung Association in Missouri

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Andrew	18,003	4,049	3,632	329	1,455	1,235	11	1,542	178	1,418	1,252
Boone	187,690	37,244	26,059	3,030	16,032	11,158	119	12,678	2,697	29,565	42,125
Buchanan	82,911	18,520	14,693	1,507	6,772	5,396	53	6,550	870	13,932	15,178
Callaway	44,762	9,146	8,093	744	3,749	2,995	29	3,638	465	4,379	4,809
Cass	110,394	25,583	20,020	2,081	8,909	7,279	70	8,924	1,159	8,972	15,522
Cedar	14,601	3,520	3,430	286	1,137	1,038	9	1,339	123	2,351	1,032
Clay	257,033	60,010	39,557	4,882	20,904	15,939	164	18,903	2,983	19,491	55,443
Clinton	21,328	4,852	3,953	395	1,730	1,435	14	1,768	210	2,655	1,490
Greene	303,293	62,165	52,521	5,057	25,388	19,485	193	23,298	3,716	44,048	41,973
Jackson	716,531	164,000	115,576	13,341	58,422	44,831	455	53,439	8,471	105,642	276,298
Jasper	124,075	30,134	20,286	2,451	9,912	7,695	79	9,228	1,402	21,971	21,728
Jefferson	229,336	51,296	38,503	4,173	18,832	14,986	146	18,111	2,433	20,356	15,128
Lincoln	63,155	15,673	9,356	1,275	5,048	3,858	40	4,573	685	6,143	4,817
Monroe	8,652	1,869	2,166	152	694	646	6	838	72	1,162	683
Perry	18,858	4,199	3,833	342	1,527	1,297	12	1,621	185	2,138	1,106
St. Charles	413,803	92,296	70,807	7,508	33,926	26,886	263	32,496	4,539	21,209	61,898
Ste. Genevieve	18,644	3,945	3,949	321	1,528	1,315	12	1,652	169	1,801	1,032
St. Louis	990,414	215,261	191,271	17,511	81,054	66,645	628	82,139	10,944	101,623	353,982
St. Louis City	286,578	51,566	45,084	4,195	24,950	18,330	182	21,399	3,874	59,041	155,294

MONTANA

American Lung Association in Montana

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Custer	INC	INC	INC	INC	INC
Fergus	5	0	0	1.7	C
Flathead	0	0	0	0.0	A
Gallatin	DNC	DNC	DNC	DNC	DNC
Lewis and Clark	1	0	0	0.3	B
Lincoln	DNC	DNC	DNC	DNC	DNC
Missoula	0	0	0	0.0	A
Phillips	1	0	0	0.3	B
Powder River	2	0	0	0.7	B
Ravalli	DNC	DNC	DNC	DNC	DNC
Richland	1	0	0	0.3	B
Rosebud	INC	INC	INC	INC	INC
Silver Bow	DNC	DNC	DNC	DNC	DNC
Yellowstone	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Custer	INC	INC	INC	INC	INC	INC	INC	INC
Fergus	13	3	0	0	5.8	F	5.2	Pass
Flathead	13	7	0	0	7.8	F	7.7	Pass
Gallatin	13	0	0	0	4.3	F	3.9	Pass
Lewis and Clark	18	10	0	0	11.0	F	8.4	Pass
Lincoln	17	12	2	1	13.8	F	13.4	Fail
Missoula	25	12	0	0	14.3	F	10.1	Fail
Phillips	4	0	0	0	1.3	C	5.6	Pass
Powder River	15	3	0	0	6.5	F	7.7	Pass
Ravalli	22	18	2	0	17.7	F	7.8	Pass
Richland	3	0	0	0	1.0	C	5.2	Pass
Rosebud	INC	INC	INC	INC	INC	INC	INC	INC
Silver Bow	27	11	0	0	14.5	F	7.8	Pass
Yellowstone	12	3	0	0	5.5	F	7.9	Pass

MONTANA

American Lung Association in Montana

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Custer	12,032	2,321	2,479	145	1,150	649	5	875	116	1,249	1,189
Fergus	11,663	2,423	2,927	151	1,077	669	5	932	100	1,396	764
Flathead	111,814	24,010	23,353	1,501	10,373	5,956	46	8,088	1,063	11,987	9,323
Gallatin	124,857	23,217	17,085	1,451	12,316	5,700	51	7,108	1,532	11,442	12,165
Lewis and Clark	73,832	15,488	15,004	968	6,908	3,905	30	5,273	715	6,649	7,001
Lincoln	21,525	3,800	6,452	238	2,040	1,380	9	1,971	166	3,686	1,804
Missoula	121,041	21,492	20,930	1,344	11,932	6,031	49	7,815	1,454	10,920	14,034
Phillips	4,240	1,010	1,012	63	377	236	2	329	32	630	743
Powder River	1,725	296	523	19	164	111	1	158	12	198	138
Ravalli	47,298	8,710	12,820	544	4,479	2,873	19	4,042	383	5,325	4,040
Richland	11,237	2,833	1,909	177	1,003	543	5	721	105	1,104	1,377
Rosebud	8,088	2,377	1,357	149	680	374	3	499	72	1,424	3,768
Silver Bow	36,068	7,127	7,088	446	3,438	1,889	15	2,525	351	5,658	3,586
Yellowstone	169,852	38,688	30,656	2,418	15,627	8,417	69	11,172	1,748	15,385	25,741

NEBRASKA

American Lung Association in Nebraska

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Douglas	3	0	0	1.0	C
Hall	DNC	DNC	DNC	DNC	DNC
Knox	5	0	0	1.7	C
Lancaster	0	0	0	0.0	A
Sarpy	DNC	DNC	DNC	DNC	DNC
Scotts Bluff	DNC	DNC	DNC	DNC	DNC
Washington	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Douglas	4	1	0	0	1.8	C	7.5	Pass
Hall	2	0	0	0	0.7	B	6.2	Pass
Knox	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lancaster	0	0	0	0	0.0	A	6.4	Pass
Sarpy	4	0	0	0	1.3	C	7.8	Pass
Scotts Bluff	1	0	0	0	0.3	B	INC	INC
Washington	1	0	0	0	0.3	B	6.2	Pass

NEBRASKA

American Lung Association in Nebraska

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Douglas	586,327	146,425	83,930	6,864	35,998	22,651	262	32,900	7,727	69,886	190,104
Hall	62,097	16,727	9,903	784	3,701	2,502	28	3,697	719	7,017	23,064
Knox	8,336	2,067	2,116	97	504	421	4	660	75	1,280	1,330
Lancaster	324,756	71,900	50,522	3,370	20,665	12,850	145	18,799	4,466	38,884	65,909
Sarpy	196,553	51,267	25,525	2,403	11,912	7,361	88	10,574	2,544	11,259	42,449
Scotts Bluff	35,603	8,637	7,338	405	2,185	1,619	16	2,466	402	5,280	10,593
Washington	21,167	4,957	4,053	232	1,317	971	9	1,460	229	1,493	1,357

NEVADA

American Lung Association in Nevada

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Churchill	11	1	0	4.2	F
Clark	58	1	0	19.8	F
Douglas	DNC	DNC	DNC	DNC	DNC
Lyon	10	0	0	3.3	F
Washoe	35	2	0	12.7	F
White Pine	5	0	0	1.7	C
Carson City	14	0	0	4.7	F

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Churchill	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clark	12	7	0	0	7.5	F	10.8	Fail
Douglas	14	36	6	0	26.7	F	9.6	Fail
Lyon	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Washoe	17	33	7	0	26.8	F	11.0	Fail
White Pine	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Carson City	24	24	7	0	24.7	F	8.7	Pass

NEVADA

American Lung Association in Nevada

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Churchill	25,843	5,844	4,999	418	1,996	1,467	13	1,981	236	2,556	7,549
Clark	2,322,985	515,201	366,683	36,856	181,006	124,439	1,146	164,144	24,775	304,986	1,420,834
Douglas	49,628	7,399	16,244	529	4,249	3,755	24	5,334	348	4,170	10,110
Lyon	61,585	12,541	13,343	897	4,916	3,745	30	5,108	545	6,757	17,616
Washoe	496,745	102,060	88,149	7,301	39,406	27,862	245	37,131	5,104	50,322	197,583
White Pine	8,788	1,780	1,747	127	702	518	4	699	69	912	2,579
Carson City	58,130	11,543	12,417	826	4,669	3,529	29	4,801	506	7,235	20,523

NEW HAMPSHIRE

American Lung Association in New Hampshire

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Belknap	0	0	0	0.0	A
Cheshire	0	0	0	0.0	A
Coos	1	0	0	0.3	B
Grafton	0	0	0	0.0	A
Hillsborough	0	0	0	0.0	A
Merrimack	1	0	0	0.3	B
Rockingham	4	0	0	1.3	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Belknap	1	0	0	0	0.3	B	4.5	Pass
Cheshire	1	0	0	0	0.3	B	6.6	Pass
Coos	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Grafton	1	0	0	0	0.3	B	5.3	Pass
Hillsborough	2	0	0	0	0.7	B	3.9	Pass
Merrimack	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rockingham	2	0	0	0	0.7	B	6.0	Pass

NEW HAMPSHIRE

American Lung Association in New Hampshire

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Belknap	64,781	11,095	15,620	498	6,909	3,924	35	5,412	495	5,552	3,732
Cheshire	77,350	13,717	17,356	616	8,298	4,390	42	6,049	664	6,432	5,271
Coos	31,504	5,094	8,136	229	3,378	1,980	17	2,744	220	3,810	1,726
Grafton	91,126	14,459	21,486	649	9,983	5,324	49	7,359	795	8,774	9,158
Hillsborough	426,594	83,023	73,963	3,729	45,566	21,873	229	29,474	3,844	27,790	76,794
Merrimack	156,020	28,600	31,170	1,284	16,746	8,478	84	11,557	1,358	11,090	13,371
Rockingham	319,424	58,456	64,876	2,625	34,078	17,887	172	24,335	2,632	17,191	27,631

NEW JERSEY

American Lung Association in New Jersey

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Atlantic	0	0	0	0.0	A
Bergen	11	0	0	3.7	F
Camden	3	0	0	1.0	C
Cumberland	2	0	0	0.7	B
Essex	2	0	0	0.7	B
Gloucester	6	0	0	2.0	C
Hudson	5	0	0	1.7	C
Hunterdon	0	0	0	0.0	A
Mercer	11	0	0	3.7	F
Middlesex	5	0	0	1.7	C
Monmouth	4	2	0	2.3	D
Morris	0	0	0	0.0	A
Ocean	5	0	0	1.7	C
Passaic	0	0	0	0.0	A
Union	DNC	DNC	DNC	DNC	DNC
Warren	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Atlantic	0	1	0	0	0.5	B	6.3	Pass
Bergen	1	0	0	0	0.3	B	INC	INC
Camden	2	0	0	0	0.7	B	9.1	Fail
Cumberland	0	0	0	0	0.0	A	INC	INC
Essex	2	0	0	0	0.7	B	INC	INC
Gloucester	0	0	0	0	0.0	A	INC	INC
Hudson	0	0	0	0	0.0	A	INC	INC
Hunterdon	0	0	0	0	0.0	A	7.4	Pass
Mercer	2	0	0	0	0.7	B	7.9	Pass
Middlesex	2	0	0	0	0.7	B	7.7	Pass
Monmouth	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Morris	0	0	0	0	0.0	A	INC	INC
Ocean	2	0	0	0	0.7	B	6.6	Pass
Passaic	INC	INC	INC	INC	INC	INC	INC	INC
Union	2	0	0	0	0.7	B	9.0	Pass
Warren	1	0	0	0	0.3	B	7.8	Pass

NEW JERSEY

American Lung Association in New Jersey

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Atlantic	275,638	56,930	54,828	3,629	19,670	12,478	125	19,552	2,880	30,748	123,803
Bergen	952,997	196,727	174,718	12,542	68,203	42,166	434	65,563	10,350	66,461	451,048
Camden	524,907	118,164	87,302	7,533	36,589	21,879	239	33,303	6,020	64,621	242,857
Cumberland	151,356	36,326	24,685	2,316	10,345	6,182	69	9,401	1,564	22,152	84,939
Essex	849,477	197,954	122,609	12,620	58,750	33,757	386	50,540	10,150	128,727	598,604
Gloucester	306,601	64,357	52,035	4,103	21,825	13,103	139	20,043	3,467	22,578	74,859
Hudson	703,366	139,389	90,019	8,886	50,564	27,148	320	38,601	9,428	98,969	505,002
Hunterdon	129,777	24,278	27,387	1,548	9,535	6,200	59	9,905	1,260	5,227	22,296
Mercer	380,688	81,493	62,955	5,195	26,964	16,080	173	24,526	4,329	38,810	208,610
Middlesex	861,418	183,007	140,320	11,667	61,092	36,139	392	54,807	9,919	69,157	526,635
Monmouth	644,098	131,494	124,888	8,383	46,271	29,260	293	46,062	6,574	40,420	164,000
Morris	511,151	103,843	94,230	6,620	36,771	22,801	233	35,570	5,353	22,171	161,266
Ocean	655,735	161,552	149,822	10,299	44,146	29,955	298	47,874	5,938	72,554	109,668
Passaic	513,936	120,185	81,941	7,662	35,442	20,988	234	31,822	5,799	62,652	314,439
Union	569,815	132,045	87,296	8,418	39,521	23,226	259	35,271	6,414	54,080	355,389
Warren	110,926	21,073	22,003	1,343	8,109	5,135	51	8,086	1,122	7,628	25,885

NEW MEXICO

American Lung Association in New Mexico

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Bernalillo	34	1	0	11.8	F
Doña Ana	43	6	0	17.3	F
Eddy	62	2	0	21.7	F
Lea	6	1	0	2.5	D
Rio Arriba	2	0	0	0.7	B
Sandoval	9	0	0	3.0	D
San Juan	15	0	0	5.0	F
Santa Fe	3	0	0	1.0	C
Taos	DNC	DNC	DNC	DNC	DNC
Valencia	4	0	0	1.3	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Bernalillo	12	4	0	0	6.0	F	9.6	Fail
Doña Ana	8	3	0	0	4.2	F	8.9	Pass
Eddy	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lea	1	0	0	0	0.3	B	6.3	Pass
Rio Arriba	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sandoval	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
San Juan	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Santa Fe	1	0	0	0	0.3	B	4.3	Pass
Taos	1	0	0	0	0.3	B	5.5	Pass
Valencia	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

NEW MEXICO

American Lung Association in New Mexico

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Bernalillo	672,508	136,095	121,749	13,187	55,985	29,253	185	45,651	7,215	92,866	422,970
Doña Ana	223,337	51,624	37,433	5,002	17,901	8,897	61	13,791	2,482	50,613	165,037
Eddy	60,400	15,862	9,092	1,537	4,644	2,313	17	3,573	603	7,904	34,408
Lea	72,452	21,307	8,332	2,065	5,324	2,410	20	3,640	743	12,954	49,986
Rio Arriba	40,048	8,961	8,725	868	3,253	1,918	11	3,058	357	7,214	34,866
Sandoval	153,501	33,253	30,489	3,222	12,568	7,019	42	11,083	1,502	15,683	90,657
San Juan	120,418	30,195	20,154	2,926	9,417	4,920	33	7,670	1,206	26,630	77,459
Santa Fe	155,664	25,170	42,963	2,439	13,676	8,682	43	14,046	1,365	18,396	88,084
Taos	34,580	5,593	10,209	542	3,041	2,015	9	3,280	277	6,319	22,129
Valencia	78,080	17,809	14,663	1,726	6,297	3,447	21	5,422	748	14,404	54,229

NEW YORK

American Lung Association in New York

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Albany	0	0	0	0.0	A
Bronx	9	0	0	3.0	D
Chautauqua	5	0	0	1.7	C
Dutchess	1	0	0	0.3	B
Erie	2	0	0	0.7	B
Essex	2	0	0	0.7	B
Hamilton	0	0	0	0.0	A
Jefferson	0	0	0	0.0	A
Kings	DNC	DNC	DNC	DNC	DNC
Monroe	2	0	0	0.7	B
New York	8	0	0	2.7	D
Niagara	2	0	0	0.7	B
Onondaga	0	0	0	0.0	A
Orange	0	0	0	0.0	A
Oswego	0	0	0	0.0	A
Putnam	1	0	0	0.3	B
Queens	14	0	0	4.7	F
Richmond	8	0	0	2.7	D
Rockland	0	0	0	0.0	A
Saratoga	0	0	0	0.0	A
Steuben	0	0	0	0.0	A
Suffolk	24	1	0	8.5	F
Tompkins	1	0	0	0.3	B
Wayne	1	0	0	0.3	B
Westchester	6	0	0	2.0	C

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Albany	5	0	0	0	1.7	C	7.3	Pass
Bronx	0	1	0	0	0.5	B	8.1	Pass
Chautauqua	0	0	0	0	0.0	A	5.8	Pass
Dutchess	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Erie	1	1	0	0	0.8	B	7.1	Pass
Essex	0	0	0	0	0.0	A	3.5	Pass
Hamilton	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jefferson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Kings	0	0	0	0	0.0	A	INC	INC
Monroe	0	0	0	0	0.0	A	6.5	Pass
New York	0	0	0	0	0.0	A	INC	INC
Niagara	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Onondaga	1	0	0	0	0.3	B	6.1	Pass
Orange	0	0	0	0	0.0	A	INC	INC
Oswego	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Putnam	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Queens	0	1	0	0	0.5	B	7.4	Pass
Richmond	0	0	0	0	0.0	A	INC	INC
Rockland	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Saratoga	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Steuben	1	0	0	0	0.3	B	5.7	Pass
Suffolk	0	0	0	0	0.0	A	INC	INC
Tompkins	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wayne	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Westchester	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

NEW YORK

American Lung Association in New York

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Albany	315,811	55,855	58,271	4,628	26,942	13,516	153	21,003	3,626	41,781	95,333
Bronx	1,379,946	334,805	199,305	27,741	109,179	51,816	666	80,188	15,450	372,320	1,260,207
Chautauqua	126,027	25,247	27,707	2,092	10,426	5,939	61	9,375	1,153	21,515	17,327
Dutchess	297,545	53,776	57,962	4,456	25,383	13,532	144	21,244	2,947	25,435	93,290
Erie	950,312	188,519	184,854	15,620	79,022	41,909	460	65,638	9,676	122,456	252,296
Essex	36,910	5,706	9,751	473	3,219	1,984	18	3,157	295	4,576	2,658
Hamilton	5,118	636	1,739	53	459	323	2	520	34	546	302
Jefferson	116,637	27,397	17,771	2,270	9,252	4,320	57	6,644	1,136	15,329	22,525
Kings	2,590,516	572,893	404,929	47,467	209,909	100,376	1,251	155,198	30,181	508,254	1,639,413
Monroe	752,035	150,986	142,139	12,510	62,372	32,593	364	50,958	7,877	100,844	233,797
New York	1,596,273	223,884	293,598	18,550	142,215	69,226	771	107,105	20,470	266,257	870,645
Niagara	210,880	41,266	44,168	3,419	17,601	9,798	102	15,443	1,981	29,821	34,204
Onondaga	468,249	97,115	88,503	8,047	38,527	20,277	226	31,737	4,822	61,353	115,440
Orange	405,941	102,874	59,782	8,524	31,706	15,462	197	24,038	4,075	57,032	164,454
Oswego	118,287	24,055	21,535	1,993	9,821	5,128	57	8,032	1,151	19,649	8,220
Putnam	98,045	18,672	18,938	1,547	8,289	4,490	48	7,072	903	6,116	25,994
Queens	2,278,029	442,591	409,990	36,671	191,284	98,478	1,102	153,955	23,970	295,825	1,734,068
Richmond	491,133	104,850	85,466	8,687	40,329	20,824	238	32,594	4,954	54,478	213,267
Rockland	339,022	99,211	53,868	8,220	24,954	12,793	164	19,974	3,115	48,087	128,931
Saratoga	238,797	44,869	48,242	3,718	20,178	11,033	116	17,369	2,294	15,356	25,825
Steuben	92,599	19,570	19,461	1,621	7,576	4,277	45	6,751	828	11,667	6,420
Suffolk	1,525,465	309,450	277,424	25,640	126,985	66,887	739	104,973	14,710	100,921	543,708
Tompkins	104,777	14,350	17,175	1,189	9,351	4,179	51	6,375	1,434	14,405	24,314
Wayne	91,125	18,927	19,092	1,568	7,502	4,243	44	6,704	797	10,101	9,999
Westchester	990,427	206,814	182,382	17,136	81,720	43,297	479	67,961	9,885	90,385	480,654

NORTH CAROLINA

American Lung Association in North Carolina

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Alexander	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Avery	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Buncombe	0	0	0	0.0	A	0	0	0	0	0.0	A	5.8	Pass
Caldwell	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Carteret	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Caswell	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Catawba	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.2	Pass
Cumberland	1	0	0	0.3	B	1	0	0	0	0.3	B	7.6	Pass
Davidson	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.8	Pass
Durham	0	0	0	0.0	A	0	0	0	0	0.0	A	7.3	Pass
Edgecombe	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Forsyth	0	0	0	0.0	A	4	0	0	0	1.3	C	8.4	Pass
Graham	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Granville	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Guilford	0	0	0	0.0	A	0	0	0	0	0.0	A	7.4	Pass
Haywood	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jackson	DNC	DNC	DNC	DNC	DNC	INC	INC	INC	INC	INC	INC	INC	INC
Johnston	1	0	0	0.3	B	0	0	0	0	0.0	A	7.2	Pass
Lenoir	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lincoln	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Macon	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Martin	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Mecklenburg	3	0	0	1.0	C	3	0	0	0	1.0	C	8.7	Pass
Mitchell	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	5.8	Pass
Montgomery	0	0	0	0.0	A	1	0	0	0	0.3	B	7.6	Pass
New Hanover	0	0	0	0.0	A	0	0	0	0	0.0	A	4.4	Pass
Northampton	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.7	Pass
Person	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Pitt	0	0	0	0.0	A	0	0	0	0	0.0	A	6.1	Pass
Rockingham	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rowan	0	0	0	0.0	A	0	0	0	0	0.0	A	7.7	Pass
Swain	0	0	0	0.0	A	2	0	0	0	0.7	B	6.0	Pass
Union	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wake	1	0	0	0.3	B	1	0	0	0	0.3	B	6.9	Pass
Yancey	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

NORTH CAROLINA

American Lung Association in North Carolina

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Alexander	36,512	7,155	7,628	822	2,738	2,458	21	3,224	335	4,854	5,199
Avery	17,571	2,501	4,167	287	1,405	1,284	10	1,693	155	2,288	2,044
Buncombe	273,589	47,788	59,079	5,492	20,989	18,494	154	24,234	3,080	32,755	47,226
Caldwell	80,492	15,713	17,125	1,806	6,047	5,497	46	7,222	774	12,850	11,537
Carteret	69,380	11,570	18,943	1,330	5,418	5,430	39	7,274	589	8,260	9,275
Caswell	22,614	4,044	5,322	465	1,734	1,623	13	2,147	188	3,515	8,875
Catawba	163,462	34,969	31,004	4,018	11,962	10,380	92	13,518	1,683	19,702	43,026
Cumberland	336,699	84,140	44,027	9,669	23,231	16,746	190	21,033	4,012	50,909	200,256
Davidson	172,586	36,934	33,092	4,244	12,640	11,072	98	14,439	1,752	21,311	39,038
Durham	332,680	64,171	49,180	7,374	24,746	18,373	187	23,217	4,486	35,109	187,785
Edgecombe	48,301	10,915	10,219	1,254	3,482	3,156	27	4,156	502	9,969	31,204
Forsyth	389,157	86,877	66,754	9,984	28,037	23,074	219	29,766	4,509	55,366	175,710
Graham	7,980	1,569	1,936	180	599	571	5	760	74	1,167	1,194
Granville	61,903	12,383	11,207	1,423	4,612	3,937	35	5,101	605	6,631	27,144
Guilford	546,101	118,118	88,505	13,574	39,627	31,577	307	40,462	6,738	85,573	286,931
Haywood	62,609	10,916	16,027	1,254	4,832	4,674	35	6,228	587	7,163	5,647
Jackson	42,955	6,884	9,019	791	3,341	2,829	24	3,686	510	6,916	8,456
Johnston	234,778	57,226	33,139	6,576	16,472	12,957	133	16,488	2,623	23,285	85,279
Lenoir	54,633	12,385	11,856	1,423	3,939	3,622	31	4,780	535	11,408	28,457
Lincoln	93,095	19,011	17,957	2,185	6,913	6,100	53	7,956	916	8,267	15,539
Macon	38,065	6,846	11,128	787	2,924	3,014	21	4,066	322	4,662	4,824
Martin	21,508	4,327	5,551	497	1,607	1,584	12	2,118	197	4,340	10,317
Mecklenburg	1,145,392	256,574	139,268	29,484	81,970	58,787	646	73,377	15,056	115,511	631,421
Mitchell	15,094	2,774	3,857	319	1,152	1,122	9	1,496	134	2,356	1,439
Montgomery	25,894	5,362	5,758	616	1,916	1,772	15	2,340	249	4,139	9,483
New Hanover	234,921	40,801	45,528	4,689	17,999	15,048	132	19,508	2,849	26,876	53,098
Northampton	16,779	2,928	4,920	336	1,299	1,348	9	1,818	135	3,229	10,111
Person	39,386	8,035	8,309	923	2,927	2,664	22	3,501	381	5,397	13,595
Pitt	173,542	36,569	25,870	4,202	12,618	9,413	97	11,921	2,374	32,848	82,071
Rockingham	91,957	18,489	19,732	2,125	6,859	6,272	52	8,252	900	15,436	26,479
Rowan	149,645	32,480	27,140	3,732	10,894	9,258	85	12,008	1,561	21,651	45,288
Swain	13,967	3,103	2,735	357	1,011	887	8	1,160	147	1,846	5,798
Union	249,070	62,851	34,328	7,223	17,316	13,813	141	17,590	2,702	17,565	77,591
Wake	1,175,021	266,490	153,110	30,624	84,012	62,718	664	78,944	14,588	86,727	490,299
Yancey	18,811	3,322	5,036	382	1,449	1,433	11	1,918	170	2,766	1,555

NORTH DAKOTA

American Lung Association in North Dakota

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Billings	1	0	0	0.3	B
Burke	0	0	0	0.0	A
Burleigh	0	0	0	0.0	A
Cass	1	0	0	0.3	B
Dunn	1	0	0	0.3	B
McKenzie	0	0	0	0.0	A
Mercer	1	0	0	0.3	B
Oliver	2	0	0	0.7	B
Ward	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Billings	3	1	0	0	1.5	C	4.9	Pass
Burke	7	2	0	0	3.3	F	6.4	Pass
Burleigh	11	5	0	0	6.2	F	7.7	Pass
Cass	8	9	0	0	7.2	F	8.3	Pass
Dunn	6	3	0	0	3.5	F	5.8	Pass
McKenzie	6	2	0	0	3.0	D	5.4	Pass
Mercer	5	4	0	0	3.7	F	6.0	Pass
Oliver	9	6	0	0	6.0	F	7.2	Pass
Ward	10	4	0	0	5.3	F	6.3	Pass

NORTH DAKOTA

American Lung Association in North Dakota

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Billings	1,018	210	246	14	83	54	1	85	10	102	87
Burke	2,155	533	488	35	165	109	1	172	19	207	186
Burleigh	99,280	22,999	17,968	1,496	7,907	4,563	51	6,909	1,173	9,332	12,484
Cass	192,734	42,124	25,220	2,741	15,994	7,701	98	11,042	2,797	21,797	32,400
Dunn	4,015	1,061	744	69	304	184	2	282	40	450	863
McKenzie	13,908	4,489	1,420	292	992	485	7	684	164	1,188	3,570
Mercer	8,333	1,919	1,897	125	650	433	4	679	79	587	684
Oliver	1,856	444	475	29	143	100	1	160	16	179	118
Ward	68,870	16,466	9,833	1,071	5,528	2,810	35	4,105	872	6,529	12,843

OHIO

American Lung Association in Ohio

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Allen	1	0	0	0.3	B	0	0	0	0	0.0	A	6.4	Pass
Ashtabula	7	0	0	2.3	D	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Athens	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	5.9	Pass
Belmont	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	INC	INC
Butler	9	0	0	3.0	D	1	0	0	0	0.3	B	INC	INC
Clark	2	0	0	0.7	B	0	0	0	0	0.0	A	8.4	Pass
Clermont	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clinton	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cuyahoga	16	1	0	5.8	F	3	1	0	0	1.5	C	9.3	Fail
Delaware	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fayette	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Franklin	3	0	0	1.0	C	1	0	0	0	0.3	B	8.8	Pass
Geauga	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Greene	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hamilton	12	1	0	4.5	F	3	0	0	0	1.0	C	10.5	Fail
Harrison	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	INC	INC
Jefferson	1	0	0	0.3	B	2	1	0	0	1.2	C	INC	INC
Knox	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lake	17	0	0	5.7	F	0	0	0	0	0.0	A	6.4	Pass
Lawrence	0	0	0	0.0	A	0	0	0	0	0.0	A	8.1	Pass
Licking	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lorain	1	0	0	0.3	B	INC	INC	INC	INC	INC	INC	INC	INC
Lucas	16	0	0	5.3	F	1	0	0	0	0.3	B	INC	INC
Madison	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Mahoning	2	0	0	0.7	B	1	0	0	0	0.3	B	INC	INC
Medina	2	0	0	0.7	B	0	0	0	0	0.0	A	6.6	Pass
Miami	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Montgomery	7	0	0	2.3	D	0	0	0	0	0.0	A	9.4	Fail
Noble	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Portage	5	1	0	2.2	D	0	0	0	0	0.0	A	INC	INC
Preble	3	0	0	1.0	C	0	0	0	0	0.0	A	8.1	Pass
Scioto	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	INC	INC
Stark	7	0	0	2.3	D	2	0	0	0	0.7	B	9.2	Fail
Summit	5	0	0	1.7	C	4	0	0	0	1.3	C	8.4	Pass
Trumbull	3	0	0	1.0	C	4	1	0	0	1.8	C	7.4	Pass
Warren	9	0	0	3.0	D	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Washington	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wood	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

OHIO

American Lung Association in Ohio

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Allen	101,115	23,592	19,202	1,607	8,876	7,405	59	8,737	1,025	12,570	20,149
Ashtabula	97,014	21,012	19,788	1,432	8,686	7,534	57	8,969	898	16,280	11,523
Athens	58,979	8,857	9,283	603	5,810	4,168	34	4,669	816	11,625	5,975
Belmont	65,509	12,231	14,458	833	6,069	5,306	38	6,360	590	10,591	5,441
Butler	388,420	89,677	63,066	6,110	34,512	27,165	226	31,210	4,378	44,146	88,501
Clark	134,831	30,036	27,404	2,046	11,966	10,302	78	12,271	1,367	19,944	22,998
Clermont	210,805	46,277	39,010	3,153	18,904	15,733	123	18,438	2,180	18,724	16,057
Clinton	41,964	9,317	7,905	635	3,746	3,133	24	3,683	436	4,970	3,223
Cuyahoga	1,236,041	250,777	242,560	17,086	112,839	93,731	718	110,473	13,749	201,450	522,591
Delaware	226,296	55,396	34,411	3,774	19,823	15,795	132	18,043	2,469	10,385	42,578
Fayette	28,839	6,719	5,291	458	2,541	2,127	17	2,497	297	4,166	2,485
Franklin	1,321,820	303,005	174,828	20,645	118,640	85,072	770	94,322	16,830	195,678	528,728
Geauga	95,469	21,009	21,332	1,431	8,461	7,696	56	9,311	841	5,997	4,769
Greene	168,456	34,488	31,523	2,350	15,374	12,431	98	14,534	1,878	15,145	28,244
Hamilton	825,037	186,440	138,701	12,703	73,603	57,722	480	66,579	9,532	124,767	297,168
Harrison	14,378	2,989	3,260	204	1,294	1,171	8	1,416	135	1,962	860
Jefferson	64,330	12,416	14,642	846	5,897	5,224	37	6,302	648	11,626	6,703
Knox	63,183	14,273	12,223	972	5,597	4,687	37	5,538	660	7,287	3,258
Lake	231,842	44,145	50,758	3,008	21,394	18,767	135	22,482	2,312	20,444	32,220
Lawrence	56,653	12,144	11,137	827	5,100	4,363	33	5,159	580	9,583	3,225
Licking	181,359	41,150	31,811	2,804	16,152	13,256	106	15,424	1,917	18,074	24,358
Lorain	316,268	67,724	63,044	4,614	28,446	24,331	184	28,836	3,203	39,513	73,317
Lucas	426,643	96,670	75,204	6,587	37,962	30,662	248	35,675	4,763	74,533	140,288
Madison	43,540	8,715	7,302	594	4,030	3,231	26	3,713	403	3,926	5,447
Mahoning	225,636	45,401	50,746	3,093	20,472	18,062	131	21,785	2,227	41,912	56,224
Medina	183,512	38,799	36,469	2,644	16,582	14,320	107	16,958	1,811	12,288	13,345
Miami	110,247	25,054	21,544	1,707	9,750	8,308	64	9,841	1,104	10,693	10,049
Montgomery	533,892	116,630	100,283	7,946	47,840	39,169	310	45,969	5,915	74,391	165,041
Noble	14,335	2,697	4,276	184	1,296	1,327	9	1,674	100	1,835	843
Portage	161,745	29,015	29,530	1,977	15,285	12,169	94	14,098	1,931	19,299	19,634
Preble	40,596	8,942	8,236	609	3,619	3,153	24	3,753	393	4,221	1,778
Scioto	72,194	15,549	13,790	1,059	6,495	5,421	42	6,379	742	15,113	5,302
Stark	372,657	79,440	76,827	5,413	33,471	28,750	217	34,253	3,816	48,044	54,766
Summit	535,882	109,628	105,152	7,469	48,840	40,977	312	48,326	5,736	66,303	134,075
Trumbull	200,643	40,959	45,205	2,791	18,138	16,129	117	19,472	1,939	31,959	27,980
Warren	249,778	58,741	39,478	4,002	22,129	17,762	146	20,371	2,593	13,373	41,301
Washington	58,901	11,411	13,243	777	5,400	4,772	34	5,746	586	8,812	3,162
Wood	131,592	26,431	21,857	1,801	12,137	9,234	77	10,563	1,609	15,268	17,114

OKLAHOMA

American Lung Association in Oklahoma

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Adair	2	0	0	0.7	B
Canadian	6	0	0	2.0	C
Carter	INC	INC	INC	INC	INC
Cleveland	3	0	0	1.0	C
Comanche	2	0	0	0.7	B
Creek	3	0	0	1.0	C
Dewey	3	0	0	1.0	C
Johnston	INC	INC	INC	INC	INC
Kay	INC	INC	INC	INC	INC
Kiowa	INC	INC	INC	INC	INC
Love	INC	INC	INC	INC	INC
McClain	INC	INC	INC	INC	INC
Mayes	1	0	0	0.3	B
Nowata	INC	INC	INC	INC	INC
Oklahoma	10	0	0	3.3	F
Osage	5	2	0	2.7	D
Ottawa	6	0	0	2.0	C
Pittsburg	3	0	0	1.0	C
Pontotoc	INC	INC	INC	INC	INC
Sequoyah	1	0	0	0.3	B
Tulsa	13	3	0	5.8	F
Washington	INC	INC	INC	INC	INC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Adair	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Canadian	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Carter	2	1	0	0	1.2	C	8.7	Pass
Cleveland	6	0	0	0	2.0	C	10.3	Fail
Comanche	3	0	0	0	1.0	C	8.0	Pass
Creek	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dewey	1	0	0	0	0.3	B	7.7	Pass
Johnston	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Kay	9	1	0	0	3.5	F	9.9	Fail
Kiowa	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Love	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
McClain	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Mayes	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Nowata	INC	INC	INC	INC	INC	INC	INC	INC
Oklahoma	5	0	0	0	1.7	C	10.1	Fail
Osage	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Ottawa	12	3	0	0	5.5	F	INC	INC
Pittsburg	7	0	0	0	2.3	D	8.9	Pass
Pontotoc	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sequoyah	1	0	0	0	0.3	B	7.7	Pass
Tulsa	6	1	0	0	2.5	D	9.2	Fail
Washington	INC	INC	INC	INC	INC	INC	INC	INC

OKLAHOMA

American Lung Association in Oklahoma

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Adair	19,576	5,173	3,097	507	1,788	1,198	11	1,681	214	4,014	12,022
Canadian	169,149	42,988	23,213	4,212	15,641	9,707	95	13,324	2,112	14,428	47,690
Carter	48,510	12,109	8,288	1,186	4,506	3,038	27	4,275	550	7,436	15,690
Cleveland	299,587	60,307	45,068	5,909	29,589	18,145	169	24,868	4,050	37,908	92,807
Comanche	123,046	29,313	16,778	2,872	11,597	6,990	70	9,525	1,467	17,939	55,684
Creek	72,699	16,754	13,468	1,642	6,926	4,802	41	6,810	792	10,554	18,911
Dewey	4,401	1,170	827	115	399	282	2	403	43	611	916
Johnston	10,406	2,454	1,953	240	982	677	6	960	114	2,080	3,467
Kay	43,668	10,784	8,436	1,057	4,057	2,830	25	4,029	465	6,820	12,367
Kiowa	8,345	2,028	1,701	199	781	565	5	812	83	1,872	2,343
Love	10,218	2,477	1,940	243	956	666	6	947	110	1,363	3,340
McClain	45,306	11,223	7,088	1,100	4,229	2,788	26	3,892	519	4,499	10,633
Mayes	39,589	9,104	7,506	892	3,772	2,632	22	3,740	431	6,977	14,666
Nowata	9,483	2,224	1,864	218	898	641	5	916	97	1,476	3,383
Oklahoma	802,559	200,456	117,422	19,641	74,549	46,914	452	64,735	10,077	125,992	370,153
Osage	45,839	9,427	9,945	924	4,498	3,272	26	4,705	458	6,270	16,979
Ottawa	30,338	7,592	5,494	744	2,811	1,926	17	2,726	336	5,806	11,319
Pittsburg	43,613	9,934	8,829	973	4,158	2,951	25	4,218	434	7,068	14,137
Pontotoc	38,141	9,518	6,527	933	3,538	2,359	21	3,315	447	5,262	14,139
Sequoyah	39,667	9,386	7,393	920	3,749	2,619	22	3,721	428	8,282	15,530
Tulsa	677,358	167,056	104,516	16,369	63,175	40,591	382	56,359	8,309	102,568	275,658
Washington	53,242	12,734	10,675	1,248	4,996	3,526	30	5,037	578	7,268	15,524

OREGON

American Lung Association in Oregon

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Clackamas	5	1	0	2.2	D
Columbia	0	0	0	0.0	A
Crook	DNC	DNC	DNC	DNC	DNC
Harney	DNC	DNC	DNC	DNC	DNC
Jackson	3	0	0	1.0	C
Josephine	DNC	DNC	DNC	DNC	DNC
Klamath	DNC	DNC	DNC	DNC	DNC
Lake	DNC	DNC	DNC	DNC	DNC
Lane	1	0	0	0.3	B
Marion	3	0	0	1.0	C
Multnomah	3	0	0	1.0	C
Umatilla	1	0	0	0.3	B
Washington	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Clackamas	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Columbia	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Crook	2	1	0	2	2.8	D	10.0	Fail
Harney	9	12	0	1	9.8	F	10.8	Fail
Jackson	4	8	1	1	6.8	F	13.5	Fail
Josephine	0	4	0	1	2.8	D	INC	INC
Klamath	42	46	1	2	39.3	F	15.6	Fail
Lake	10	3	0	0	4.8	F	INC	INC
Lane	18	26	13	13	38.5	F	14.7	Fail
Marion	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Multnomah	1	2	0	1	2.2	D	8.1	Pass
Umatilla	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Washington	0	1	1	1	2.0	C	8.1	Pass

OREGON

American Lung Association in Oregon

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Clackamas	423,177	87,301	84,709	6,067	38,823	23,145	176	33,566	3,669	34,381	88,309
Columbia	53,588	10,839	10,929	753	4,949	2,990	22	4,348	437	5,957	7,300
Crook	26,375	5,167	6,708	359	2,442	1,602	11	2,417	198	2,786	3,463
Harney	7,515	1,455	1,979	101	696	460	3	698	54	1,095	1,089
Jackson	221,644	44,922	51,629	3,122	20,308	12,669	92	18,852	1,855	27,349	47,968
Josephine	87,730	16,622	23,936	1,155	8,165	5,481	37	8,360	643	15,571	13,190
Klamath	70,212	15,367	15,664	1,068	6,307	3,900	29	5,780	563	10,752	16,997
Lake	8,385	1,610	2,171	112	780	516	4	781	54	1,291	1,484
Lane	382,353	66,030	81,012	4,589	36,325	21,129	159	30,704	3,658	56,320	75,815
Marion	346,703	81,028	58,491	5,631	30,654	17,025	145	24,094	3,140	45,903	129,433
Multnomah	795,083	138,094	119,340	9,597	75,927	39,289	332	53,762	8,720	94,900	258,437
Umatilla	80,215	19,454	13,245	1,352	7,011	3,879	34	5,481	664	8,917	29,156
Washington	600,176	127,723	89,851	8,877	54,664	28,991	250	40,016	5,946	45,303	227,194

PENNSYLVANIA

American Lung Association in Pennsylvania

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Adams	1	0	0	0.3	B	2	0	0	0	0.7	B	INC	INC
Allegheny	8	0	0	2.7	D	18	2	0	0	7.0	F	10.9	Fail
Armstrong	5	0	0	1.7	C	1	0	0	0	0.3	B	8.9	Pass
Beaver	2	0	0	0.7	B	3	0	0	0	1.0	C	8.6	Pass
Berks	5	0	0	1.7	C	3	0	0	0	1.0	C	8.1	Pass
Blair	1	0	0	0.3	B	1	0	0	0	0.3	B	8.3	Pass
Bradford	0	0	0	0.0	A	1	0	0	0	0.3	B	INC	INC
Bucks	16	0	0	5.3	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cambria	1	0	0	0.3	B	1	0	0	0	0.3	B	9.6	Fail
Centre	0	0	0	0.0	A	1	0	0	0	0.3	B	7.8	Pass
Chester	0	0	0	0.0	A	3	0	0	0	1.0	C	8.5	Pass
Clearfield	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cumberland	DNC	DNC	DNC	DNC	DNC	4	0	0	0	1.3	C	7.6	Pass
Dauphin	1	0	0	0.3	B	7	0	0	0	2.3	D	9.9	Fail
Delaware	2	0	0	0.7	B	4	0	0	0	1.3	C	9.1	Fail
Elk	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Erie	0	0	0	0.0	A	0	0	0	0	0.0	A	INC	INC
Fayette	0	0	0	0.0	A	1	0	0	0	0.3	B	INC	INC
Franklin	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Greene	1	0	0	0.3	B	1	0	0	0	0.3	B	INC	INC
Indiana	3	0	0	1.0	C	1	0	0	0	0.3	B	INC	INC
Lackawanna	0	0	0	0.0	A	1	0	0	0	0.3	B	7.5	Pass
Lancaster	1	0	0	0.3	B	17	2	0	0	6.7	F	9.2	Fail
Lawrence	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lebanon	INC	INC	INC	INC	INC	4	0	0	0	1.3	C	INC	INC
Lehigh	0	0	0	0.0	A	0	1	0	0	0.5	B	8.7	Pass
Luzerne	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lycoming	0	0	0	0.0	A	2	0	0	0	0.7	B	INC	INC
Mercer	4	0	0	1.3	C	1	0	0	0	0.3	B	INC	INC
Monroe	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Montgomery	5	0	0	1.7	C	2	0	0	0	0.7	B	8.2	Pass
Northampton	3	0	0	1.0	C	4	0	0	0	1.3	C	8.1	Pass
Philadelphia	15	1	0	5.5	F	3	1	0	0	1.5	C	9.1	Fail
Somerset	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Susquehanna	DNC	DNC	DNC	DNC	DNC	2	0	0	0	0.7	B	INC	INC
Tioga	0	0	0	0.0	A	1	0	0	0	0.3	B	INC	INC
Washington	0	0	0	0.0	A	1	0	0	0	0.3	B	8.5	Pass
Westmoreland	0	0	0	0.0	A	1	0	0	0	0.3	B	INC	INC
Wyoming	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	INC	INC
York	0	0	0	0.0	A	3	0	0	0	1.0	C	9.6	Fail

PENNSYLVANIA

American Lung Association in Pennsylvania

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Adams	106,027	20,235	23,117	2,007	8,721	6,676	55	9,718	976	8,731	12,442
Allegheny	1,233,253	226,322	251,498	22,446	103,039	74,775	635	106,553	12,874	135,204	281,102
Armstrong	64,747	12,210	15,538	1,211	5,307	4,256	33	6,350	543	7,982	2,205
Beaver	165,677	31,752	37,934	3,149	13,579	10,588	85	15,616	1,480	16,640	19,401
Berks	430,449	93,693	78,368	9,292	34,486	24,980	222	34,996	4,251	45,310	137,832
Blair	121,032	24,113	26,311	2,391	9,856	7,515	62	10,958	1,124	15,337	7,552
Bradford	59,866	13,116	13,513	1,301	4,733	3,729	31	5,529	506	7,360	2,832
Bucks	645,054	126,822	133,370	12,578	52,719	40,238	333	57,915	5,896	37,561	116,492
Cambria	131,441	25,026	31,766	2,482	10,764	8,531	68	12,756	1,144	20,467	11,404
Centre	158,425	22,716	25,381	2,253	14,101	9,003	82	11,840	1,886	22,171	23,865
Chester	545,823	118,765	97,653	11,779	43,728	31,754	281	44,315	5,386	29,965	123,001
Clearfield	77,904	14,230	17,248	1,411	6,463	5,007	40	7,302	641	8,635	4,790
Cumberland	268,579	54,201	51,228	5,375	21,965	15,806	139	22,271	2,729	20,090	48,661
Dauphin	288,800	63,727	52,675	6,320	23,062	16,612	149	23,294	2,934	34,778	109,332
Delaware	575,182	124,857	101,157	12,383	46,225	32,849	296	45,574	6,040	53,893	209,015
Elk	30,477	5,792	7,328	574	2,491	2,015	16	3,010	241	3,009	915
Erie	267,689	55,114	52,963	5,466	21,727	15,942	138	22,719	2,626	38,149	45,706
Fayette	125,755	24,031	28,717	2,383	10,311	8,063	65	11,883	1,093	21,097	11,218
Franklin	156,902	33,759	32,188	3,348	12,537	9,491	81	13,706	1,472	13,339	21,421
Greene	34,663	6,635	7,265	658	2,855	2,153	18	3,103	301	4,164	2,368
Indiana	82,957	14,695	17,168	1,457	6,988	5,053	43	7,211	869	10,759	5,656
Lackawanna	215,615	43,803	44,401	4,344	17,519	13,093	111	18,844	2,087	27,211	40,433
Lancaster	556,629	127,271	109,854	12,622	43,859	32,281	287	46,311	5,427	48,929	110,248
Lawrence	84,849	16,762	19,873	1,662	6,894	5,425	44	8,064	748	10,521	7,610
Lebanon	144,011	32,232	29,594	3,197	11,385	8,578	74	12,424	1,346	15,850	29,813
Lehigh	376,317	83,883	66,127	8,319	30,007	21,381	194	29,717	3,855	41,650	152,596
Luzerne	326,369	65,845	65,876	6,530	26,582	19,786	168	28,320	3,083	47,930	81,027
Lycoming	113,104	23,172	23,541	2,298	9,168	6,858	58	9,901	1,088	12,939	11,986
Mercer	109,220	20,420	25,441	2,025	9,001	7,027	56	10,395	975	12,979	11,123
Monroe	167,198	31,883	32,801	3,162	13,798	10,358	86	14,686	1,566	20,227	63,810
Montgomery	864,683	181,249	164,248	17,976	69,880	51,227	445	72,372	8,578	55,916	229,089
Northampton	318,526	60,421	64,684	5,992	26,363	19,450	164	27,765	3,144	32,077	85,358
Philadelphia	1,567,258	330,406	230,631	32,768	128,283	83,453	804	109,967	19,309	325,746	1,035,930
Somerset	72,710	13,130	17,446	1,302	6,026	4,788	38	7,124	571	9,781	3,991
Susquehanna	38,074	7,048	9,651	699	3,125	2,555	20	3,863	298	4,219	1,725
Tioga	41,106	7,895	9,682	783	3,364	2,639	21	3,921	368	4,822	1,731
Washington	210,383	40,748	46,466	4,041	17,229	13,270	108	19,401	1,917	23,615	18,226
Westmoreland	352,057	63,155	86,063	6,263	29,194	23,325	181	34,864	3,015	33,697	24,926
Wyoming	26,014	4,943	5,995	490	2,136	1,668	13	2,464	232	2,952	1,438
York	461,058	99,537	87,446	9,872	36,935	27,261	238	38,589	4,407	41,364	88,791

PUERTO RICO

American Lung Association in Puerto Rico

	HIGH OZONE DAYS 2020–2022				
County	Orange	Red	Purple	Wgt. Avg.	Grade
Adjuntas	DNC	DNC	DNC	DNC	DNC
Bayamón	0	0	0	0.0	A
Caguas	DNC	DNC	DNC	DNC	DNC
Cataño	INC	INC	INC	INC	INC
Fajardo	DNC	DNC	DNC	DNC	DNC
Guayama	DNC	DNC	DNC	DNC	DNC
Guaynabo	DNC	DNC	DNC	DNC	DNC
Juncos	INC	INC	INC	INC	INC
Mayagüez	0	0	0	0.0	A
Ponce	DNC	DNC	DNC	DNC	DNC

	HIGH PARTICLE POLLUTION DAYS 2020–2022							
	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Adjuntas	INC	INC	INC	INC	INC	INC	INC	INC
Bayamón	0	0	0	0	0.0	A	INC	INC
Caguas	0	0	0	0	0.0	A	INC	INC
Cataño	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Fajardo	0	0	0	0	0.0	A	INC	INC
Guayama	0	0	0	0	0.0	A	INC	INC
Guaynabo	0	0	0	0	0.0	A	INC	INC
Juncos	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Mayagüez	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Ponce	0	0	0	0	0.0	A	INC	INC

PUERTO RICO

American Lung Association in Puerto Rico

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Adjuntas	17,905	3,054	4,103	317	1,809	784	2	1,534	101	11,367	17,901
Bayamón	181,577	27,939	44,453	2,900	18,590	8,013	25	15,699	1,068	62,427	183,238
Caguas	125,136	19,807	28,380	2,056	12,774	5,468	17	10,638	777	46,606	125,008
Cataño	22,364	3,710	5,463	385	2,257	974	3	1,911	134	10,499	22,867
Fajardo	31,375	5,220	7,480	542	3,179	1,379	4	2,706	186	13,569	31,856
Guayama	35,262	5,841	7,376	606	3,544	1,481	5	2,841	207	16,295	36,262
Guaynabo	89,057	12,277	22,984	1,274	9,338	4,087	12	8,072	499	22,384	88,573
Juncos	36,672	6,474	6,703	672	3,641	1,498	5	2,836	251	14,047	36,849
Mayagüez	70,609	10,861	18,841	1,127	7,184	3,106	10	6,123	405	38,344	72,270
Ponce	132,138	22,600	33,553	2,345	13,280	5,801	18	11,463	728	67,203	135,975

RHODE ISLAND

American Lung Association in Rhode Island

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Kent	3	0	0	1.0	C
Providence	6	0	0	2.0	C
Washington	6	2	0	3.0	D

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Kent	1	0	0	0	0.3	B	4.5	Pass
Providence	1	0	0	0	0.3	B	7.9	Pass
Washington	0	0	0	0	0.0	A	4.3	Pass

RHODE ISLAND

American Lung Association in Rhode Island

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Kent	171,275	30,746	35,220	3,104	18,749	10,079	86	12,861	1,484	12,518	25,743
Providence	657,288	131,373	108,254	13,264	70,640	34,134	331	42,275	6,452	88,238	273,525
Washington	130,330	19,638	30,567	1,983	14,682	8,111	66	10,466	1,144	7,993	12,730

SOUTH CAROLINA

American Lung Association in South Carolina

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Aiken	0	0	0	0.0	A
Anderson	0	0	0	0.0	A
Berkeley	0	0	0	0.0	A
Charleston	0	0	0	0.0	A
Chesterfield	0	0	0	0.0	A
Darlington	0	0	0	0.0	A
Edgefield	0	0	0	0.0	A
Florence	DNC	DNC	DNC	DNC	DNC
Greenville	1	0	0	0.3	B
Horry	0	0	0	0.0	A
Lexington	DNC	DNC	DNC	DNC	DNC
Richland	1	0	0	0.3	B
Spartanburg	1	0	0	0.3	B
York	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Aiken	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Anderson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Berkeley	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Charleston	1	0	0	0	0.3	B	7.2	Pass
Chesterfield	0	0	0	0	0.0	A	6.7	Pass
Darlington	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Edgefield	0	0	0	0	0.0	A	7.6	Pass
Florence	0	0	0	0	0.0	A	7.5	Pass
Greenville	1	0	0	0	0.3	B	8.2	Pass
Horry	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Lexington	2	0	0	0	0.7	B	7.9	Pass
Richland	0	0	0	0	0.0	A	7.0	Pass
Spartanburg	0	0	0	0	0.0	A	8.1	Pass
York	0	0	0	0	0.0	A	6.9	Pass

SOUTH CAROLINA

American Lung Association in South Carolina

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Aiken	174,150	36,757	36,704	2,478	12,437	10,987	92	13,925	1,785	29,144	60,702
Anderson	209,581	46,801	38,939	3,155	14,719	12,666	111	15,774	2,231	31,607	49,338
Berkeley	245,117	57,108	37,302	3,850	16,887	13,562	130	16,411	2,759	21,513	92,328
Charleston	419,279	79,891	76,429	5,386	30,509	25,141	222	31,017	4,940	47,690	139,637
Chesterfield	43,683	9,568	8,555	645	3,094	2,730	23	3,424	432	8,439	17,964
Darlington	62,398	13,824	12,387	932	4,397	3,853	33	4,846	666	12,842	28,843
Edgefield	26,932	4,484	5,439	302	2,029	1,745	15	2,178	239	4,048	11,401
Florence	136,721	32,048	24,771	2,161	9,449	8,039	72	9,995	1,524	27,332	68,376
Greenville	547,950	123,968	92,748	8,357	38,186	31,651	290	38,877	6,159	54,179	179,972
Horry	383,101	64,164	101,863	4,326	29,068	27,549	203	35,912	3,554	46,928	85,504
Lexington	304,797	68,858	52,680	4,642	21,309	17,997	162	22,178	3,310	33,295	84,421
Richland	421,566	89,565	59,667	6,038	29,640	22,594	223	26,906	5,474	63,715	251,403
Spartanburg	345,831	79,660	56,915	5,370	23,973	19,795	183	24,231	3,861	49,261	114,867
York	294,248	68,657	45,639	4,629	20,351	16,808	156	20,411	3,337	23,957	94,275

SOUTH DAKOTA

American Lung Association in South Dakota

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Brookings	3	0	0	1.0	C
Brown	DNC	DNC	DNC	DNC	DNC
Clay	INC	INC	INC	INC	INC
Codington	2	0	0	0.7	B
Custer	2	0	0	0.7	B
Hughes	DNC	DNC	DNC	DNC	DNC
Jackson	0	0	0	0.0	A
Meade	7	0	0	2.3	D
Minnehaha	1	0	0	0.3	B
Pennington	DNC	DNC	DNC	DNC	DNC
Union	INC	INC	INC	INC	INC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Brookings	3	1	1	0	2.2	D	4.9	Pass
Brown	0	3	0	0	1.5	C	5.5	Pass
Clay	INC	INC	INC	INC	INC	INC	INC	INC
Codington	2	2	1	0	2.3	D	7.6	Pass
Custer	3	1	0	0	1.5	C	4.1	Pass
Hughes	1	0	1	0	1.0	C	3.3	Pass
Jackson	0	1	1	0	1.2	C	4.5	Pass
Meade	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Minnehaha	3	2	0	0	2.0	C	INC	INC
Pennington	3	1	0	0	1.5	C	7.3	Pass
Union	INC	INC	INC	INC	INC	INC	INC	INC

SOUTH DAKOTA

American Lung Association in South Dakota

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Brookings	35,484	7,373	4,876	514	2,369	1,604	17	1,977	557	4,298	4,254
Brown	37,972	8,866	6,972	618	2,444	2,048	19	2,605	486	4,064	5,672
Clay	15,280	2,590	1,929	181	1,072	680	7	822	288	2,550	2,093
Codington	28,721	6,553	5,609	457	1,859	1,613	14	2,065	336	3,090	2,709
Custer	9,006	1,197	3,007	83	637	684	4	949	79	831	1,053
Hughes	17,692	4,332	3,289	302	1,123	967	9	1,229	222	1,619	3,427
Jackson	2,821	1,041	354	73	151	120	1	146	31	799	1,785
Meade	30,698	6,378	5,268	445	2,050	1,632	15	2,042	392	2,299	4,234
Minnehaha	203,971	51,281	28,366	3,576	13,003	10,058	100	12,091	2,691	18,266	41,006
Pennington	114,461	24,993	22,971	1,743	7,496	6,533	56	8,391	1,329	15,784	23,852
Union	17,063	4,013	3,303	280	1,096	961	8	1,225	200	1,020	1,745

TENNESSEE

American Lung Association in Tennessee

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Anderson	0	0	0	0.0	A
Blount	2	0	0	0.7	B
Claiborne	0	0	0	0.0	A
Davidson	3	0	0	1.0	C
DeKalb	0	0	0	0.0	A
Dyer	DNC	DNC	DNC	DNC	DNC
Hamilton	2	0	0	0.7	B
Jefferson	0	0	0	0.0	A
Knox	0	0	0	0.0	A
Lawrence	DNC	DNC	DNC	DNC	DNC
Loudon	0	0	0	0.0	A
McMinn	DNC	DNC	DNC	DNC	DNC
Madison	DNC	DNC	DNC	DNC	DNC
Maury	DNC	DNC	DNC	DNC	DNC
Montgomery	DNC	DNC	DNC	DNC	DNC
Putnam	DNC	DNC	DNC	DNC	DNC
Roane	DNC	DNC	DNC	DNC	DNC
Sevier	0	0	0	0.0	A
Shelby	12	2	0	5.0	F
Sullivan	0	0	0	0.0	A
Sumner	2	0	0	0.7	B
Williamson	2	0	0	0.7	B
Wilson	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Anderson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Blount	1	0	0	0	0.3	B	7.0	Pass
Claiborne	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Davidson	5	0	0	0	1.7	C	9.1	Fail
DeKalb	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dyer	3	0	0	0	1.0	C	7.2	Pass
Hamilton	0	1	0	0	0.5	B	7.7	Pass
Jefferson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Knox	5	0	0	0	1.7	C	9.4	Fail
Lawrence	0	0	0	0	0.0	A	5.8	Pass
Loudon	0	0	0	0	0.0	A	6.6	Pass
McMinn	0	0	0	0	0.0	A	7.4	Pass
Madison	3	0	0	0	1.0	C	7.4	Pass
Maury	1	0	0	0	0.3	B	6.6	Pass
Montgomery	3	0	0	0	1.0	C	7.0	Pass
Putnam	1	0	0	0	0.3	B	6.6	Pass
Roane	0	1	0	0	0.5	B	7.1	Pass
Sevier	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Shelby	0	1	0	0	0.5	B	8.5	Pass
Sullivan	0	0	0	0	0.0	A	6.3	Pass
Sumner	2	0	0	0	0.7	B	7.4	Pass
Williamson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wilson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

TENNESSEE

American Lung Association in Tennessee

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Anderson	78,913	16,536	15,982	1,610	7,397	7,588	48	7,879	820	10,167	9,261
Blount	139,958	27,488	29,806	2,677	13,366	13,958	86	14,585	1,438	13,365	14,186
Claiborne	32,431	6,162	6,637	600	3,117	3,191	20	3,302	348	6,259	1,788
Davidson	708,144	140,751	95,239	13,708	66,376	57,896	432	55,052	10,050	95,816	308,978
DeKalb	21,003	4,537	3,916	442	1,962	2,012	13	2,048	218	3,245	2,790
Dyer	36,410	8,635	6,558	841	3,293	3,302	22	3,366	399	6,131	7,947
Hamilton	374,682	77,527	70,079	7,551	35,082	34,568	229	35,311	4,355	43,066	109,788
Jefferson	56,727	10,745	11,849	1,046	5,479	5,737	35	5,946	583	6,138	4,803
Knox	494,574	101,703	81,914	9,905	46,264	43,713	302	43,484	6,116	55,899	92,706
Lawrence	45,415	11,372	7,956	1,108	4,042	4,069	28	4,135	469	6,112	3,204
Loudon	58,181	10,837	16,211	1,055	5,621	6,322	36	7,020	496	5,881	8,060
McMinn	54,719	11,525	11,139	1,122	5,130	5,304	33	5,510	572	8,003	6,433
Madison	99,245	21,910	18,140	2,134	9,141	9,038	60	9,214	1,136	14,152	45,065
Maury	108,159	24,425	18,850	2,379	9,904	9,718	66	9,813	1,230	11,092	23,716
Montgomery	235,201	62,497	23,538	6,087	20,180	16,801	144	15,303	3,104	25,722	93,231
Putnam	82,382	16,743	13,719	1,631	7,711	7,213	50	7,187	977	15,140	10,671
Roane	55,082	10,266	13,004	1,000	5,337	5,765	34	6,142	531	7,203	4,506
Sevier	98,789	19,883	20,779	1,936	9,390	9,841	60	10,260	997	11,335	11,741
Shelby	916,371	228,438	138,108	22,248	81,186	76,759	557	75,647	11,121	150,180	603,045
Sullivan	160,820	30,307	36,007	2,952	15,498	16,314	98	17,216	1,646	24,274	12,307
Sumner	203,858	46,298	34,528	4,509	18,706	18,529	125	18,563	2,282	15,086	37,723
Williamson	260,815	66,560	39,009	6,482	23,218	23,189	160	22,737	2,848	10,671	43,896
Wilson	158,555	36,461	25,560	3,551	14,502	14,240	97	14,122	1,782	11,221	28,625

TEXAS

American Lung Association in Texas

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Atascosa	DNC	DNC	DNC	DNC	DNC	2	1	0	0	1.2	C	INC	INC
Bell	6	0	0	2.0	C	1	0	0	0	0.3	B	7.4	Pass
Bexar	30	0	0	10.0	F	1	1	0	0	0.8	B	8.6	Pass
Bowie	DNC	DNC	DNC	DNC	DNC	2	0	0	0	0.7	B	10.0	Fail
Brazoria	21	2	0	8.0	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Brazos	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	INC	INC
Brewster	0	0	0	0.0	A	1	0	0	0	0.3	B	5.5	Pass
Cameron	0	0	0	0.0	A	9	3	0	0	4.5	F	9.1	Fail
Collin	16	2	0	6.3	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Culberson	15	0	0	5.0	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dallas	25	1	0	8.8	F	1	0	0	0	0.3	B	9.4	Fail
Denton	43	4	0	16.3	F	2	0	0	0	0.7	B	7.5	Pass
Ector	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	7.4	Pass
Ellis	1	0	0	0.3	B	0	0	0	0	0.0	A	INC	INC
El Paso	49	1	0	16.8	F	1	0	0	0	0.3	B	9.2	Fail
Galveston	10	1	0	3.8	F	2	0	0	0	0.7	B	7.9	Pass
Gregg	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Harris	50	13	0	23.2	F	4	1	0	0	1.8	C	11.4	Fail
Harrison	2	0	0	0.7	B	2	2	0	0	1.7	C	INC	INC
Hidalgo	1	0	0	0.3	B	7	2	0	0	3.3	F	10.1	Fail
Hood	12	0	0	4.0	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hunt	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Jefferson	8	0	0	2.7	D	2	0	0	0	0.7	B	8.3	Pass
Johnson	21	1	0	7.5	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Kaufman	3	0	0	1.0	C	INC	INC	INC	INC	INC	INC	INC	INC
Kleberg	DNC	DNC	DNC	DNC	DNC	9	2	0	0	4.0	F	10.3	Fail
Lubbock	DNC	DNC	DNC	DNC	DNC	2	0	0	0	0.7	B	5.8	Pass
McLennan	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Maverick	DNC	DNC	DNC	DNC	DNC	1	1	0	0	0.8	B	7.9	Pass
Montgomery	14	1	0	5.2	F	INC	INC	INC	INC	INC	INC	INC	INC
Navarro	1	0	0	0.3	B	INC	INC	INC	INC	INC	INC	INC	INC
Nueces	2	0	0	0.7	B	1	2	0	0	1.3	C	8.7	Pass
Orange	2	0	0	0.7	B	2	0	0	0	0.7	B	8.2	Pass
Parker	16	0	0	5.3	F	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Polk	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Potter	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	5.9	Pass
Randall	7	0	0	2.3	D	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rockwall	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Smith	6	0	0	2.0	C	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Tarrant	42	6	1	17.7	F	3	0	0	0	1.0	C	9.1	Fail
Travis	7	0	0	2.3	D	1	1	0	0	0.8	B	9.3	Fail
Victoria	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Webb	0	0	0	0.0	A	3	1	0	0	1.5	C	10.1	Fail

TEXAS

American Lung Association in Texas

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Atascosa	50,864	13,626	7,553	866	2,924	2,179	21	3,531	600	8,191	35,322
Bell	388,386	106,162	45,913	6,745	21,853	14,965	158	23,247	5,106	53,701	221,468
Bexar	2,059,530	506,417	262,624	32,177	120,827	84,496	837	132,726	27,314	314,925	1,527,050
Bowie	92,035	21,698	16,068	1,379	5,542	4,280	37	7,045	1,032	16,274	35,243
Brazoria	388,181	98,908	49,627	6,285	22,651	16,171	158	25,677	4,862	38,062	224,784
Brazos	242,014	48,124	24,944	3,058	14,743	9,141	99	13,407	3,913	49,079	109,417
Brewster	9,343	1,668	2,357	106	611	522	4	895	97	1,239	5,022
Cameron	425,208	121,422	59,843	7,715	23,750	17,382	173	27,918	5,105	95,070	388,876
Collin	1,158,696	283,701	135,234	18,026	68,574	48,112	471	75,765	15,278	55,552	564,447
Culberson	2,155	492	461	31	132	109	1	185	21	432	1,628
Dallas	2,600,840	648,322	306,984	41,194	151,967	104,912	1,056	163,751	34,891	364,132	1,904,763
Denton	977,281	226,335	113,352	14,381	58,730	40,794	397	63,906	13,357	75,587	446,372
Ector	160,869	48,910	15,687	3,108	8,658	5,745	66	8,777	2,001	25,752	117,048
Ellis	212,182	55,450	27,737	3,523	12,290	8,864	86	14,144	2,658	18,830	98,686
El Paso	868,763	224,877	113,529	14,289	50,114	35,388	353	55,856	10,986	179,428	771,729
Galveston	357,117	83,660	56,246	5,316	21,558	16,273	145	26,527	4,320	47,446	160,634
Gregg	125,443	32,076	20,096	2,038	7,327	5,524	51	8,996	1,506	19,744	55,360
Harris	4,780,913	1,230,488	560,415	78,185	276,530	191,428	1,942	299,226	63,334	775,281	3,484,481
Harrison	69,955	16,591	12,520	1,054	4,211	3,287	28	5,436	820	10,570	26,742
Hidalgo	888,367	273,656	102,005	17,388	47,757	33,144	361	51,858	11,194	240,721	837,830
Hood	66,373	13,468	17,009	856	4,233	3,708	27	6,419	646	6,447	11,956
Hunt	108,282	25,978	17,148	1,651	6,475	4,876	44	7,938	1,316	13,548	35,271
Jefferson	250,830	61,097	39,139	3,882	14,899	11,142	102	18,079	2,816	44,645	157,101
Johnson	195,506	49,899	27,582	3,171	11,430	8,382	80	13,482	2,333	19,258	66,815
Kaufman	172,366	48,999	18,520	3,113	9,600	6,568	70	10,206	2,272	14,630	85,882
Kleberg	30,362	7,178	4,117	456	1,783	1,220	12	1,893	424	7,761	24,416
Lubbock	317,561	74,292	41,810	4,720	18,788	12,915	129	20,096	4,484	52,929	155,150
McLennan	266,836	63,415	40,466	4,029	15,843	11,505	108	18,403	3,532	40,862	121,134
Maverick	57,843	17,768	6,753	1,129	3,116	2,175	24	3,413	702	12,535	56,200
Montgomery	678,490	173,811	94,361	11,044	39,676	29,130	276	46,886	8,292	57,427	266,621
Navarro	54,636	14,345	9,127	911	3,178	2,455	22	4,043	599	12,232	25,996
Nueces	351,674	83,688	55,489	5,317	20,999	15,632	143	25,309	4,360	59,461	254,494
Orange	84,934	21,406	13,662	1,360	5,006	3,813	34	6,239	989	11,655	18,605
Parker	165,834	40,655	26,484	2,583	9,899	7,577	67	12,430	1,893	12,854	32,513
Polk	53,255	10,736	10,008	682	3,390	2,712	22	4,536	487	9,204	15,357
Potter	115,645	30,697	16,350	1,950	6,642	4,836	47	7,750	1,331	21,130	66,452
Randall	146,140	34,582	22,997	2,197	8,725	6,459	59	10,428	1,850	12,193	48,388
Rockwall	123,208	32,328	15,560	2,054	7,144	5,151	50	8,222	1,515	5,809	44,458
Smith	241,922	58,090	42,031	3,691	14,452	11,104	98	18,235	2,967	27,902	101,191
Tarrant	2,154,595	543,108	265,948	34,509	125,852	88,529	874	139,528	28,476	225,849	1,233,287
Travis	1,326,436	264,281	145,551	16,792	82,174	54,382	541	82,974	19,435	131,687	690,910
Victoria	91,065	22,701	15,522	1,442	5,368	4,105	37	6,727	1,087	13,969	52,493
Webb	267,780	83,029	27,350	5,276	14,345	9,726	109	15,038	3,358	55,124	258,156

UTAH

American Lung Association in Utah

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Box Elder	7	0	0	2.3	D
Cache	3	0	0	1.0	C
Carbon	4	0	0	1.3	C
Davis	39	1	0	13.5	F
Duchesne	7	0	0	2.3	D
Garfield	2	0	0	0.7	B
Iron	2	0	0	0.7	B
Salt Lake	60	8	0	24.0	F
San Juan	4	0	0	1.3	C
Tooele	13	1	0	4.8	F
Uintah	10	0	0	3.3	F
Utah	21	0	0	7.0	F
Washington	4	1	0	1.8	C
Weber	20	0	0	6.7	F

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Box Elder	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Cache	19	3	0	0	7.8	F	8.1	Pass
Carbon	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Davis	14	1	0	0	5.2	F	7.4	Pass
Duchesne	10	1	0	0	3.8	F	6.9	Pass
Garfield	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Iron	2	1	0	0	1.2	C	5.8	Pass
Salt Lake	22	5	0	0	9.8	F	9.9	Fail
San Juan	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Tooele	13	3	0	0	5.8	F	6.9	Pass
Uintah	4	1	0	0	1.8	C	6.3	Pass
Utah	14	0	0	0	4.7	F	7.5	Pass
Washington	1	1	0	0	0.8	B	5.6	Pass
Weber	9	0	0	0	3.0	D	7.0	Pass

UTAH

American Lung Association in Utah

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Box Elder	61,498	18,730	7,922	1,377	4,717	1,948	12	2,956	742	4,923	8,504
Cache	140,173	40,550	14,210	2,981	10,943	4,066	28	5,858	2,073	16,598	23,915
Carbon	20,571	5,170	3,904	380	1,693	771	4	1,245	243	2,748	3,648
Davis	369,948	110,709	41,111	8,138	28,623	11,330	74	16,691	4,817	23,448	67,451
Duchesne	20,161	6,443	2,652	474	1,513	634	4	971	235	2,760	3,159
Garfield	5,281	1,166	1,270	86	451	221	1	371	55	479	776
Iron	62,429	16,840	8,624	1,238	5,008	2,035	12	3,098	852	7,723	9,911
Salt Lake	1,186,257	296,883	143,157	21,822	98,153	38,912	237	57,477	16,336	90,158	369,156
San Juan	14,359	4,041	2,180	297	1,139	495	3	771	166	3,208	7,835
Tooele	79,934	24,706	7,489	1,816	6,111	2,347	16	3,364	1,055	5,151	16,496
Uintah	37,141	11,473	4,589	843	2,831	1,156	7	1,742	460	4,402	6,944
Utah	702,434	219,921	56,215	16,165	53,103	18,953	140	26,344	10,225	55,585	138,916
Washington	197,680	47,470	44,209	3,489	16,433	7,792	39	12,996	2,235	18,880	34,016
Weber	269,561	71,104	33,475	5,226	21,901	8,805	54	13,121	3,564	22,590	67,665

VERMONT

American Lung Association in Vermont

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Bennington	0	0	0	0.0	A
Chittenden	0	0	0	0.0	A
Rutland	0	0	0	0.0	A

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Bennington	1	0	0	0	0.3	B	5.7	Pass
Chittenden	1	0	0	0	0.3	B	6.9	Pass
Rutland	1	0	0	0	0.3	B	7.5	Pass

VERMONT

American Lung Association in Vermont

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Bennington	37,392	6,910	9,229	500	3,921	2,350	18	2,998	267	3,986	2,674
Chittenden	169,301	28,707	28,732	2,078	18,478	8,656	80	10,782	1,687	15,769	21,643
Rutland	60,366	10,355	14,905	749	6,440	3,819	28	4,868	430	7,261	3,106

VIRGINIA

American Lung Association in Virginia

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Albemarle	0	0	0	0.0	A	0	0	0	0	0.0	A	7.3	Pass
Arlington	3	0	0	1.0	C	0	0	0	0	0.0	A	7.1	Pass
Caroline	2	0	0	0.7	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Charles City	0	0	0	0.0	A	0	0	0	0	0.0	A	6.1	Pass
Chesterfield	1	0	0	0.3	B	0	0	0	0	0.0	A	6.1	Pass
Fairfax	3	0	0	1.0	C	1	0	0	0	0.3	B	8.3	Pass
Fauquier	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Frederick	0	0	0	0.0	A	0	0	0	0	0.0	A	7.7	Pass
Giles	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hanover	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Henrico	1	0	0	0.3	B	1	0	0	0	0.3	B	7.6	Pass
Loudoun	3	0	0	1.0	C	1	0	0	0	0.3	B	6.6	Pass
Madison	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Prince Edward	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Prince William	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Roanoke	0	0	0	0.0	A	1	0	0	0	0.3	B	7.5	Pass
Rockbridge	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rockingham	0	0	0	0.0	A	0	0	0	0	0.0	A	6.7	Pass
Stafford	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wythe	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Bristol City	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.5	Pass
Hampton City	0	0	0	0.0	A	0	0	0	0	0.0	A	6.5	Pass
Lynchburg City	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	5.9	Pass
Norfolk City	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.5	Pass
Richmond City	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	7.7	Pass
Salem City	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.5	Pass
Suffolk City	1	0	0	0.3	B	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Virginia Beach City	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.7	Pass

VIRGINIA

American Lung Association in Virginia

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Albemarle	114,534	21,866	23,862	1,719	9,163	6,780	54	9,022	1,279	9,024	27,478
Arlington	234,000	42,262	28,026	3,322	19,146	11,765	111	13,886	3,227	15,822	93,896
Caroline	31,957	7,155	5,524	562	2,470	1,782	15	2,332	322	3,302	12,020
Charles City	6,605	947	1,791	74	560	470	3	664	53	776	3,652
Chesterfield	378,408	88,045	61,824	6,921	28,931	20,482	178	26,520	4,173	25,672	158,413
Fairfax	1,138,331	257,820	172,070	20,268	87,927	60,827	538	77,631	12,552	66,177	586,029
Fauquier	74,664	17,110	13,235	1,345	5,737	4,231	35	5,602	717	4,759	17,543
Frederick	95,051	21,327	18,114	1,677	7,325	5,462	45	7,284	923	6,794	19,598
Giles	16,453	3,215	3,677	253	1,313	1,033	8	1,418	150	1,954	952
Hanover	112,938	24,023	21,908	1,889	8,844	6,652	53	8,910	1,101	5,754	19,938
Henrico	333,962	72,694	57,141	5,715	25,998	18,473	157	23,980	3,739	30,491	164,653
Loudoun	432,085	113,893	46,737	8,953	31,989	20,796	204	25,451	4,942	16,440	206,825
Madison	14,000	2,758	3,307	217	1,113	894	7	1,239	126	1,469	2,237
Prince Edward	21,927	3,452	3,716	271	1,829	1,204	10	1,495	267	3,554	8,529
Prince William	486,943	127,844	55,027	10,050	36,021	23,362	230	28,573	5,497	33,481	296,340
Roanoke	96,914	18,763	21,672	1,475	7,736	6,009	46	8,194	963	7,062	15,905
Rockbridge	22,593	3,849	6,249	303	1,846	1,551	11	2,197	192	2,677	1,984
Rockingham	85,397	18,529	17,518	1,457	6,624	5,009	40	6,737	855	8,740	11,885
Stafford	163,380	42,310	18,934	3,326	12,142	7,923	77	9,731	1,788	8,703	74,529
Wythe	28,111	5,416	6,307	426	2,251	1,774	13	2,435	259	4,392	1,874
Bristol City	16,975	3,403	3,883	268	1,341	1,050	8	1,438	163	3,452	2,180
Hampton City	138,037	29,434	23,108	2,314	10,784	7,448	65	9,517	1,608	19,408	88,713
Lynchburg City	79,287	15,118	11,523	1,188	6,357	3,982	37	4,781	1,143	13,550	30,145
Norfolk City	232,995	46,759	30,525	3,676	18,531	11,567	110	13,828	2,865	39,741	134,059
Richmond City	229,395	38,919	33,454	3,060	18,937	12,087	108	14,681	3,233	47,338	130,140
Salem City	25,523	4,869	5,004	383	2,048	1,498	12	1,978	286	2,548	4,386
Suffolk City	98,537	23,084	15,101	1,815	7,529	5,234	46	6,701	1,064	11,279	51,879
Virginia Beach City	455,618	98,907	73,023	7,775	35,500	24,468	215	31,199	5,118	44,340	182,843

WASHINGTON

American Lung Association in Washington

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Benton	3	0	0	1.0	C
Clallam	0	0	0	0.0	A
Clark	0	0	0	0.0	A
Columbia	INC	INC	INC	INC	INC
King	9	2	0	4.0	F
Kitsap	DNC	DNC	DNC	DNC	DNC
Kittitas	DNC	DNC	DNC	DNC	DNC
Okanogan	DNC	DNC	DNC	DNC	DNC
Pierce	1	0	0	0.3	B
Skagit	0	0	0	0.0	A
Snohomish	DNC	DNC	DNC	DNC	DNC
Spokane	3	0	0	1.0	C
Stevens	DNC	DNC	DNC	DNC	DNC
Thurston	INC	INC	INC	INC	INC
Whatcom	0	0	0	0.0	A
Yakima	DNC	DNC	DNC	DNC	DNC

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Benton	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clallam	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Clark	4	2	2	5	7.8	F	9.1	Fail
Columbia	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
King	11	7	3	0	9.2	F	8.5	Pass
Kitsap	7	3	3	0	5.8	F	6.4	Pass
Kittitas	9	4	3	1	7.8	F	7.5	Pass
Okanogan	16	11	7	2	17.2	F	13.4	Fail
Pierce	12	6	3	0	9.0	F	8.1	Pass
Skagit	2	1	0	0	1.2	C	INC	INC
Snohomish	19	12	4	1	15.8	F	8.9	Pass
Spokane	4	12	1	3	10.5	F	INC	INC
Stevens	13	13	1	3	14.0	F	11.6	Fail
Thurston	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Whatcom	6	8	1	0	6.7	F	INC	INC
Yakima	16	18	1	4	18.3	F	11.8	Fail

WASHINGTON

American Lung Association in Washington

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Benton	212,791	54,976	34,231	4,019	17,308	8,285	89	11,960	2,130	23,033	70,542
Clallam	77,805	12,580	25,159	920	7,152	4,317	32	6,987	597	9,001	14,550
Clark	516,779	115,159	87,493	8,418	44,101	21,410	215	30,995	5,378	44,218	129,066
Columbia	4,026	695	1,172	51	366	214	2	340	33	471	690
King	2,266,789	435,698	322,915	31,849	200,767	89,738	946	124,387	26,594	190,175	1,020,593
Kitsap	277,673	53,752	55,091	3,929	24,551	12,248	116	18,121	2,657	25,406	70,563
Kittitas	45,189	7,723	8,282	565	4,104	1,950	19	2,820	512	4,918	7,735
Okanogan	43,127	9,688	10,002	708	3,670	1,995	18	3,072	364	7,212	15,750
Pierce	927,380	210,895	138,494	15,416	78,589	36,276	387	51,218	9,993	82,369	342,870
Skagit	131,179	27,297	29,554	1,995	11,397	6,048	55	9,218	1,212	14,795	36,153
Snohomish	840,079	183,512	125,944	13,414	72,095	33,596	350	47,468	8,987	70,524	299,990
Spokane	549,690	117,125	96,054	8,562	47,439	22,875	229	33,174	5,784	65,239	95,766
Stevens	48,229	10,043	12,257	734	4,197	2,377	20	3,714	386	6,201	6,732
Thurston	298,758	61,635	56,583	4,505	26,006	12,866	124	18,928	3,145	25,609	84,077
Whatcom	230,677	42,239	43,622	3,088	20,636	9,950	96	14,519	2,620	25,890	53,056
Yakima	257,001	74,062	37,021	5,414	20,057	9,348	107	13,306	2,600	41,877	154,133

WEST VIRGINIA

American Lung Association in West Virginia

	HIGH OZONE DAYS 2020–2022					HIGH PARTICLE POLLUTION DAYS 2020–2022							
						24-Hour						Annual	
County	Orange	Red	Purple	Wgt. Avg.	Grade	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Berkeley	0	0	0	0.0	A	0	0	0	0	0.0	A	8.2	Pass
Brooke	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	8.5	Pass
Cabell	0	0	0	0.0	A	0	0	0	0	0.0	A	7.1	Pass
Gilmer	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Greenbrier	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Hancock	1	0	0	0.3	B	0	0	0	0	0.0	A	7.8	Pass
Harrison	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	6.9	Pass
Kanawha	0	0	0	0.0	A	0	0	0	0	0.0	A	7.5	Pass
Marion	DNC	DNC	DNC	DNC	DNC	0	0	0	0	0.0	A	INC	INC
Marshall	DNC	DNC	DNC	DNC	DNC	1	0	0	0	0.3	B	8.4	Pass
Monongalia	0	0	0	0.0	A	0	0	0	0	0.0	A	7.0	Pass
Ohio	1	0	0	0.3	B	0	0	0	0	0.0	A	7.5	Pass
Tucker	0	0	0	0.0	A	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Wood	1	0	0	0.3	B	0	0	0	0	0.0	A	7.5	Pass

WEST VIRGINIA

American Lung Association in West Virginia

				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Berkeley	129,490	29,553	19,865	2,782	13,040	13,106	88	12,893	1,329	14,175	24,172
Brooke	21,733	3,745	5,489	353	2,319	2,625	15	2,839	187	2,656	1,066
Cabell	92,730	18,068	18,467	1,701	9,571	9,892	63	10,106	1,005	17,142	9,721
Gilmer	7,325	1,111	1,324	105	801	798	5	789	54	1,314	1,587
Greenbrier	32,435	6,217	8,040	585	3,383	3,843	22	4,162	281	5,783	2,472
Hancock	28,172	5,136	6,873	484	2,984	3,378	19	3,641	244	3,322	1,985
Harrison	64,915	13,665	13,441	1,287	6,644	7,190	44	7,513	602	9,584	4,220
Kanawha	175,515	34,376	38,827	3,236	18,229	19,904	119	20,994	1,667	30,549	22,151
Marion	55,952	10,967	11,372	1,033	5,792	6,093	38	6,281	561	8,380	4,189
Marshall	29,752	5,563	7,173	524	3,130	3,530	20	3,798	244	5,071	1,232
Monongalia	106,869	17,014	14,576	1,602	11,493	10,374	73	9,506	1,381	18,418	13,142
Ohio	41,447	8,069	9,523	760	4,288	4,694	28	4,982	393	5,831	3,542
Tucker	6,568	883	1,833	83	736	859	4	943	54	1,040	198
Wood	83,340	17,275	18,061	1,626	8,565	9,407	56	9,929	759	15,321	4,649

WISCONSIN

American Lung Association in Wisconsin

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Ashland	1	0	0	0.3	B
Brown	3	0	0	1.0	C
Columbia	4	0	0	1.3	C
Dane	3	0	0	1.0	C
Dodge	2	0	0	0.7	B
Door	12	0	0	4.0	F
Eau Claire	0	0	0	0.0	A
Fond du Lac	3	0	0	1.0	C
Forest	0	0	0	0.0	A
Grant	DNC	DNC	DNC	DNC	DNC
Jackson	DNC	DNC	DNC	DNC	DNC
Jefferson	5	0	0	1.7	C
Kenosha	24	2	0	9.0	F
Kewaunee	5	1	0	2.2	D
La Crosse	0	0	0	0.0	A
Manitowoc	10	2	0	4.3	F
Marathon	0	0	0	0.0	A
Milwaukee	15	1	0	5.5	F
Monroe	DNC	DNC	DNC	DNC	DNC
Outagamie	3	0	0	1.0	C
Ozaukee	15	2	0	6.0	F
Racine	17	2	0	6.7	F
Rock	3	0	0	1.0	C
Sauk	1	0	0	0.3	B
Sheboygan	15	3	0	6.5	F
Taylor	0	0	0	0.0	A
Vilas	0	0	0	0.0	A
Walworth	8	0	0	2.7	D
Waukesha	8	0	0	2.7	D

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
County	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Ashland	2	1	0	0	1.2	C	5.6	Pass
Brown	3	0	0	0	1.0	C	7.8	Pass
Columbia	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Dane	0	0	0	0	0.0	A	8.8	Pass
Dodge	0	0	0	0	0.0	A	7.9	Pass
Door	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Eau Claire	4	1	0	0	1.8	C	8.1	Pass
Fond du Lac	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Forest	3	1	0	0	1.5	C	5.9	Pass
Grant	0	0	0	0	0.0	A	8.7	Pass
Jackson	INC	INC	INC	INC	INC	INC	INC	INC
Jefferson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Kenosha	1	0	0	0	0.3	B	7.9	Pass
Kewaunee	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
La Crosse	1	0	0	0	0.3	B	7.9	Pass
Manitowoc	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Marathon	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Milwaukee	2	0	0	0	0.7	B	9.4	Fail
Monroe	INC	INC	INC	INC	INC	INC	INC	INC
Outagamie	3	0	0	0	1.0	C	8.0	Pass
Ozaukee	0	0	0	0	0.0	A	INC	INC
Racine	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Rock	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Sauk	0	0	0	0	0.0	A	7.7	Pass
Sheboygan	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Taylor	2	2	0	0	1.7	C	6.7	Pass
Vilas	3	0	0	0	1.0	C	5.3	Pass
Walworth	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Waukesha	2	0	0	0	0.7	B	9.2	Fail

WISCONSIN

American Lung Association in Wisconsin

		AT-RISK GROUPS									
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Ashland	16,039	3,340	3,496	208	1,381	871	8	1,271	145	2,180	2,950
Brown	270,036	61,272	44,663	3,820	23,065	13,167	140	18,266	2,832	25,824	56,882
Columbia	58,193	11,952	11,472	745	5,066	3,129	30	4,453	531	4,341	5,001
Dane	568,203	110,187	87,071	6,869	50,875	26,606	294	36,295	6,947	57,011	125,205
Dodge	88,282	16,941	16,901	1,056	7,839	4,765	46	6,718	782	7,403	9,847
Door	30,526	4,719	9,922	294	2,726	1,993	16	3,123	225	2,350	2,158
Eau Claire	106,837	20,971	18,488	1,307	9,474	5,109	55	7,161	1,271	11,756	11,731
Fond du Lac	103,836	21,571	20,911	1,345	8,996	5,501	54	7,894	1,011	9,397	12,480
Forest	9,381	1,807	2,332	113	817	556	5	825	75	1,284	1,885
Grant	51,276	10,742	9,549	670	4,451	2,541	27	3,614	499	6,152	2,876
Jackson	20,836	4,440	4,294	277	1,790	1,115	11	1,608	169	2,485	2,937
Jefferson	85,784	16,648	16,286	1,038	7,598	4,554	44	6,425	872	6,817	9,779
Kenosha	167,817	36,087	26,790	2,250	14,600	8,400	87	11,498	1,778	16,116	43,925
Kewaunee	20,623	4,196	4,609	262	1,784	1,150	11	1,680	180	1,539	1,324
La Crosse	120,294	23,108	21,797	1,441	10,701	5,936	62	8,372	1,414	13,327	13,771
Manitowoc	81,172	16,353	18,416	1,019	7,035	4,563	42	6,682	703	8,492	9,111
Marathon	137,958	30,625	26,669	1,909	11,756	7,177	71	10,239	1,300	14,999	17,349
Milwaukee	918,661	216,233	136,828	13,480	77,956	41,990	474	57,395	10,723	157,016	467,935
Monroe	46,109	11,430	8,499	713	3,802	2,316	24	3,293	416	6,209	4,817
Outagamie	192,127	43,697	31,935	2,724	16,397	9,466	99	13,129	1,945	13,737	26,805
Ozaukee	93,009	19,245	20,216	1,200	8,026	5,093	48	7,413	852	5,245	9,249
Racine	195,846	44,229	35,720	2,757	16,663	10,018	101	14,129	1,895	18,463	59,351
Rock	164,060	36,417	29,460	2,270	14,045	8,359	85	11,746	1,640	16,659	30,802
Sauk	65,777	14,439	13,297	900	5,607	3,462	34	4,985	614	6,112	6,790
Sheboygan	117,841	25,004	23,349	1,559	10,160	6,226	61	8,905	1,094	10,828	21,121
Taylor	19,975	4,552	4,258	284	1,678	1,092	10	1,586	165	2,249	945
Vilas	23,763	3,843	7,538	240	2,109	1,573	12	2,441	151	2,456	3,394
Walworth	105,380	20,220	21,075	1,260	9,328	5,618	55	8,024	1,054	10,286	15,794
Waukesha	410,434	84,982	84,430	5,298	35,551	22,267	212	31,996	3,841	21,345	54,715

WYOMING

American Lung Association in Wyoming

HIGH OZONE DAYS 2020–2022

County	Orange	Red	Purple	Wgt. Avg.	Grade
Albany	12	1	0	4.5	F
Big Horn	3	0	0	1.0	C
Campbell	11	0	0	3.7	F
Converse	7	0	0	2.3	D
Fremont	8	0	0	2.7	D
Johnson	7	0	0	2.3	D
Laramie	10	0	0	3.3	F
Lincoln	INC	INC	INC	INC	INC
Natrona	6	0	0	2.0	C
Park	DNC	DNC	DNC	DNC	DNC
Sheridan	DNC	DNC	DNC	DNC	DNC
Sublette	10	0	0	3.3	F
Sweetwater	6	0	0	2.0	C
Teton	3	0	0	1.0	C
Uinta	INC	INC	INC	INC	INC
Weston	1	0	0	0.3	B

HIGH PARTICLE POLLUTION DAYS 2020–2022

	24-Hour						Annual	
	Orange	Red	Purple	Maroon	Wgt. Avg.	Grade	Design Value	Pass/ Fail
Albany	4	1	0	0	1.8	C	INC	INC
Big Horn	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Campbell	6	0	0	0	2.0	C	INC	INC
Converse	INC	INC	INC	INC	INC	INC	INC	INC
Fremont	6	1	0	0	2.5	D	2.0	Pass
Johnson	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Laramie	4	2	0	0	2.3	D	4.9	Pass
Lincoln	INC	INC	INC	INC	INC	INC	INC	INC
Natrona	5	0	0	0	1.7	C	3.8	Pass
Park	2	0	0	0	0.7	B	4.9	Pass
Sheridan	0	0	0	0	0.0	A	INC	INC
Sublette	4	1	0	0	1.8	C	3.6	Pass
Sweetwater	1	0	0	0	0.3	B	INC	INC
Teton	17	5	0	0	8.2	F	4.5	Pass
Uinta	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Weston	DNC	DNC	DNC	DNC	DNC	DNC	DNC	DNC

WYOMING

American Lung Association in Wyoming

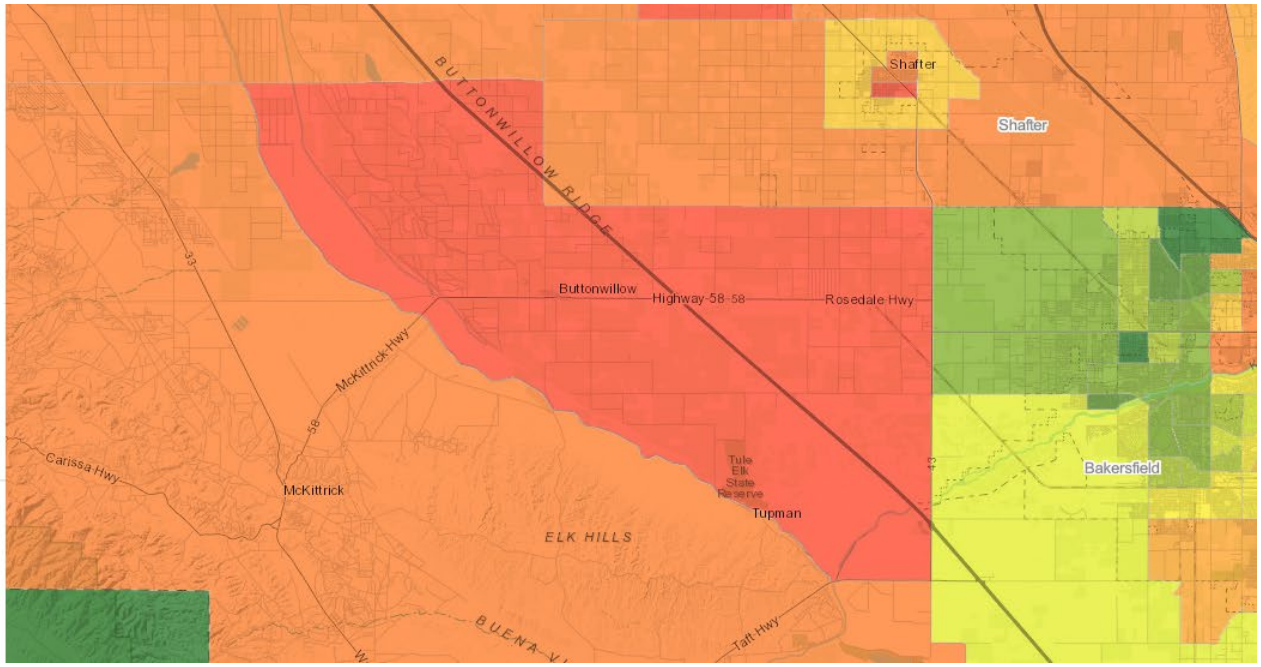
				AT-RISK GROUPS							
				Lung Diseases							
County	Total Population	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	CV Disease	Pregnancies	Poverty	People of Color
Albany	38,031	5,781	5,055	388	3,590	1,674	14	1,958	552	5,927	6,761
Big Horn	11,855	2,834	2,597	190	934	688	4	845	106	1,658	1,663
Campbell	47,058	12,397	6,203	833	3,747	2,208	17	2,563	502	3,998	6,386
Converse	13,786	3,318	2,560	223	1,099	761	5	914	134	1,653	1,673
Fremont	39,472	9,654	7,913	648	3,119	2,182	14	2,659	374	6,508	12,105
Johnson	8,730	1,794	2,362	121	702	573	3	718	73	741	900
Laramie	100,723	22,434	17,547	1,507	8,339	5,298	36	6,336	1,058	10,114	22,688
Lincoln	20,660	5,198	4,073	349	1,611	1,160	7	1,405	187	1,677	1,806
Natrona	79,601	18,644	13,729	1,252	6,486	4,150	29	4,963	850	8,480	11,446
Park	30,518	6,211	7,666	417	2,492	1,917	11	2,386	279	3,211	3,027
Sheridan	32,096	6,623	7,405	445	2,635	1,948	12	2,398	304	2,981	2,903
Sublette	8,763	1,865	2,093	125	708	544	3	671	78	658	978
Sweetwater	41,345	10,228	6,174	687	3,342	2,039	15	2,398	449	5,039	8,749
Teton	23,287	3,989	4,096	268	2,061	1,296	8	1,537	265	1,212	4,691
Uinta	20,712	5,559	3,479	373	1,607	1,051	7	1,257	209	2,207	2,776
Weston	6,860	1,304	1,570	88	576	424	2	519	54	725	784

Legend

CalEnviroScreen 4.0 Results

- > 90 - 100 (Highest Scores)
- > 80 - 90
- > 70 - 80
- > 60 - 70
- > 50 - 60
- > 40 - 50
- > 30 - 40
- > 20 - 30
- > 10 - 20
- 0 - 10 (Lowest Scores)

CalEnviroScreen 4.0 High Pollution, Low Population



Census Tract: 6029003700 (Population: 3,415)

The results for each indicator range from 0-100 and represent the percentile ranking of census tract 6029003700 relative to other census tracts.

Overall Percentiles	
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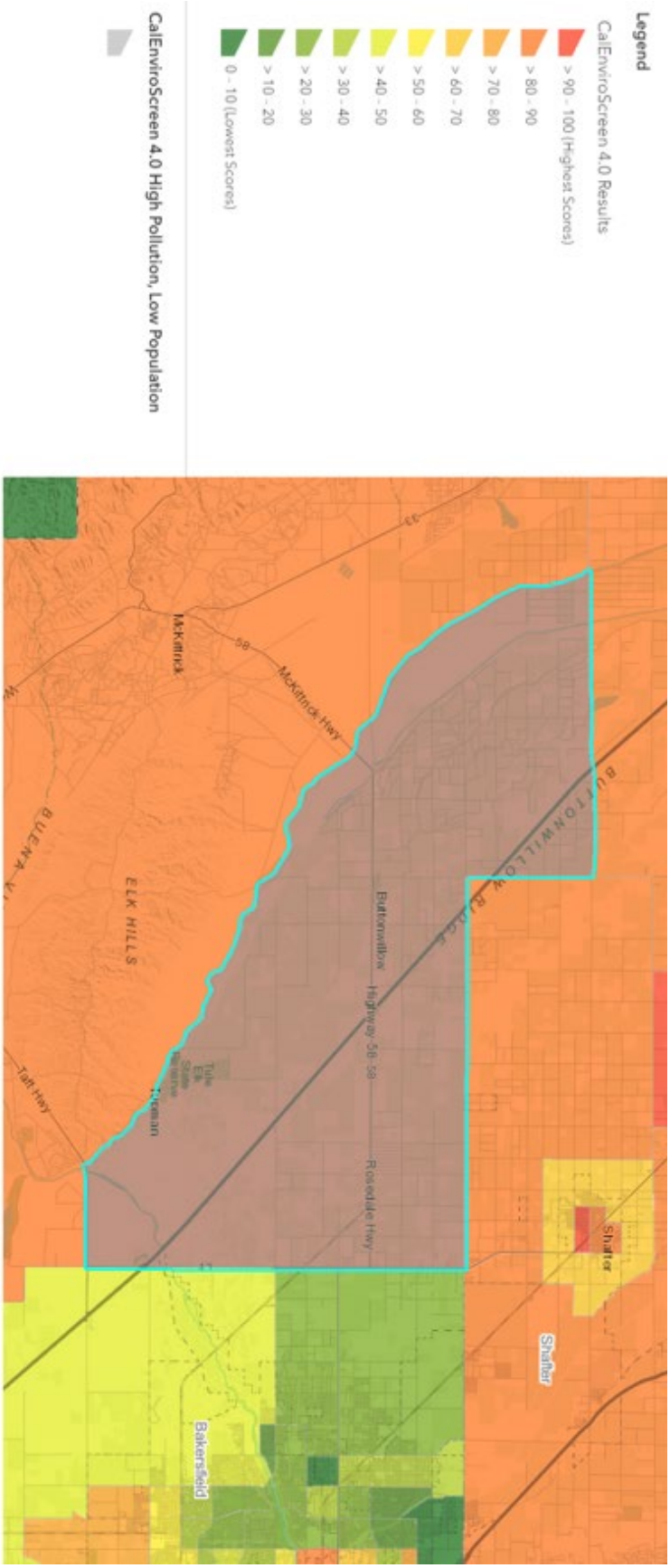
Race/Ethnicity Profiles

Hover your mouse over the pie chart segment to see the race/ethnicity in percentages and approximate counts.

Age Profiles

Hover your mouse over the pie chart segment to see the age characteristics in percentages and approximate counts.



San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING

Guidance for Assessing and Mitigating Air Quality Impacts

March 19, 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Material
ADT	Average Daily Trips
APCD	San Joaquin Valley Air Pollution Control District
APS	Auxiliary Power System
ARB	California Air Resources Board
ATCM	Air Toxics Control Measure
BACT	Best Available Control Technology for Construction Equipment
CAAA	1990 Clean Air Act Amendments
CAAQS	California Ambient Air Quality Standards
CAMP	Construction Activity Management Plan
CAP	Clean Air Plan for San Luis Obispo County
CAPCOA	California Air Pollution Control officers Associations
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
DEIR	Draft Environmental Impact Report
DOC	Diesel Oxidation Catalyst
DPM	Diesel Particulate Matter
EIR	Environmental Impact Report
EPA	United States Environmental Protection Agency
GAMAQI	Guidance for Assessing and Mitigating Air Quality Impacts
GHG	Greenhouse Gases
HRA	Health Risk Assessment
ISR	Indirect Source Review
ITE	Institute of Transportation Engineers
LNG	Liquid Natural Gas
µ/m3	Micrograms per Cubic Meter
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standard for Hazardous Air Pollutants
NO	Nitrogen Oxide
NOA	Naturally Occurring Asbestos
NOP	Notice of Preparation
NOx	Oxides of Nitrogen
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter (2.5µm and smaller)
PM_{10}	Particulate Matter (10µm in size and smaller)
ROG	Reactive Organic Gases
SJVAPCD	San Joaquin Valley Air Pollution Control District
tpy	Tons per Year
TAC	Toxic Air Contaminant
Mm	Micrometer [micron]
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds

GLOSSARY

Area Sources: A collection of similar emission units within a geographic area (i.e., a County) that are small and numerous and may not have been inventoried as specific point, mobile, or biogenic sources. The California Air Resources Board (CARB) has grouped these individual sources with other like sources into area source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology.

Area-Wide Sources: Sources of pollution where the emissions are spread over a wide area, such as consumer products, fireplaces, road dust and farming operations. Area-wide sources do not include mobile sources or stationary sources.

Climate Change: Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other elements of the earth's climate system. An ever-increasing body of scientific research attributes these climatological changes to greenhouse gases (GHGs), particularly those generated from the human production and use of fossil fuels.

Commenting Agency: See “Trustee Agency”.

Criteria Pollutant: The EPA has identified ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur oxides, and lead as criteria pollutants. The EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based guidelines (criteria) for setting permissible levels.

Cumulative Impacts: Refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. (a) The individual effects may be changes resulting from a single project or a number of separate projects. (b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects.

Development Project: Refers generally to a land use development project such as a residential project, a commercial project, an industrial project, or a transportation project.

Discretionary Approval: A governmental decision in which an agency can use its judgment in deciding whether and how to carry out or approve a project.

Discretionary Project: A project which requires the exercise of judgment or deliberation when the public agency or body decides to approve or disapprove a particular activity, as distinguished from situations where the public agency or body merely has to determine whether there has been conformity with applicable statutes, ordinances, or regulations.

Effects: Direct or primary environmental changes that are caused by the project and occur at the same time and place, and indirect or secondary environmental changes that are caused by the project and are later in time or farther removed in distance, but are still reasonably foreseeable.

Fugitive Dust: Small particles which are entrained and suspended into the air by the wind or external disturbances. Fugitive dust typically originates over an area and not a specific point. Typical sources include unpaved or paved roads, construction sites, mining operations, disturbed soil and tilled agricultural areas.

Hazardous Air Pollutants (HAPs): HAPs are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects, or birth defects, or adverse environmental effects. The EPA, in the Clean Air Act lists 189 HAPs.

Impacts: See “Effects”.

Lead Agency: The public agency with the principal responsibility for carrying out or approving a project subject to CEQA.

Ministerial Approval: A governmental decision involving little or no personal judgment by the public official as to the wisdom or manner of carrying out the project. The public official merely applies the law to the facts as presented but uses no special discretion or judgment in reaching a decision.

Mitigation: Feasible alternatives or measures that would substantially lessen any significant effects that the project would have on the environment. Mitigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments [CCR §15126.4(a)(2)]. Mitigation includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments.

Mobile Sources: Sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes. (See also stationary sources).

Offsets: Emission reductions recognized by the District in the form of Emission Reduction Credits that are used in accordance with the provisions of District Rule 2301 (Emission

Reduction Credit Banking), or other actual emission reductions that may be used to mitigate an emission increase.

See District Rule 2301 at
www.valleyair.org/rules/1ruleslist.htm

Ozone Precursors: Gaseous compounds needed to form ozone by the process of photochemistry. Photochemical air pollution (primarily ozone) is produced by the atmospheric reaction of organic substances, such as reactive organic gases (ROG) and nitrogen dioxide (NO2) under the influence of sunlight.

$$NO_2 + ROG + Sunlight \rightarrow O_3$$

During the summer, in areas with high emissions and high ozone concentrations, ozone concentrations are very dependent on the amount of solar radiation. Ozone levels typically peak in the late afternoon, at the end of the longest period of daily solar radiation. After the sun goes down, the chemical reaction between nitrous oxide and ozone begins to dominate and ozone usually decreases.

$$O_3 + NO \rightarrow NO_2 + O_2$$

In some remote rural locations away from emission sources, ozone concentrations can remain high overnight because there are no nitrogen oxide (NO) sources to react with the existing ozone. Ozone precursors are typically considered to be the combination of ROG and NOx.

Particulate Matter: Small particles that become airborne and have the potential to cause adverse health impacts. There are three general size components: 1) PM or Total Suspended Particulate (TSP) which includes all airborne particles regardless of size or source; 2) PM_{10} which includes airborne particles 10µm [micrometers] in size and smaller; and 3) $PM_{2.5}$ or fine airborne particles 2.5µm [micrometers] and smaller.

Project: The whole of an action, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and that is any of the following:

(1) An activity directly undertaken by any public agency including but not limited to public works construction and related activities clearing or grading of land, improvements to existing public structures, enactment and amendment of zoning ordinances, and the adoption and amendment of local General Plans or elements thereof pursuant to Government Code Sections 65100–65700.
(2) An activity undertaken by a person which is supported in whole or in part through public agency contacts, grants, subsidies, loans, or other forms of assistance from one or more public agencies.
(3) An activity involving the issuance to a person of a lease, permit, license, certificate, or other entitlement for use by one or more public agencies.

Responsible Agency: A public agency, other than the Lead Agency, that has responsibility for carrying out or approving a project subject to CEQA.

Sensitive Receptors: People that have an increased sensitivity to air pollution or environmental contaminants. Sensitive receptor locations include schools, parks and playgrounds, day care centers, nursing homes, hospitals, and residential dwelling unit(s). The location of sensitive receptors is needed to assess toxic impacts on public health.

Significant effect on the environment: means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance.

Stationary Sources: Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit air pollutants. (See also Mobile Sources).

Threshold of Significance: An identifiable quantitative, qualitative or performance level of a particular environmental effect. Non-compliance with a threshold of significance means the effect will normally be determined to be significant by the Lead Agency. Compliance with a threshold of significance means the effect normally will be determined to be less than significant (CCR §15064.7).

Toxic Air Contaminants (TACs): Toxic pollutants in California are identified as toxic air contaminates (TACs) and are listed in the AB2588 Air Toxic “Hot Spots” and Assessment Act’s “Emissions Inventory Criteria and Guideline Regulation“. A subset of these pollutants has been listed by the Office of Environmental Health Hazard Assessment (OEHHA) as having acute, chronic, and/or carcinogenic effects, as defined by California Health and Safety Code (CH&SC) §39655. Toxic pollutants used for modeling should not be confused with the 189 Hazardous Air Pollutants (HAP) listed by EPA in the Clean Air Act. The California TAC list has ~700 plus pollutants listed.

Trustee Agency: An agency that has “jurisdiction by law” over a particular natural resource, but does not have discretionary approval power over a project subject to CEQA.

CHAPTER 1

INTRODUCTION

1.1 Purpose of this Guide

The California Environmental Quality Act (CEQA) requires environmental impacts of a proposed project be identified, assessed, and avoided or mitigated as feasible, if these impacts are significant. This document, *Guidance for Assessing and Mitigating Air Quality Impacts (GAMAQI*), provides technical guidance for the review of air quality impacts from proposed projects within the boundaries of the San Joaquin Valley Unified Air Pollution Control District (District). The guide provides District staff uniform procedures for assessing potential air quality impacts of proposed projects and for preparing the air quality section of environmental documents. The guide is intended to be a user friendly advisory document for use by other agencies, consultants, and project proponents.

1.2 Using This Guide

One purpose of CEQA is to publicly disclose all environmental effects of a project, so the public is informed, and decision-makers make decisions based on a thorough understanding of a project's impacts. Information such as environmental setting, existing air quality conditions, regulatory setting, etc. is important in fulfilling this "spirit" of CEQA. The public deserves to understand the air quality implications of all projects approved in this air basin. This guide presents information which is not subject to frequent revision, such as general guidance for assessing and mitigating project-related impacts on air quality, information on air quality conditions within the San Joaquin Valley Air Basin, District attainment status, and District recommended procedures relating to CEQA.

The structure of this document has been established according to the logical process steps to be addressed when preparing a project-specific environmental document and the information provided in this document can be used as narrative by a third party when preparing an environmental review document.

Information which is subject to more frequent revision, such as methodologies and models to assess project-related impacts on air quality, is contained in separate technical guidance documents available on the District's website at www.valleyair.org/transportation/ceqa_guidance_documents.htm

The District will prepare additional technical guidance and update existing documents as approaches and methodologies for characterizing project-related impacts on air quality become available. Users of this Guide are responsible for ensuring that they are using the most current technical guides when preparing environmental assessments. Technical guides and resources are available on the District's website at www.valleyair.org/ceqa or can be obtained by contacting the District's Central Region office at:

Phone: (559) 230-6000
e-mail: CEQA: ceqa@valleyair.org
Modeling: hramodeler@valleyair.org
Mail: San Joaquin Valley Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno, CA 93726

CHAPTER 2

SAN JOAQUIN VALLEY AIR BASIN

2.1 Introduction

The San Joaquin Valley Air Basin (SJVAB) consists of eight counties: Fresno, Kern (western and central), Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare (*Figure 1 – San Joaquin Valley Air Pollution Control District Boundaries*). Cumulatively, these counties represent approximately 16 percent of California's geographic area, making the SJVAB the second largest air quality basin (based on area) as delineated by the California Air Resources Board (ARB). Air pollution in the SJVAB can be attributed to both human-related (anthropogenic) and natural (non-anthropogenic) activities that produce emissions. Air pollution from significant anthropogenic activities in the SJVAB includes a variety of industrial-based sources as well as on- and off-road mobile sources. Activities that tend to increase mobile activity include increases in population, increases in general traffic activity (including automobiles, trucks, aircraft, and rail), urban sprawl (which will increase commuter driving distances), and general local land management practices as they pertain to modes of commuter transportation. These sources, coupled with geographical and meteorological conditions unique to the area, stimulate the formation of unhealthy air.

Figure 1: San Joaquin Valley Air Pollution Control District Boundaries

The San Joaquin Valley's (SJV) topography and meteorology provide ideal conditions for trapping air pollution for long periods of time and producing harmful levels of air pollutants, including ozone and particulate matter. Low precipitation levels, cloudless days, high temperatures, and light winds during the summer in the SJV are conducive to high ozone levels resulting from the photochemical reaction of nitrogen oxides (NOx) and volatile organic compounds (VOC). Inversion layers in the atmosphere during the winter can trap emissions of directly emitted $PM_{2.5}$ (particulate matter that is 2.5 microns or less in diameter) and $PM_{2.5}$ precursors (such as NOx and sulfur dioxide (SO2)) within the SJV for several days, accumulating to unhealthy levels.

The region also houses the State's major arteries for goods and people movement, I-5 to the west and CA Highway 99 through the Central Valley (Valley), thereby attracting a large volume of vehicular traffic. Another compounding factor is the region's historically high rate of population growth compared to other regions of California. Increased population

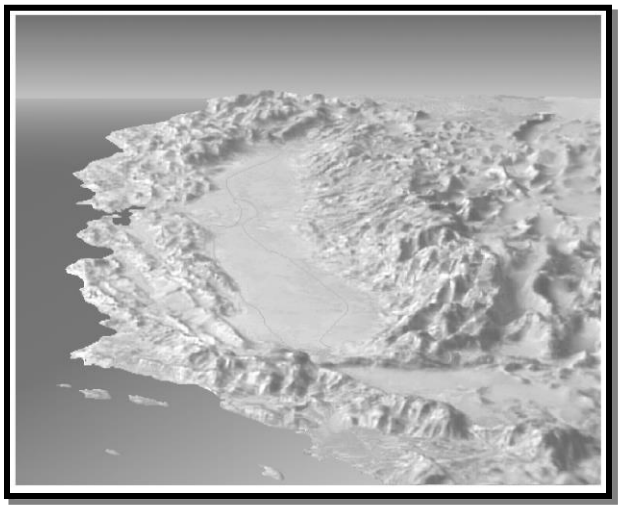
typically results in an even greater increase in vehicle activity and more consumer product use, leading to increased emissions of air pollution, including NOx. In fact, mobile sources account for about 80% of the Valley's total NOx emissions inventory. Since NOx is a significant precursor for both ozone and $PM_{2.5}$, reducing NOx from mobile sources is critical for progressing the Valley towards attainment of ozone and $PM_{2.5}$ standards.

The geography of mountainous areas to the east, west and south, in combination with long summers and relatively short winters, contributes to local climate episodes that prevent the dispersion of pollutants. Transport, as affected by wind flows and inversions, also plays a role in the creation of air pollution.

2.2 Topography

The climate of the SJV is modified by topography. This creates climatic conditions that are particularly conducive to air pollution formation. Figure 2 (*Aerial View of the San Joaquin Valley Air Basin*) provides an aerial view of the SJV illustrating its bowl shape. As shown, the SJV is surrounded by mountains on three sides and open to the Sacramento Valley and the San Francisco Bay Area to the north.

Figure 2: Aerial View of the San Joaquin Valley Air Basin



The SJVAB is the southern half of California's Central Valley and is approximately 250 miles long and averages 35 miles wide. The SJV is bordered by the Sierra Nevada Mountains in the east (8,000 to 14,491 feet in elevation), the Coast Ranges in the west (averaging 3,000 feet in elevation), and the Tehachapi mountains in the south (6,000 to 7,981 feet in elevation). There is a slight downward elevation gradient from Bakersfield in the southeast end (elevation 408 feet) to sea level at the northwest end where the valley opens to the San Francisco Bay at the Carquinez Straits. At its northern end is the Sacramento Valley, which comprises the northern half of California's Central Valley. The bowl shaped topography inhibits movement of pollutants out of the valley.

2.3 Climate

The SJV is in a Mediterranean Climate Zone. Mediterranean Climates Zones occur on the west coast of continents at 30 to 40 degrees latitude and are influenced by a subtropical high-pressure cell most of the year. Mediterranean Climates are characterized by sparse rainfall, which occurs mainly in winter. Summers are hot and dry. Summertime maximum temperatures often exceed 100 degrees F in the Valley.

The subtropical high-pressure cell is strongest during spring, summer and fall and produces subsiding air, which can result in temperature inversions in the Valley. A temperature inversion can act like a lid, inhibiting vertical mixing of the air mass at the surface. Any emissions of pollutants can be trapped below the inversion. Most of the surrounding mountains are above the normal height of summer inversions (1,500-3,000 feet).

Winter-time high pressure events can often last many weeks with surface temperatures often lowering into the thirties degree Fahrenheit. During these events, fog can be present and inversions are extremely strong. These wintertime inversions can inhibit vertical mixing of pollutants to a few hundred feet.

2.4 Wind Patterns

Wind speed and direction play an important role in dispersion and transport of air pollutants. Wind at the surface and aloft can disperse pollution by mixing and by transporting the pollution to other locations.

Especially in summer, winds in the Valley most frequently blow from the northwesterly direction. The region's topographic features restrict air movement and channel the air mass towards the southeastern end of the Valley. Marine air can flow into the basin from the San Joaquin River Delta and over Altamont Pass and Pacheco Pass, where it can flow along the axis of the valley, over the Tehachapi pass, into the Southeast Desert Air Basin. The Coastal Range is a barrier to air movement to the west and the high Sierra Nevada range is a significant barrier to the east (the highest peaks in the southern Sierra Nevada reach

almost halfway through the Earth's atmosphere). Many days in the winter are marked by stagnation events where winds are very weak. Transport of pollutants during winter can be very limited. A secondary but significant summer wind pattern is from the southeasterly direction and can be associated with nighttime drainage winds, prefrontal conditions and summer monsoons.

Two significant diurnal wind cycles that occur frequently in the Valley are the sea breeze and mountain-valley upslope and drainage flows. The sea breeze can accentuate the northwest wind flow, especially on summer afternoons. Nighttime drainage flows can accentuate the southeast movement of air down the valley. In the mountains during periods of weak synoptic scale winds, winds tend to be upslope during the day and downslope at night. Nighttime and drainage flows are especially pronounced during the winter when flow from the easterly direction is enhanced by nighttime cooling in the Sierra Nevada. Eddies can form in the valley wind flow and can re-circulate a polluted air mass for an extended period. Such an eddy occurs in the Fresno area during both winter and summer.

2.5 Temperature, Sunlight and Ozone Production

Solar radiation and temperature are particularly important in the chemistry of ozone formation. The SJVAB averages over 260 sunny days per year. Photochemical air pollution (primarily ozone) is produced by the atmospheric reaction of organic substances (such as volatile organic compounds) and nitrogen dioxide under the influence of sunlight. Ozone concentrations are very dependent on the amount of solar radiation, especially during late spring, summer and early fall. Ozone levels typically peak in the afternoon. After the sun goes down, the chemical reaction between nitrous oxide and ozone begins to dominate. This reaction tends to scavenge the ozone in the metropolitan areas through the early morning hours, resulting in the lowest ozone levels, possibly reaching zero at sunrise in areas with high nitrogen oxides emissions. At sunrise, nitrogen oxides tend to peak, partly due to low levels of ozone at this time and also due to the morning commuter vehicle emissions of nitrogen oxides.

Generally, the higher the temperature, the more ozone formed, since reaction rates increase with temperature. However, extremely hot temperatures can “lift” or “break” the inversion layer. Typically, if the inversion layer doesn’t lift to allow the buildup of contaminants to be dispersed, the ozone levels will peak in the late afternoon. If the inversion layer breaks and the resultant afternoon winds occur, the ozone will peak in the early afternoon and decrease in the late afternoon as the contaminants are dispersed or transported out of the SJVAB.

Ozone levels are low during winter periods when there is much less sunlight to drive the photochemical reaction.

2.6 Temperature Inversions

The vertical dispersion of air pollutants in the SJV can be limited by persistent temperature inversions. Air temperature in the lowest layer of the atmosphere typically decreases with altitude. A reversal of this atmospheric state, where the air temperature increases with height, is termed an inversion. The height of the base of the inversion is known as the "mixing height". This is the level to which pollutants can mix vertically. Mixing of air is minimized above and below the inversion base. The inversion base represents an abrupt density change where little air movement occurs.

Inversion layers are significant in determining pollutant concentrations. Concentration levels can be related to the amount of mixing space below the inversion. Temperature inversions that occur on the summer days are usually encountered 2,000 to 2,500 feet above the valley floor. In winter months, overnight inversions occur 500 to 1,500 feet above the valley floor.

2.7 Precipitation, Humidity and Fog

Precipitation and fog may reduce or limit some pollutant concentrations. Ozone needs sunlight for its formation, and clouds and fog can block the required solar radiation.
Wet fogs can cleanse the air during winter as moisture collects on particles and deposits them on the ground. Atmospheric moisture can also increase pollution levels. In fogs with less water content, the moisture acts to form secondary ammonium nitrate particulate matter. This ammonium nitrate is part of the Valleys $PM_{2.5}$ and PM_{10} problem.

The winds and unstable air conditions experienced during the passage of winter storms result in periods of low pollutant concentrations and excellent visibility. Between winter storms, high pressure and light winds allow cold moist air to pool on the SJV floor. This creates strong low-level temperature inversions and very stable air conditions, which can lead to Tule fog. Wintertime conditions favorable to fog formation are also conditions favorable to high concentrations of $PM_{2.5}$ and PM_{10}.

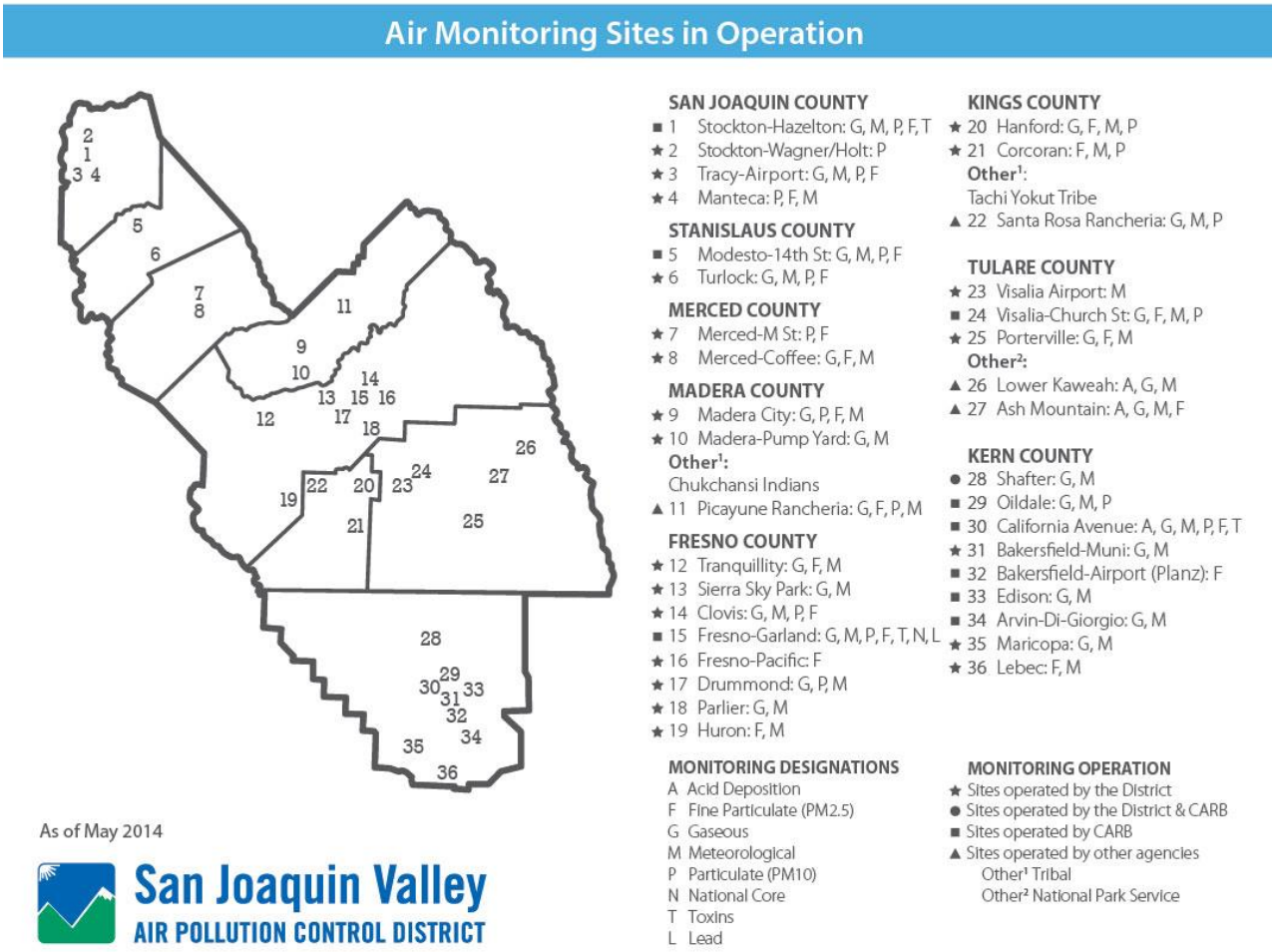
2.8 Ambient Air Quality Monitoring Sites

The District, the ARB, the U.S. National Park Service, and the Santa Rosa Rancheria in Lemoore operate an extensive air monitoring network to measure progress toward attainment of the NAAQS. Air quality monitoring networks are designed to monitor areas

with: high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Some monitors are operated specifically for use in determining attainment status, while others are operated for other purposes, such as for generating daily air quality forecasts. In total, the District utilizes ozone and PM data from over 60 monitors operated at 29 sites in the Valley. All monitors must comply with the pollutant standard for the San Joaquin Valley to be considered as attainment for that standard. Figure 3 (*District Ambient Air Quality Monitoring Sites*) identifies District air monitoring sites and the pollutants monitored at each site, as of this writing.

The District periodically updates this map at
www.valleyair.org/aqinfo/MonitoringSites.htm

Figure 3: District Ambient Air Quality Monitoring Sites



An Environmental Impact Report prepared for projects with the potential to have a significant impact on air quality within the San Joaquin Valley should include a discussion of local air quality conditions. To assist Lead Agencies, the District has developed the technical guide (*Emissions Inventory Data Guide)*, which provides a step-by-step process for identifying and compiling relevant ambient air monitoring data.

The Emissions Inventory Data Guide is available on the District's website at http://www.valleyair.org/transportation/Guidelines_for_General_Plans.htm

CHAPTER 3

AIR POLLUTANTS AND ATTAINMENT STATUS

3.1 Introduction

A substance in the air that can cause harm to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, carbon monoxide gas from a motor vehicle exhaust, or sulfur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone — one of the many secondary pollutants that make up photochemical smog. Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

3.2 Federal and State Ambient Air Quality Standards

The Clean Air Act (CAA) requires the Federal Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six (6) air pollutants commonly found all over the United States. These pollutants can be detrimental to human health and the environment.

The EPA designates areas with air quality not meeting Federal standards as “nonattainment”. The Federal CAA further classifies nonattainment areas based on the severity of the nonattainment problem, with marginal, moderate, serious, severe, and extreme nonattainment classifications for ozone. Nonattainment classifications for PM range from marginal to serious.

The Federal CAA requires areas with air quality violating the NAAQS to prepare an air quality control plan referred to as the State Implementation Plan (SIP). The SIP contains the strategies and control measures that states will use to attain the NAAQS. The Federal CAA amendments of 1990 require states containing areas that violate the NAAQS to revise their SIP to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, rules, and regulations of Air Basins as reported by the agencies with jurisdiction over them. The EPA reviews SIPs to determine if they conform to the mandates of the Federal CAA amendments and will achieve air quality goals when implemented. If the EPA determines a SIP to be inadequate, it may prepare a Federal Implementation Plan (FIP) for the nonattainment area and impose additional control measures.

States may also establish their own ambient air quality standards, provided the State standards are at least as stringent as the NAAQS. California has established California Ambient Air Quality Standards (CAAQS) pursuant to Health and Safety Code Section 39606(b) and its predecessor statutes. The ARB is the agency responsible for

coordination and oversight of State and local air pollution control programs in California and for implementing the California Clean Air Act (CCAA) of 1988. The CCAA classifies ozone nonattainment areas as moderate, serious, severe, and extreme based on severity of violations of State ambient air quality standards. For each class, the CCAA specifies air quality management strategies that must be adopted. For all nonattainment categories, attainment plans are required to demonstrate a five-percent-per-year reduction in nonattainment air pollutants or their precursors, averaged every consecutive three-year period, unless an approved alternative measure of progress is developed. Air Districts with air quality that is in violation of CAAQS are required to prepare an air quality attainment plan that lays out a program to attain the CCAA mandates.

3.3 Criteria Pollutants

The Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These pollutants can harm individual health and the environment, and cause property damage. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats. EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. The set of limits based on human health is called primary standards. Another set of limits intended to prevent environmental and property damage is called secondary standards.

The following section summarizes the pollutants of greatest importance in the San Joaquin Valley. For each air pollutant it provides a description of the physical properties, health and other effects, sources, and the extent of the problems. These pollutants are identified in District Rule 1020 (Definitions) and District Rule 2201 (New and Modified Stationary Source Review Rule) as “Affected Pollutants”.

In general, primary pollutants are directly emitted into the atmosphere, and secondary pollutants are formed by chemical reactions in the atmosphere. Air pollution in the Valley results from emissions generated in the Valley as well as from emissions and secondary pollutants transported into the Valley. It is thought that the bulk of the Valley’s summer and winter air pollution is caused by locally generated emissions. Due to the Valley’s meteorology, topography, and the chemical composition of the air pollutants, oxides of nitrogen (NOx) is the primary culprit in the formation of both ozone and $PM_{2.5}$.

Ozone: (O_3), a reactive gas consisting of three atoms of oxygen. In the troposphere, it is a product of the photochemical process involving the sun's energy. It is a secondary pollutant that is formed when nitrogen oxides (NO_x) and volatile organic compounds (VOC) react in the presence of sunlight. Ozone at the earth's surface causes numerous adverse health effects and is a criteria pollutant. It is a major component of smog. In the

stratosphere, ozone exists naturally and shields Earth from harmful incoming ultraviolet radiation.

High concentrations of ground level ozone can adversely affect the human respiratory system and aggravate cardiovascular disease and many respiratory ailments. Ozone also damages natural ecosystems such as forests and foothill communities, agricultural crops, and some man-made materials, such as rubber, paint, and plastics.

Reactive Organic Gas: (ROG) is a reactive chemical gas, composed of hydrocarbon compounds that may contribute to the formation of smog by their involvement in atmospheric chemical reactions. No separate health standards exist for ROG as a group. Because some compounds that make up ROG are also toxic, like the carcinogen benzene, they are often evaluated as part of a toxic risk assessment.

Total Organic Gases: (TOG) includes all of the ROGs, in addition to low reactivity organic compounds like methane and acetone. ROGs and volatile organic compounds (VOC) are subsets of TOG.

Volatile Organic Compounds: (VOC) are hydrocarbon compounds that exist in the ambient air. VOCs contribute to the formation of smog and/or may themselves be toxic. VOC emissions are a major precursor to the formation of ozone. VOCs often have an odor, and some examples include gasoline, alcohol, and the solvents used in paints.

Oxides of Nitrogen: (NOx) is a family of gaseous nitrogen compounds and is a precursor to the formation of ozone and particulate matter. The major component of NOx, nitrogen dioxide (NO2), is a reddish-brown gas that is toxic at high concentrations. NOx results primarily from the combustion of fossil fuels under high temperature and pressure. On-road and off-road motor vehicles and fuel combustion are the major sources of this air pollutant.

Particulate Matter: (PM), also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into three categories based on their size and where they are deposited:

- "Inhalable coarse particles ($PM_{2.5-10}$)," such as those found near roadways and dusty industries, are between 2.5 and 10 micrometers in diameter. $PM_{2.5-10}$ is deposited in the thoracic region of the lungs.
- "Fine particles ($PM_{2.5}$)," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from

sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air. They penetrate deeply into the thoracic and alveolar regions of the lungs.

- "Ultrafine particles (UFP)," are very small particles less than 0.1 micrometers in diameter largely resulting from the combustion of fossils fuels, meat, wood and other hydrocarbons. While UFP mass is a small portion of $PM_{2.5}$, its high surface area, deep lung penetration, and transfer into the bloodstream can result in disproportionate health impacts relative to their mass.

PM_{10}, $PM_{2.5}$, and UFP include primary pollutants (emitted directly to the atmosphere) as well as secondary pollutants (formed in the atmosphere by chemical reactions among precursors). Generally speaking, $PM_{2.5}$ and UFP are emitted by combustion sources like vehicles, power generation, industrial processes, and wood burning, while PM_{10} sources include these same sources plus roads and farming activities. Fugitive windblown dust and other area sources also represent a source of airborne dust in the Valley.

Acute and chronic health effects associated with high particulate levels include the aggravation of chronic respiratory diseases, heart and lung disease, coughing, bronchitis, and respiratory illnesses in children.

Carbon Monoxide: (CO) is an odorless, colorless gas that is highly toxic. It is formed by the incomplete combustion of fuels and is emitted directly into the air (unlike ozone). The main source of CO in the San Joaquin Valley is on-road motor vehicles. Other CO sources in the Valley include other mobile sources, miscellaneous processes, and fuel combustion from stationary sources.

Because of the local nature of CO problems, ARB and EPA designate urban areas as CO nonattainment areas instead of the entire basin as with ozone and PM_{10}. Motor vehicles are by far the largest source of CO emissions. Emissions from motor vehicles have been declining since 1985, despite increases in vehicle miles traveled (VMT), with the introduction of new automotive emission controls and fleet turnover.

Sulfur Dioxide: (SO_2) is a colorless, irritating gas with a "rotten egg" smell formed primarily by the combustion of sulfur-containing fossil fuels. The SJVAB is in attainment of both the Federal and California standards for SO_2. However, like airborne NOx, suspended SOx particles contribute to the poor visibility that sometimes occurs in the Valley. These SOx particles can also combine with other pollutants to form $PM_{2.5}$. The prevalence of low-sulfur fuel use in the Valley has minimized problems from this pollutant.

Lead: (Pb) is a metal that is a natural constituent of air, water, and the biosphere. Lead is neither created nor destroyed in the environment, so it essentially persists forever. The health effects of lead poisoning include loss of appetite, weakness, apathy, and miscarriage; it can also cause lesions of the neuromuscular system, circulatory system, brain, and gastrointestinal tract.

Gasoline-powered automobile engines were a major source of airborne lead through the use of leaded fuels. The use of leaded fuel has been mostly phased out, with the result that ambient concentrations of lead have dropped dramatically. Lead concentrations were last systematically measured in the SJVAB in 1989, when the average concentrations were approximately five percent of the State lead standard. Lead levels remain well below applicable standards, and the SJVAB is designated in attainment for lead.

3.4 Other Pollutants

The State of California has established air quality standards for some pollutants not addressed by Federal standards. The California Air Resources Board (ARB) has established State standards for hydrogen sulfide, sulfates, vinyl chloride, and visibility reducing particles. The following section summarizes these pollutants and provides a description of the pollutants' physical properties, health and other effects, sources, and the extent of the problems.

Hydrogen Sulfide: (H_2S) is associated with geothermal activity, oil and gas production, refining, sewage treatment plants, and confined animal feeding operations. Hydrogen sulfide is extremely hazardous in high concentrations; especially in enclosed spaces (800 ppm can cause death). OSHA regulates workplace exposure to H_2S.

Sulfates: (SO_4^{2-}) are the fully oxidized ionic form of sulfur. Sulfates occur in combination with metal and/or hydrogen ions. In California, emissions of sulfur compounds occur primarily from the combustion of petroleum-derived fuels (e.g., gasoline and diesel fuel) that contain sulfur. This sulfur is oxidized to sulfur dioxide (SO_2) during the combustion process and subsequently converted to sulfate compounds in the atmosphere. The conversion of SO_2 to sulfates takes place comparatively rapidly and completely in urban areas of California due to regional meteorological features.

The ARB sulfates standard is designed to prevent aggravation of respiratory symptoms. Effects of sulfate exposure at levels above the standard include a decrease in ventilatory function, aggravation of asthmatic symptoms, and an increased risk of cardio-pulmonary disease. Sulfates are particularly effective in degrading visibility, and, due to the fact that they are usually acidic, can harm ecosystems and damage materials and property. Data collected in the SJVAB demonstrate levels of sulfates significantly less than the health standards.

Visibility Reducing Particles: Are a mixture of suspended particulate matter consisting of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. The standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range.

Vinyl Chloride: (C_2H_3Cl, also known as VCM) is a colorless gas that does not occur naturally. It is formed when other substances such as trichloroethane, trichloroethylene, and tetrachloro-ethylene are broken down. Vinyl chloride is used to make polyvinyl chloride (PVC) which is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials.

3.5 Attainment Status

The California Air Resources Board (ARB) and the Federal Environmental Protection Agency (EPA) have established Ambient Air Quality Standards in an effort to protect human health and welfare. Geographic areas are deemed "attainment" if these standards are met or nonattainment if they are not met. Nonattainment status is classified by the severity of the nonattainment problem, with marginal, moderate, serious, severe, and extreme nonattainment classifications for ozone. Nonattainment classifications for PM range from moderate to serious.

Current Federal and State Ambient Air Quality Standards can be found on ARB's website at www.arb.ca.gov/research/aaqs/aaqs2.pdf or www.arb.ca.gov/desig/desig.htm

At the Federal level, the District is designated as extreme nonattainment for the 8-hour ozone standard, attainment for PM_{10} and CO, and nonattainment for $PM_{2.5}$. At the State level, the District is designated as nonattainment for the 8-hour ozone, PM_{10}, and $PM_{2.5}$ standards. Although the Federal 1-hour ozone standard was revoked in 2005, areas must still attain this standard, and the District recently requested an EPA finding that the Valley has attained the standard based on 2011-2013 data. The District's attainment status, at the time of this writing, is presented in Table 1 (*San Joaquin Valley Attainment Status*). Although infrequent, the District's attainment status does change.

The District's current attainment status can be found on the District's website at www.valleyair.org/aqinfo/attainment.htm

Table 1: San Joaquin Valley Attainment Status

Pollutant	Designation/Classification	
	Federal Standards	**State Standards**
Ozone - One hour	Revoked in 2005	Nonattainment/Severe
Ozone - Eight hour	Nonattainment/Extreme	Nonattainment
PM 10	Attainment	Nonattainment
PM 2.5	Nonattainment/Moderate	Nonattainment
Carbon Monoxide	Attainment/Unclassified	Attainment/Unclassified
Nitrogen Dioxide	Attainment/Unclassified	Attainment
Sulfur Dioxide	Attainment/Unclassified	Attainment
Lead (Particulate)	No Designation/Classification	Attainment
Hydrogen Sulfide	No Federal Standard	Unclassified
Sulfates	No Federal Standard	Attainment
Visibility Reducing Particles	No Federal Standard	Unclassified
Vinyl Chloride	No Federal Standard	Attainment

3.6 Air Quality Plans

The District has developed plans to attain State and Federal standards for ozone and particulate matter. The District's air quality plans include emissions inventories to measure the sources of air pollutants, to evaluate how well different control methods have worked, and to show how air pollution will be reduced. The plans also use computer modeling to estimate future levels of pollution and make sure that the Valley will meet air quality goals. The District's attainment plans are subject to approval by the District's Governing Board.

More information about Federal and State air quality standards and the District's current attainment status can be found at
www.valleyair.org/aqinfo/attainment.htm

At the time of this writing, the following attainment plans are in effect:

1-Hour Ozone

Although EPA revoked its 1979 1-hour ozone standard in June 2005, many planning requirements remain in place, and the Valley must still attain this standard before it can rescind CAA Section 185 fees. The District's most recent 1-hour ozone plan, the *2013 Plan for the Revoked 1-hour Ozone Standard*, demonstrated attainment of the 1-hour ozone standard by 2017. However, the District is in the process of requesting an EPA finding of attainment based on 2011-2013 ozone data. The District will continue working closely with ARB and EPA on this issue.

8-Hour Ozone

The District's far-reaching *2007 Ozone Plan* demonstrates attainment of EPA's 1997 8-hour ozone standard by 2023. EPA approved the *2007 Ozone Plan* effective April 30, 2012. The District is now in the process of developing the *2016 Ozone Plan* to address EPA's 2008 8-hour ozone standard, which the Valley must attain by 2032. This is a very tough standard that is nearing the Valley's naturally-occurring background concentrations. Attainment may not be possible without the virtual elimination of fossil fuel combustion.

PM_{10}

Based on PM_{10} measurements from 2003-2006, EPA found that the SJVAB has reached Federal PM_{10} standards. On September 21, 2007, the District's Governing Board adopted the *2007 PM_{10} Maintenance Plan and Request for Redesignation*. This plan demonstrates that the Valley will continue to meet the PM_{10} standard. EPA approved the document and on September 25, 2008, the SJVAB was redesignated to attainment/maintenance.

$PM_{2.5}$

The District's *2008 $PM_{2.5}$ Plan* demonstrated 2014 attainment of EPA's first $PM_{2.5}$ standard, set in 1997. EPA lowered the $PM_{2.5}$ standard in 2006, and the District's *2012 $PM_{2.5}$ Plan* showed attainment of this standard by 2019, with the majority of the Valley seeing attainment much sooner. The District continues to work with EPA on issues surrounding these plans, including EPA implementation updates. EPA lowered the $PM_{2.5}$ standard again in 2012 and is in the process of completing attainment designations.

CHAPTER 4

GREENHOUSE GASES

4.1 Introduction

Greenhouse gases (GHGs) are gases that absorb and emit radiation within the thermal infrared range, trapping heat in the earth's atmosphere. There are no "attainment" concentration standards established by the Federal or State government for greenhouse gases. In fact, GHGs are not generally thought of as traditional air pollutants because greenhouse gases, and their impacts, are global in nature, while air pollutants affect the health of people and other living things at ground level, in the general region of their release to the atmosphere. Some greenhouse gases occur naturally and are emitted into the atmosphere through both natural processes and human activities. Other GHGs are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated carbons.

4.2 Common Greenhouse Gases

Water Vapor: Although not considered a pollutant, water vapor is the most important, abundant, and variable GHG. In the atmosphere, it maintains a climate necessary for life. The main source of water vapor is evaporation from the ocean (approximately 85 percent). Other sources include sublimation (change from solid to gas) from ice and snow, evaporation from other water bodies, and transpiration from plant leaves.

Ozone: Unlike other GHG, ozone is relatively short-lived and therefore is not global in nature. It is difficult to make an accurate determination of the contribution of ozone precursors (nitrogen oxides and volatile organic compounds) to global climate change (AEP 2007).

Aerosols: Are suspensions of particulate matter in a gas emitted into the air through burning biomass (plant material) and fossil fuels. Aerosols can warm the atmosphere by absorbing and emitting heat and can cool the atmosphere by reflecting light. Cloud formation can also be affected by aerosols. Sulfate aerosols are emitted when fuel-containing sulfur is burned. Black carbon (or soot) is emitted during biomass burning or incomplete combustion of fossil fuels. Particulate matter regulation has been lowering aerosol concentrations in the United States; however, global concentrations are likely increasing.

Chlorofluorocarbons: (CFCs) are gases formed synthetically by replacing all hydrogen atoms in methane (CH_4) or ethane (C_2H_6) with chlorine and/or fluorine atoms. CFCs are nonflammable, nontoxic, insoluble, and chemically uncreative in the troposphere (the level of air at the earth's surface). CFCs were first synthesized in 1928 for use as cleaning solvents, refrigerants, and aerosol propellants. They destroy stratospheric ozone; therefore, their production was stopped as required by the Montreal Protocol in 1987 (AEP 2007).

Carbon dioxide: (CO_2) is an odorless, colorless gas, which has both natural and anthropogenic sources. Natural sources include the following: respiration of bacteria, plants, animals, and fungus, evaporation from oceans, volcanic out gassing, and decomposition of dead organic matter. Anthropogenic sources of carbon dioxide are from burning coal, oil, natural gas, and wood. Concentrations of CO_2 were 379 parts per million (ppm) in 2005, which is an increase of 1.4 ppm per year since 1960 (AEP 2007).

Methane: (CH_4) is a flammable gas and is the main component of natural gas. When one molecule of CH_4 is burned in the presence of oxygen, one molecule of carbon dioxide and two molecules of water are released. There are no direct ill health effects from CH_4. A natural source of CH_4 is from the anaerobic decay of organic matter. Geological deposits, known as natural gas fields, also contain CH_4, which is extracted for fuel. Other sources are from cattle, fermentation of manure, and landfills.

Nitrous oxide: (N_2O), also known as laughing gas, is a colorless greenhouse gas. Higher concentrations of N_2O can cause euphoria, dizziness, and slight hallucinations. N_2O is produced by microbial processes in soil and water, including those reactions that occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (nitric acid production, nylon production, fossil fuel-fired power plants, and vehicle emissions) also contribute to its atmospheric load. It is used in racecars, rocket engines, and as an aerosol spray propellant.

Fluorinated Gases: Are gases that are synthetic, powerful GHG that are emitted from a variety of industrial processes.

Hydrofluorocarbons: (HFCs) are synthetic man-made chemicals that are used as a substitute for CFCs (Chlorofluorocarbons) for automobile air conditioners and refrigerants.

Perfluorocarbons: (PFCs) have stable molecular structures and do not break down though the chemical processes in the lower atmosphere. High-energy ultraviolet rays, roughly 60 kilometers above the earth's surface are able to destroy the compounds. PFCs have long lifetimes, ranging between 10,000 and 50,000 years. Two common PFCs are

tetrafluoromethane and hexafluoroethane. Concentrations of tetrafluoromethane in the atmosphere are over 70 parts per trillion (ppt) (AEP 2007). The two main sources of PFCs are primary aluminum production and semiconductor manufacturing.

Sulfur hexafluoride: (SF_6) is an inorganic, colorless, odorless, nontoxic, nonflammable gas. Concentrations in the 1990s were roughly 4 ppt (AEP 2007). SF_6 is used for insulation in electric power transmission and distribution equipment, in semiconductor manufacturing, the magnesium industry, and as a tracer gas for leak detection.

Additional information on GHG and global climate change can be found in the staff report titled "Addressing GHG Emissions Impacts under CEQA" at www.valleyair.org/Programs/CCAP/CCAP_idx.htm

CHAPTER 5

AIR POLLUTANT EMISSION SOURCES

5.1 Introduction

In general, primary pollutants are directly emitted into the atmosphere, and secondary pollutants are formed by chemical reactions in the atmosphere. Air pollution in the Valley results from emissions generated in the Valley as well as from emissions and secondary pollutants transported into the Valley. It is thought that the bulk of the Valley's summer and winter air pollution is caused by locally generated emissions.

The types of air pollutant emission sources are commonly characterized as either point or area sources. A point source is a single, identifiable source of air pollutant emissions (for example, the emissions from a combustion furnace flue gas stack). An area source is a source of diffuse air pollutant emissions (for example, the emissions from a forest fire, a landfill or the evaporated vapors from a large spill of volatile liquid).

Sources may be further characterized as either stationary or mobile. Industrial boilers are examples of stationary sources and buses are examples of mobile sources. Sources may also be characterized as either urban or rural because urban areas constitute a so-called heat island and the heat rising from an urban area causes the atmosphere above an urban area to be more turbulent than the atmosphere above a rural area. Sources may be characterized by their elevation relative to the ground as either surface or ground-level, near surface or elevated sources. Sources may also be characterized by their time duration. Short-term sources (for example, accidental emission releases or construction emissions) constitute intermittent emissions. Long- term sources (Stationary Sources and development projects) constitute continuous emissions.

The District uses comprehensive emissions inventories to develop control strategies, determine the effectiveness of permitting and control programs, provide input into ambient dispersion models, fulfill reasonable further progress requirements, and screen sources for compliance investigations. Emissions inventory data, like ambient monitoring data, are also used as indicators for trends in air pollution. Typically, an emissions inventory is also organized by emission source category. Source categories consist of several broad groups:

5.2 Point Sources (Stationary Sources)

Facilities that have valid District permits for specific emissions units are called point sources. Refineries, gas stations, dry cleaners and industrial plants are examples of point sources in the District. Aggregated point sources are sources that are not inventoried individually but are estimated as a group and reported as a single source category.

5.3 Area Sources

Area source emissions are from sources that are not permitted by the District, or are individually so small that they may not be included in the District's emissions survey system. These small sources may not individually emit significant amounts of pollutants, but when aggregated can make an appreciable contribution to the emission inventory. Examples of these area sources are residential water heating and use of paints, varnishes, and consumer products. Emissions from these sources are grouped into categories and calculated based on surrogate variables.

5.4 Mobile Sources

Mobile sources consist of motor vehicles and other portable sources. Mobile sources are classified as being on-road or off-road. On-road motor vehicles consist of passenger cars, trucks, buses and motorcycles. Emissions from on-road motor vehicles are a major portion of the emission inventory, and are estimated by ARB using computer models. Off-road mobile sources generally consist of vehicles in which the primary function is not transportation. Examples of off-road vehicles include construction and farm equipment.

Other mobile sources include boats and ships, trains, and aircraft. The District estimates emissions for ships and aircraft in our area source inventory. The remaining sources are estimated by ARB as part of their off-road inventory

5.5 Natural Sources

Natural Sources are non-anthropogenic, naturally occurring emissions. In addition to man-made air pollution, there are significant quantities of pollutants from natural sources. Natural sources include biological and geological sources, wildfires, windblown dust, and biogenic emissions from plants and trees. Emissions from natural sources are estimated by ARB.

CHAPTER 6

LAND USE AND AIR QUALITY

6.1 Introduction

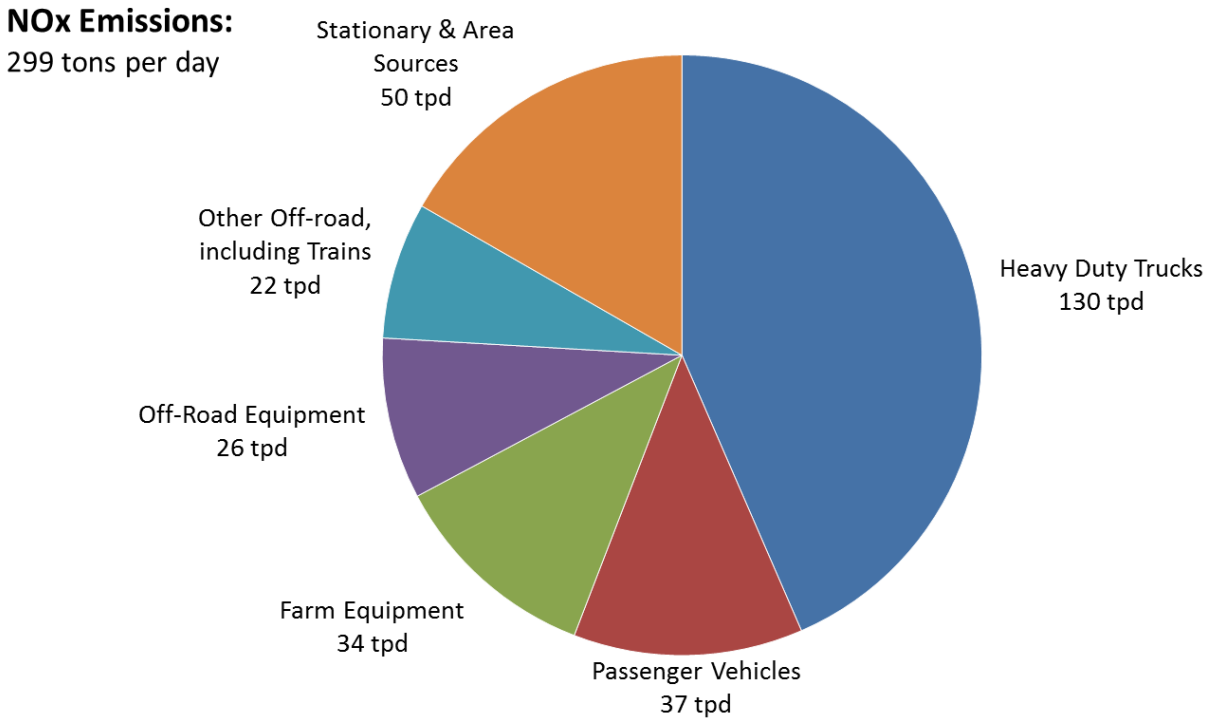
Nearly all development projects within the San Joaquin Valley Air Basin, from general plans to individual development projects have the potential to generate air pollutants, making it more difficult to attain State and Federal ambient air quality standards. Therefore, it is necessary to evaluate air quality impacts to comply with CEQA. Land use decisions are critical to improving air quality within the San Joaquin Valley Air Basin because land use patterns greatly influence transportation needs and motor vehicle emissions are the largest source of air pollution. Land use decisions and project design elements such as preventing urban sprawl, encouraging mix-use development, and project designs that reduce vehicle miles traveled (VMT) have proven benefit for air quality.

The air quality considerations that warrant particular attention during early consultation between Lead Agencies and project proponents include consistency with applicable District rules and permit requirements; land use and design measures to encourage alternatives to the automobile and to promote energy conservation; and land use conflicts and exposure of sensitive receptors to odors, toxics and criteria pollutants. Sensitive receptors refer to those segments of the population most susceptible to poor air quality (i.e., children, the elderly, and those with pre-existing serious health problems affected by air quality). Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors.

Addressing land use and site design issues while a proposed project is still in the conceptual stage increases opportunities to incorporate project design features to minimize land use compatibility issues and air quality impacts. By the time a project enters the CEQA process, it is usually more costly and time-consuming to redesign the project to incorporate mitigation measures.

The District is continuously improving processes to be more efficient and more effective, in addition to working closely with land use agencies to ensure their needs are met.

Figure 4: Sources of NOx Emissions within the San Joaquin Valley Air Basin



Source: California Emissions Projection Analysis Model – NorCal v1.04 – 2013 Annual Average

6.2 Land Use Planning

Land use decisions are critical to air quality planning because land use patterns greatly influence transportation needs, and motor vehicles are the largest source of air pollution in the San Joaquin Valley Air Basin. The design of development projects significantly influences how people travel.

Since its inception, the District has been active in promoting land use strategies that reduce the amount and distance people drive to accomplish their daily activities. Air districts with severe air pollution were required by the California Clean Air Act to develop "indirect source" control programs in their attainment plans. Indirect sources are defined as any building, facility, activity center, etc. that attracts motor vehicle trips. Land use strategies reduce trips by designing development to be more convenient for walking, bicycling, and transit, thereby allowing people to drive less.

The District's Air Quality Attainment Plans include measures to promote air quality elements in county and city general plans as one of the primary indirect source programs. The general plan is the primary long range planning document used by cities and counties to direct development. Since air districts have no authority over land use decisions, it is up to cities and counties to ensure that their general plans help achieve air quality goals. Section 65302.1 of the California Government Code requires cities and counties in the San Joaquin Valley to amend appropriate elements of their general plans to include data, analysis, comprehensive goals, policies, and feasible implementation strategies to improve air quality in their next housing element revisions.

The District's *Air Quality Guidelines for General Plans* (AQGGP), adopted by the District in 1994 and amended in 2005, is a guidance document containing goals and policy examples that cities and counties can directly incorporate into their General Plans to satisfy Section 65302.1. The document provides policies that directly and indirectly benefit air quality. Its emphasis is on cities and counties developing a comprehensive approach to air quality that targets new growth areas, redevelopment areas, and programs that reach the entire community. The general plan is the "constitution" for local development and, as such, provides a framework for deciding the way development will occur. When adopted in a general plan and implemented, the suggestions in the AQGGP can reduce vehicle trips and miles traveled and improve air quality. The specific suggestions in the AQGGP are voluntary. The District strongly encourages cities and counties to use their land use and transportation planning authority to help achieve air quality goals by incorporating as many air quality policies from the AQGGP as possible into their general plans, community plans, and specific plans to ensure that development occurs in ways that produce fewer air quality impacts. To the extent that cities and counties can implement policies that make their communities more transit-, bicycle-, and pedestrian-friendly, and avoid land use conflicts that lead to toxics and nuisance problems, they can minimize the need to mitigate air quality impacts of individual development proposals. The strategies recommended by the AQGGP are summarized as follows:

- A commitment to determine and mitigate project level and cumulative air quality impacts under the California Environmental Quality Act (CEQA);
- A commitment to integrate land use plans, transportation plans, and air quality plans;
- A commitment to plan land uses in ways that support a multi-modal transportation system;
- A commitment to take local action to support programs that reduce congestion and vehicle trips;
- A commitment to plan land uses to minimize exposure to toxic air pollutant emissions from industrial and other sources;
- A commitment to reduce particulate emissions from sources under local jurisdiction;

- A commitment of support for Air District and public utility programs to reduce emissions from energy consumption and area sources (water heaters, woodstoves, fireplaces, barbecues, etc.).

Policies promoting land use and design measures are most effective if implemented communitywide, or even at the subregional level. Issues such as allowable land use densities, mixing of land uses, street standards, parking requirements, etc. are most appropriately addressed throughout the entire community or sub-region. Implementing mechanisms such as zoning ordinances, parking standards, and design guidelines, may need to be revised to address these issues. Implementation of these strategies on an individual project basis can still be beneficial, even absent a community-wide strategy, but the benefits will be greater if implemented broadly.

Some examples of policies are:

- All City/County submittals of transportation improvement projects to be included in regional transportation plans shall be consistent with the air quality goals and policies of the General Plan.
- City/County fleet vehicle operators shall replace or convert operational fuel vehicles with clean fuel vehicles as rapidly as feasible.
- The City/County shall encourage the development of pedestrian-oriented shopping areas within walking distance of high-density residential neighborhoods.

The Air Quality Guidelines for General Plans is available on the District's website at www.valleyair.org/transportation/Guidelines_for_General_Plans.htm

6.3 Assembly Bill 170, Reyes (AB 170)

Assembly Bill 170, Reyes (AB 170), was adopted by State lawmakers in 2003 creating Government Code §65302.1 which requires cities and counties in the San Joaquin Valley to amend their general plans to include data and analysis, comprehensive goals, policies and feasible implementation strategies designed to improve air quality. These amendments are due no later than one year from the due date specified for the next revisions of a jurisdiction's housing element. As required in §65302.1.b, cities and counties within the San Joaquin Valley must amend their general plan to include a discussion of the status of air quality and strategies to improve air quality. The elements to be amended include, but are not limited to, those elements dealing with land use, circulation, housing, conservation, and open space. Section 65302.1.c identifies four (4) areas of air quality discussion required in these amendments.

These areas include:

(1) A report describing local air quality conditions, attainment status, and State and Federal air quality and transportation plans;
(2) A summary of local, district, State, and Federal policies, programs, and regulations to improve air quality;
(3) A comprehensive set of goals, policies, and objectives to improve air quality; and
(4) Feasible implementation measures designed to achieve these goals.

To aid agencies in amending their general plans consistent with AB 170, the District has prepared various guidance documents for addressing air quality issues within general plans. These documents also provide links to websites that may provide additional information and detail.

These documents are available on the District's website at
www.valleyair.org/transportation/Guidelines_for_General_Plans.htm

6.4 District Rule 9510 (Indirect Source Review)

The Indirect Source Review (ISR) rule, which went into effect March 1, 2006, requires developers of new residential, commercial and industrial projects to reduce smog-forming and particulate emissions generated by their projects. The ISR rule also applies to transportation and transit projects whose construction exhaust emissions will result in a total of two tons per year of NOx or PM_{10}. The ISR rule seeks to reduce the growth in NOx and PM_{10} emissions associated with construction and operation of new development, transportation and transit projects in the San Joaquin Valley.

The ISR rule requires developers to reduce construction NOx and PM_{10} exhaust emissions by 20% and 45%, respectively, and reduce operational NOx and PM_{10} emissions by 33.3% and 50%, respectively, as compared to the unmitigated baseline. Developers can achieve the required reductions through any combination of District approved on-site emission reduction measures. When a developer cannot achieve the required reductions through on-site measures, off-site mitigation fees are imposed to mitigate the difference between the required emission reductions and the mitigations achieved on-site. Monies collected from this fee are used by the District to fund emission reduction projects in the San Joaquin Valley on behalf of the project.

Technical resources for District Rule 9510, including a list of approved on-site emission reduction measures and tools for calculating project specific emissions are available at
www.valleyair.org/ISR/ISRHome.htm

6.5 Potential Land Use Conflicts and Exposure of Sensitive Receptors

The location of a development project is a major factor in determining whether the project will result in localized air quality impacts. The potential for adverse air quality impacts increases as the distance between the source of emissions and receptors decreases. Receptors include sensitive receptors and worker receptors. Sensitive receptors refer to those segments of the population most susceptible to poor air quality (i.e., children, the elderly, and those with pre-existing serious health problems affected by air quality). Land uses where sensitive individuals are most likely to spend time include schools and schoolyards, parks and playgrounds, daycare centers, nursing homes, hospitals, and residential communities (these sensitive land uses may also be referred to as sensitive receptors). Worker receptors refer to employees and locations where people work. Impacts on sensitive receptors are of particular concern, because they are the people most vulnerable to the effects of air pollution.

From a health risk perspective there are basically two types of land use projects that have the potential to cause long-term public health risk impacts:

- Type A Projects: Land use projects that will place new toxic sources in the vicinity of existing receptors, and
- Type B Projects: Land use projects that will place new receptors in the vicinity of existing toxics sources.

Examples of Type A projects (New project impacts existing receptors):

This category includes sources of air toxic emissions such as:

- Gasoline dispensing facilities,
- Asphalt batch plants,
- Warehouse distribution centers,
- New freeways or high traffic roads, and
- Other stationary sources that emit toxic substances.

Examples of Type B projects (New project impacted by existing toxic sources):

This category includes residential, commercial, and institutional developments proposed to be located in the vicinity of existing toxic emission sources such as:

- Stationary sources,
- Freeways or high traffic roads
- Rail yards, and
- Warehouse distribution centers.

Various tools already exist to perform a screening analysis from stationary sources impacting receptors (Type A projects) as developed for the AB2588 Hot Spots and air district permitting programs. Screening tools may include prioritization charts, AERSCREEN and various spreadsheets. For projects being impacted by existing sources (Type B projects), one screening tool is contained in the ARB Handbook: *Air Quality and Land Use Handbook: A Community Health Perspective.* The document includes a table entitled "*Recommendations on Siting New Sensitive Land Uses Such As Residences, Schools, Daycare Centers, Playgrounds, or Medical Facilities"* with recommended buffer distances associated with various types of common sources. If a proposed project is located within an established buffer distance to any of the listed sources, a health risk screening and/or assessment should be performed to assess risk to potential sensitive receptors. These guidelines are intended only for projects that are impacted by a single source.

Another useful tool is the CAPCOA Guidance Document: Health Risk Assessments for Proposed Land Use Projects. CAPCOA prepared the guidance to assist Lead Agencies in complying with CEQA requirements. The guidance document describes when and how a health risk assessment should be prepared and what to do with the results.

The CAPCOA Guidance document, Health Risk Assessment for Proposed Land use Projects, can be found at http://www.capcoa.org/documents
and the ARB Handbook, Air Quality and Land Use Handbook: A Community Health Perspective, can be found at www.arb.ca.gov/ch/landuse.htm

CHAPTER 7

CALIFORNIA ENVIRONMENTAL QUALITY ACT

CEQA

7.1 Introduction

The California Environmental Quality Act (CEQA) is a state statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The impetus for CEQA can be traced to the passage of the first federal environmental protection statute in 1969, the National Environmental Policy Act (NEPA). In response to this federal law, the California State Assembly created the Assembly Select Committee on Environmental Quality to study the possibility of supplementing NEPA through state law. This legislative committee, in 1970, issued a report entitled The Environmental Bill of Rights, which called for a California counterpart to NEPA. Later that same year, acting on the recommendations of the select committee, the legislature passed, and Governor Reagan signed, the CEQA statute.

CEQA applies to certain activities of state and local public agencies. A public agency must comply with CEQA when it undertakes an activity defined by CEQA as a "project". A project is an activity undertaken by a public agency or a private activity which must receive some discretionary approval (meaning that the agency has the authority to deny the requested permit or approval) from a government agency which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment.

Most proposals for physical projects in California are subject to the provisions of CEQA, as are many governmental decisions which do not immediately result in physical development (such as adoption of a general or community plan). Every project which requires a discretionary governmental approval will require an environmental review pursuant to CEQA, unless an exemption applies.

The CEQA Guidelines are the regulations that explain and interpret the law for both the public agencies required to administer CEQA and for the public generally. They are found in the California Code of Regulations (CCR), in Chapter 3 of Title 14. The Guidelines provide objectives, criteria and procedures for the orderly evaluation of projects and the preparation of environmental impact reports, negative declarations, and mitigated negative declarations by public agencies. The fundamental purpose of the Guidelines is to make the CEQA process comprehensible to those who administer it, to those subject to it, and to those for whose benefit it exists. To that end, the Guidelines are more than mere regulations which implement CEQA as they incorporate and interpret both the statutory mandates of CEQA and the principles advanced by judicial decisions.

The Governor's Office of Planning and Research (OPR) prepares and develops proposed amendments to the Guidelines and transmits them to the Secretary for Resources. The

Secretary for Resources is responsible for certification and adoption of the Guidelines and amendments thereto.

CEQA is intended to address a broad range of environmental issues, including water quality, noise, land use, natural resources, transportation, energy, human health, biological species, and air quality. CEQA has four primary objectives:

1. Inform governmental decision makers and the public about the potential, significant environmental effects of proposed activities.
2. Identify the ways that environmental damage can be avoided or significantly reduced.
3. Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.
4. Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

7.2 Roles in the CEQA Process

As a public agency, the District takes an active part in the intergovernmental review process under CEQA. The District is available to assist governmental agencies and project proponents in understanding how to characterize project-related impacts on air quality and how to reduce or mitigate those impacts. As part of this ongoing effort, the District develops and publishes technical guidance relevant to assessing project specific emissions of criteria pollutants and assessing potential health risks to sensitive receptors.

In carrying out its duties under CEQA, the District may act as a Lead Agency, a Responsible Agency, or a Trustee/“Commenting” Agency. As discussed below, the role the District serves under CEQA is dependent upon the extent of the District’s discretionary approval power over the project.

CEQA applies to discretionary projects. A discretionary project is one that requires the exercise of judgment or deliberation when the public agency or body decides to approve or disapprove a particular activity. Ministerial projects are statutorily exempt from the requirements of CEQA [PRC §21080(b)(1)]. Ministerial projects involve little or no personal judgment by the public official as to the wisdom or manner of carrying out the project. The official merely applies the law to the facts presented but uses no special discretion or judgment in reaching a decision.

“The determination of what is ministerial can most appropriately be made by the particular agency involved based on its analysis of its own laws, and each public agency should make such determinations either as part of its implementing regulations or on a case-by-case basis.” [CCR §15268(a)].

The District has determined that it exercises discretionary judgment when issuing air permits for stationary sources with sufficient emission increases to be subject to Best Available Control Technology (BACT) requirements. For such projects, the District conducts a top-down BACT analysis to determine whether the proposed control technology meets BACT requirements. In making a BACT determination, California Courts (*see*, *e.g.*, *Security Environmental Systems, Inc. v. South Coast Air Quality Management Dist.*, 229 Cal.App.3d 110, 117-118; 120 (1991)) have found that District staff exercises discretionary judgment in considering the proposed Achieved in Practice control technology, evaluating the feasibility of alternative control technology, and determining whether the alternatives are cost effective. If there is no approved BACT, District staff exercises discretionary judgment in establishing BACT for the particular source category and comparing the newly approved BACT to the proposed control technology.

7.3 Lead Agency

A Lead Agency is the public agency with the principal responsibility for carrying out or approving a project subject to CEQA. Lead Agencies are responsible for complying with CEQA by ensuring that all potential environmental impacts of proposed projects are adequately assessed and environmental damage is avoided or minimized where feasible. When determining whether a project will have a significant environmental effect, the Lead Agency must consider the whole of an action and not simply its constituent parts. The Lead Agency must consult with and solicit comments from Responsible and Trustee agencies. In deciding whether changes in a project are feasible, an agency may consider specific economic, environmental, legal, social, and technological factors.

Under CEQA the Lead Agency is required to:

1. Conduct preliminary reviews to determine if applications are subject to CEQA [CCR §15060];
2. Conduct review to determine if projects are exempt from CEQA [CCR §15061;
3. Prepare Initial Studies for projects that may have adverse environmental impacts [CCR §15063];
4. Determine the significance of the environmental effects caused by the project [CCR §15064];
5. Prepare Negative Declarations or Mitigated Negative Declarations for projects with no significant environmental impacts [CCR §15070];
6. Prepare, or contract to prepare, EIRs for projects with significant environmental impacts [CCR §15081];
7. Adopt reporting or monitoring programs for the changes made to projects or conditions of project approval, adopted in order to mitigate or avoid significant effects on the environment [PRC §21081.6 & CCR §15097];
8. Comply with CEQA noticing and filing requirements.

District Role

The District is always the Lead Agency for projects such as the development of District rules and regulations. The District may be Lead Agency for projects subject to District permit requirements. As discussed above, for projects triggering BACT, the District has discretionary approval in deciding how to permit the project. For projects subject to BACT, the District serves as Lead Agency when no other agency has principal responsibility for approving the project. This commonly occurs when the proposed project is a modification to an existing facility and the project does not require discretionary land use approval, such as issuance of a zone change or conditional use permit.

The District is seldom Lead Agency for projects consisting of construction and operation of a new facility, such as a dairy, glass manufacturing operation, or other stationary sources of pollution. For such projects, the local government agency with jurisdiction over land use, such as a city or county, typically has principal responsibility for approving the project and serves as Lead Agency. An exception is when the land use agency determines that the project is an allowed use and has only ministerial approval power over the project, such as issuance of building permits. This can occur, for example, when the District issues permits for certain oil field projects involving installation of steam generators.

The District is frequently Lead Agency for projects consisting of modifications to existing stationary sources, such as changes in existing procession operations, modifications to existing equipment, or installation of new stationary source equipment. Such projects typically are consistent with existing land uses and are not subject to a discretionary approval by the local land use agency.

7.4 Responsible Agency

A Responsible Agency is a public agency, other than the Lead Agency, that has responsibility for carrying out or approving a project subject to CEQA. The discretionary authority of a Responsible Agency is more limited than a Lead Agency; having responsibility for mitigating or avoiding only the environmental effects of those parts of the project which it decides to approve, carry out, or finance.

Under CEQA a Responsible Agency is required to:

1. Decide on the adequacy of the EIR or Negative Declaration for use by the District [CCR §15096(e)];
2. Consider the environmental effects of the project as shown in the EIR or Negative Declaration [CCR §15096(f)];

3. Adopt feasible alternative or mitigations for the direct or indirect environmental effects of those parts of the project, which it decides to carry out, finance, or approve [CCR §15096(g)];
4. Prepare and submit mitigation monitoring and reporting programs where appropriate [PRC §21081.6 & CCR §15097];
5. Make appropriate findings [CCR §15096(h)]; and
6. File appropriate notices [CCR §15096(i)].

District Role

As a Responsible Agency, the District assists Lead Agencies by providing technical expertise in characterizing project-related impacts on air quality and is available to provide technical assistance in addressing air quality issues in environmental documents. When commenting on a Lead Agency's environmental analysis, the District reviews the air quality section of the analysis and other sections relevant to assessing potential impacts on air quality, i.e. sections assessing public health impacts. At the conclusion of its review the District may submit to the Lead Agency comments regarding the project air quality analysis. Where appropriate, the District will recommend feasible mitigation measures.

As discussed above, for projects triggering BACT, the District has discretionary approval in deciding how to permit the project. As such, District staff reviews the Lead Agency's environmental document and considers the environmental effects of the project. When issuing permits for a project that would have a significant environmental effect, the District prepares written findings and files a Notice of Determination, as required under CEQA.

7.5 Trustee/Commenting Agency

Under CEQA, an agency that has "jurisdiction by law" over a particular natural resource but does not have discretionary approval power over the project is a "Trustee Agency", otherwise known as a "Commenting Agency". CEQA Guidelines §15004(b)(2) require a Lead Agency to consult with *"Any other State, Federal, and local agencies which have jurisdiction by law with respect to the project or which exercise authority over resources which may be affected by the project…."*

District Role

The District has jurisdiction over most air quality matters in the San Joaquin Valley Air Basin and is tasked with implementing certain programs and regulations required by the Federal Clean Air Act and the California Clean Air Act. Although the District has no statutory authority over land-use, nearly all development projects in the District, from general plans to individual development applications, have the potential to generate pollutants that could adversely impact air quality or make it more difficult for the District to achieve national and State air quality attainment standards. Therefore, for most

development projects, it is necessary for the land-use agency to consult with the District in matters related to air quality impacts.

As a Trustee Agency, the District assists Lead Agencies by providing technical expertise or tools in characterizing project-related impacts on air quality and identifying potential mitigation measures, and is available to provide technical assistance in addressing air quality issues in environmental documents. At the conclusion of its review the District may submit to the Lead Agency comments regarding the project air quality analysis. Where appropriate, the District will recommend feasible mitigation measures. The process is subject to change due to the District's continuous improvements efforts.

7.6 Environmental Review Process

The environmental review process imposes both procedural and substantive requirements. At a minimum, an initial review of the project and its environmental effects must be conducted. Depending on the potential effects, a further, and more substantial, review may be conducted in the form of an environmental impact report (EIR). A project may not be approved as submitted if feasible alternatives or mitigation measures are able to substantially lessen the significant environmental effects of the project.

"Project" under CEQA

The CEQA Statutes (PRC §21065) define "project" as the whole of an activity, which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and which is any of the following:

1. An activity directly undertaken by a public agency;
2. An activity undertaken by a person which is supported, in whole or in part, through contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies;
3. An activity that involves the issuance to a person of a lease, permit, license, certificate;
4. Or other entitlement for use by one or more public agencies.

7.7 CEQA "*Steps*"

The CEQA procedure involves a number of steps which produce an environmental document examining the Lead Agency's as well as the responsible and/or trustee agencies' permit decisions. An agency will normally take up to three separate steps in deciding which document to prepare for a project subject to CEQA.

7.7.1 CEQA Step 1: CEQA Exemptions

In the first step the Lead Agency examines the project to determine whether the project is subject to CEQA at all. An activity is not subject to CEQA if:

1. The activity does not involve the exercise of discretionary powers by a public agency;
2. The activity will not result in a direct or reasonably foreseeable indirect physical change in the environment; or
3. The activity is not a project as defined in PRC §21065.

Once a Lead Agency has determined that an activity is a project subject to CEQA, a Lead Agency shall determine whether the project is exempt from CEQA. A project is exempt from CEQA if:

1. The project is exempt by statute (See CCR §15260).
2. The project is exempt pursuant to a categorical exemption (See CCR §15300) and the application of that categorical exemption is not barred by one of the exceptions set forth in CCR §15300.2.
3. The activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA (see CCR §15061 (b)(3))
4. The project will be rejected or disapproved by a public agency (see CCR §15270(b))
5. The project is exempt pursuant to the provisions of Article 12.5 (Exemptions for Agricultural Housing, Affordable Housing, and Residential Infill Projects) of Chapter 3 “Guidelines for Implementation of the California Environmental Quality Act”.

It should be noted that a public agency can also, in the course of establishing its own procedures, list those specific activities which fall within each of the categorical exempt classes (see CCR §15300.4). If the project is exempt, the process does not need to proceed any further. The agency may prepare a Notice of Exemption. [See: CCR §15061 and §15062].

7.7.2 CEQA Step 2: Initial Study

If the project is not exempt, the Lead Agency takes the second step and conducts an Initial Study (See: CCR §15063) to determine whether the project may have a significant effect on the environment. The air quality impact of a project is determined by examining the types and levels of emissions generated by the project, the existing air quality conditions, and neighboring land uses.

The purposes of an Initial Study are to:

1. Provide the Lead Agency with information to use as the basis for deciding whether to prepare an EIR or a Negative Declaration;
2. Enable an applicant or Lead Agency to modify a project, mitigating adverse impacts before an EIR is prepared, thereby enabling the project to qualify for a Negative Declaration;
3. Assist in the preparation of an EIR, if one is required, by:
   a. Focusing the EIR on the effects determined to be significant,
   b. Identifying the effects determined not to be significant,
   c. Explaining the reasons for determining that potentially significant effects would not be significant, and
   d. Identifying whether a program EIR, tiering, or another appropriate process can be used for analysis of the project's environmental effects;
4. Facilitate environmental assessment early in the design of a project;
5. Provide documentation of the factual basis for the finding in a Negative Declaration that a project will not have a significant effect on the environment;
6. Eliminate unnecessary EIRs; and
7. Determine whether a previously prepared EIR could be used with the project.

Project Analysis

The Initial Study should analyze all phases of project planning, construction and operation, as well as cumulative impacts. When considering a project's impact on air quality, a Lead Agency should provide substantial evidence that supports its conclusions in an explicit, quantitative analysis whenever possible. An initial study may rely upon expert opinion supported by facts, technical studies or other substantial evidence to document its findings. However, an initial study is neither intended nor required to include the level of detail included in a Negative Declaration (ND), a Mitigated Negative Declaration (MND), or an EIR (CCR §15063(a)(3).

If it is not obvious that a project's air quality impacts are less than significant, Lead Agencies should prepare an analysis report that includes a quantitative air quality assessment to determine the project's impact on air quality. The analysis report should also contain the information described below.

- **Climate and Topography**. Provide a description of the influence of climate and topography on a project's impacts on local and regional air quality.

- **Regulatory Environment**. Describe the regulatory requirements in the District.

- **Prevention of Significant Deterioration (PSD) Consideration.** The analysis should place special emphasis on air quality resources that are rare or unique to the region and would be affected by the project. Regulatory requirements identify areas that are pristine and classified as Class I airsheds. These airsheds are subject to specific standards, e.g. Prevention of Significant Deterioration requirements. Within the District, the Kings Canyon and Sequoia National Parks and Ansel Adams, Kaiser, John Muir, and Domeland Wilderness Areas are Class I areas. Any project proposed in the vicinity of one of these areas should note its proximity to a Class I area in the description of the project setting.

- **Air Quality Standards.** Identify state and federal AAQS for all criteria pollutants. Provide the air quality attainment status for the criteria pollutants.

- **Ambient Air Quality.** Summarize ambient air quality, including data for at least the last three years from the air quality monitoring station(s) closest to the project site. The setting should also include basin-wide data for ozone given its regional characteristics.

- **Existing Emissions.** Describe any existing emissions from the project site, if applicable. Include any District permitted stationary sources of emissions that are being eliminated.

- **Sensitive Receptors.** Identify any sensitive receptors located near the project site. For CEQA purposes, a sensitive receptor is generically defined as a location where human populations, especially children, seniors, and sick persons are found, and there is reasonable expectation of continuous human exposure according to the averaging period for the AAQS (e.g., 24-hour, 8-hour, 1-hour). These typically include residences, hospitals, and schools. Locations of sensitive receptors may or may not correspond with the location of the maximum off-site concentration. The location of sensitive receptors should be explained in terms that demonstrate the relationship between the project site and potential air quality impacts (e.g., proximity, topography, or upwind or downwind location). The analysis should also identify reasonably foreseeable sensitive receptors. This would include future receptors if development is pending, as well as potential receptors that could reasonably be sited nearby based on permitted zoning or land use designations. Land uses in the vicinity of the project site should be extensively described in the

Land Use Section of an EIR. If no sensitive receptors are in the project vicinity, the Land Use Section may be referenced with an appropriate reference to the lack of sensitive receptors. If sensitive receptors are in the project vicinity, the Land Use Section may also be referenced, but the description of any sensitive receptors should be expanded upon as necessary for air quality impact analysis purposes.

- **Sources of Air Pollutants in Project Vicinity.** Identify sources of air pollutants on or near the project site. The description of existing air pollution sources should include criteria pollutants, toxic air contaminants, and nuisance emissions such as odors and dust. More detailed information regarding existing emissions, including emissions of odors and toxic air contaminants, may be obtained by contacting the District.

- **Transportation System.** Describe the transportation system serving the project site. Discuss traffic conditions, including traffic volumes and levels of service; transit service; and other relevant transportation facilities such as bicycle facilities, shuttle services, telecommuting centers, etc. The discussion of the existing transportation system should describe both current conditions and future conditions with the project. Much of this information may be located in the Traffic and Circulation section of the EIR (or Initial Study). Many EIR traffic and circulation sections, however, do not adequately describe bicycle facilities, telecommuting centers, and other alternative transportation forms. The traffic and circulation information may be referenced and/or summarized, but any additional information relative to non-motorized trip reduction alternatives not discussed should be described as necessary and appropriate for the project in the air quality setting.

Project Air Impact Assessment – District Approved Model

When quantifying project emissions, the latest approved models by the District should always be used for air quality analysis. Models are subject to change. At the time of writing, the model available is the California Emissions Estimator Model (CalEEMod). CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and greenhouse gas (GHG) emissions associated with both construction and operations from a variety of land use projects. The model quantifies direct emissions from construction and operations (including vehicle use), as well as indirect emissions, such as GHG emissions from energy use, solid waste disposal, vegetation planting and/or removal, and water use.

The model is available at www.caleemod.com and at
http://www.valleyair.org/transportation/air_quality_models.htm
Assistance with operating the model is available by contacting the District at
(559) 230-6000, or hramodeler@valleyair.org

Initial Study Conclusion

If the Initial Study shows that there is no substantial evidence that the project may have a significant effect or identifies potentially significant effects but the project is revised to avoid or mitigate those significant effects, the Lead Agency prepares a Negative Declaration (ND) or a Mitigated Negative Declaration (MND) (See: CCR §15070 et seq.). If the Initial Study shows that the project may have a significant effect, the Lead Agency takes the third step and prepares an EIR [See: CCR §15080 et seq.].

7.7.3 CEQA Step 3: Environmental Impact Report

This third step consists of preparing the Environmental Impact Report (EIR). (See: CCR §15080 et seq.). This report provides State and local agencies and the general public with detailed information on the potentially significant environmental effects which a proposed project is likely to have and to list ways which the significant environmental effects may be minimized and indicate alternatives to the project.

Information Needed for District Review

In order for the District to properly review a project for which an Initial Study has been conducted, Lead Agencies should send a complete project description and location (preferably including a map), site plans, and tentative tract or parcel maps, if applicable; and data relative to number of vehicles or trips associated with the project. At minimum, Lead Agencies should allow ten working days for the District to respond.

> *Environmental Impact Report*: For all EIRs prepared for projects in the District, the District requests that it be sent the Notice of Preparation (NOP). The CEQA Guidelines require that the NOP include, at minimum, a description of the project, project location, and the probable environmental effects of the project. The CEQA Guidelines provides for a 30-day consultation period for NOPs.
>
> Where an air quality study is prepared for a project, it should be summarized and the results reported in the Draft EIR and the entire air quality study should be included as an appendix or as a separate report. The air quality report should include a brief air quality setting, the

emissions analysis results, results of other air analyses, and a description of mitigation measures used to reduce the project's emissions. Provide either full documentation of calculations with justification of mitigation measures used when using manual method of quantification or using a model approved by the District. All assumptions used in the modeling analysis for any project should be clearly stated. When the Draft EIR includes air quality mitigation measures, the required mitigation monitoring and reporting should be included in or with the Draft EIR. The District recommends that the modeling outputs be provided as appendices to the EIR. The District further recommends that the District be provided with an electronic copy of all input and output files for all modeling.

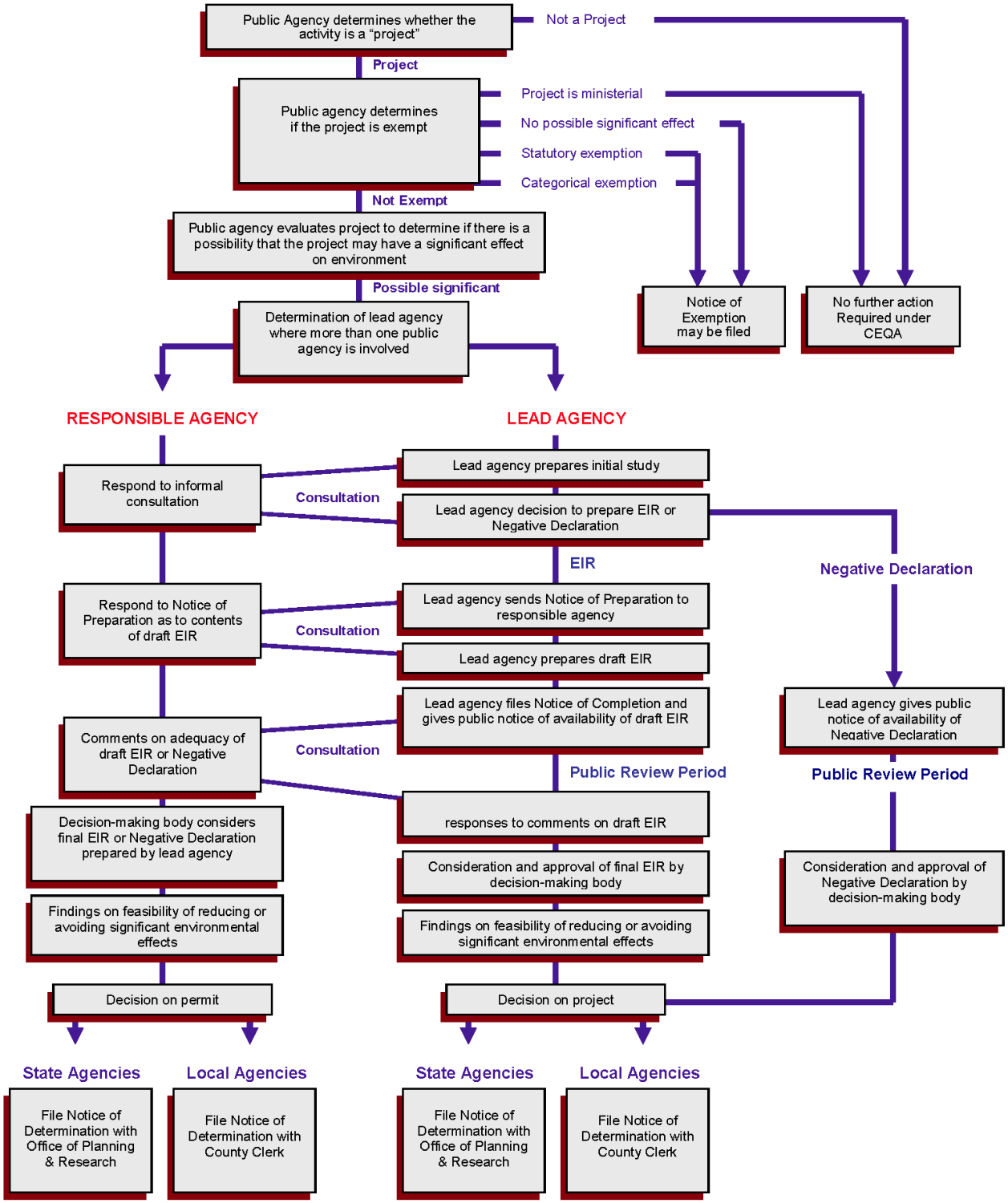
Negative Declaration/Mitigated Negative Declaration: The District needs all of the basic information required by CEQA Guidelines in order to provide a thorough review. This includes a brief description of the project, including a commonly used name for the project, if any; the location of the project, preferably shown on a map; and the name of the project proponent. To help the District identify previously reviewed projects, this information should correspond to, or reference, the same information provided during the Initial Study consultation process. The Lead Agency should include a copy of the Initial Study that documents reasons to support the Negative Declaration. Finally, any mitigation measures included in the project to avoid potentially significant effects should be in the consultation packet. If an air quality study is prepared for a project at the Initial Study level, it should be summarized and the results reported in the Initial Study and the entire air quality study should be provided to the District. All assumptions used in the modeling analysis for any project should be clearly stated.

Where an air quality study is prepared for a project, it should be summarized and the results reported in the Draft Negative Declaration/Mitigated Negative Declaration and the entire air quality study should be included as an appendix or as a separate report. The air quality report should include a brief air quality setting, the emissions analysis results, results of other air analyses, and a description of mitigation measures used to reduce the project's emissions. Provide either full documentation of calculations with justification of mitigation measures used when using manual method of quantification or using a model approved by the District. All assumptions used in the modeling analysis for any project should be clearly stated. When the Draft Negative Declaration/Mitigated includes air quality mitigation measures, the required mitigation monitoring and reporting should be included in or with the Draft Negative Declaration/Mitigated. The District recommends that the modeling outputs be provided as appendices to the Draft Negative Declaration/Mitigated. The District further recommends that the District be

provided with an electronic copy of all input and output files for all modeling.

Response to Comments: A Lead Agency's response to the District's comments on a Draft EIR may be in the form of the final EIR or may be a separate letter. The response should include the date, time, and location for when the Lead Agency proposes to certify the EIR.

Figure 5: CEQA Process Flowchart



7.8 Consultation with the District

CEQA provides that if a project may have a significant environmental effect the Lead Agency shall either prepare an Initial Study or proceed directly with preparation of an EIR [CCR §15063(a)]. As soon as a Lead Agency has determined that an Initial Study will be required, the Lead Agency shall consult informally with all Responsible Agencies and all Trustee Agencies responsible for resources affected by the project to obtain recommendations as to whether an EIR or a Negative Declaration should be prepared [CCR §15063(g)]. The District is available for consultation at any time in the project review process, but there are certain times when consultation is required. When the District has discretionary approval authority over a project for which another public agency is serving as Lead Agency, it is to be consulted as a Responsible Agency. When the District does not have any approval authority over a project, the District may be consulted as a commenting agency. CEQA requires or provides opportunities for consultation at various times during the environmental review process. These include opportunities for review prior to the preparation of the environmental document and during public review of the completed document. CEQA guidelines do not specify a time period for the informal consultation period; however, the District recommends Lead Agencies allow a minimum of ten working days.

In addition to satisfying CEQA requirements, identifying significant air quality impacts and mitigation measures early in the development of a project will allow fundamental design changes for the benefit of air quality at the lowest possible cost. The District invites project proponents, Lead Agencies, and interested parties to contact District staff or visit the District's Central Region office for consultation on the use of this guidance document or project review.

In addition to total annual emissions of criteria pollutants, the significance of project specific impacts on air quality is influenced by proximity of emission sources to sensitive receptors, frequency and duration of exposure, and the type of pollutant being emitted. Thus, not all projects require the same level of air quality assessment. When consulting with the District, it is imperative that all relevant emission sources be disclosed; permitted sources (e.g.: stationary sources) and non-permitted sources (e.g., construction related activities sources, and mobile sources), as well as proximity to sensitive receptors.

When provided sufficient project details, District staff's review of potential environmental impacts on air quality include the following determinations:

- Accuracy of the air quality setting data;
- Appropriate modeling assumptions;
- Whether air quality impacts are adequately described;
- Whether feasible mitigation measures are identified; and
- Whether the District agrees with the overall conclusions regarding impacts on air quality.

To facilitate District review of the proposed project, the District recommends that a Lead Agency's consultation request includes the following information:

- Complete and accurate project description, including project proponent contact information
- Identification of potential emission sources and potential magnitude including air pollutant emissions resulting from:
  - Construction related activities;
  - Operational activities; and
  - Mobile source activities
- Land use designation
- Project size
- Proximity to sensitive receptors
- Conformance with ARB's *Recommendations on Siting New Sensitive Land Uses*
- A copy of the Lead Agency's Initial Study, if prepared
- Identification of project design elements or potential mitigation measures that would reduce project-related impacts on air quality

The consultation process can be further expedited when the Lead Agency or project proponent has conducted a screening level analysis to identify potential impacts on air quality. Lead Agencies are encouraged to use the screening tool presented in section 6.5 (Potential Land Use Conflicts and Exposure of Sensitive Receptors) to identify potential conflicts between land use and sensitive receptors and include the result of their analysis in the referral document.

The most current screening tools are available on the District's website:
www.valleyair.org/ceqa

7.9 Determining Significance

The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting (See:

CCR §15064 et seq.). When evaluating environmental impacts of a project, all project phases must be considered: planning, acquisition, development, and operation.

The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record. Substantial evidence shall include facts, reasonable assumptions predicated upon facts and expert opinion supported by facts. Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence (CCR §15064(f)(5)). In determining whether a project would have an adverse environmental impact both direct physical changes in the environment and reasonably foreseeable indirect physical changes in the environment, which may be caused by the project shall be considered (CCR §15064(d)).

CEQA Guidelines establish the required content in environmental review documents. However, standards of adequacy for environmental assessments are not precise. Readers should be aware that the adequacy of an assessing significance is influenced by changes in statutes, guidelines, and case law.

"Substantial evidence", as used in the CEQA guidelines, means enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached. Whether a fair argument can be made that the project may have a significant effect on the environment is to be determined by examining the whole record before the Lead Agency. Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly erroneous or inaccurate, or evidence of social or economic impacts, which do not contribute to or are not caused by physical impacts on the environment does not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.

7.10 Thresholds of Significance

A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect. Non-compliance with a threshold of significance means the effect will normally be determined to be significant. Compliance with a threshold of significance means the effect normally will be determined to be less than significant (CCR §15064.7).

Under CEQA, each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. Thresholds of significance to be adopted for general use as part of the Lead Agency's environmental review process must be adopted by ordinance, resolution, rule, or regulation, and developed through a public review process and be supported by substantial evidence. When adopting thresholds of significance, a Lead Agency may consider thresholds of significance previously adopted or recommended by other public

agencies or recommended by experts, provided the decision of the Lead Agency to adopt such thresholds is supported by substantial evidence (CCR §15064.7).

As discussed further in Chapter 8 of this document, the District has established thresholds of significance for assessing potential air quality impacts.

Specific information for assessing significance of project specific impacts on air quality, including screening tools and modeling guidance is available online at www.valleyair.org/ceqa

Furthermore, the District maintains a staff of air quality specialists, highly trained in assessing air quality impacts. For large, unusual, or complex projects, the District recommends that Lead Agencies and project proponents contact the District to discuss project specific details.

The District recommends that other agencies apply the adopted air quality significance thresholds when evaluating project specific impacts on air quality within the San Joaquin Valley. However, it is recognized that the final determination of whether a project would have a significant effect on air quality is ultimately within the purview of the Lead Agency (CCR §15064(c)).

7.11 Environmental Checklist – Air Quality Impacts

The Environmental Checklist Form (Appendix G) of the CEQA Guidelines provides that the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to determine if a project would:

a. Conflict with or obstruct implementation of the applicable air quality plan,
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation,
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors),
d. Expose sensitive receptors to substantial pollutant concentrations, or
e. Create objectionable odors affecting a substantial number of people.

7.12 Conflict With or Obstruct Implementation of the Applicable Air Quality Plan?

The District is tasked with implementing programs and regulations required by the Federal Clean Air Act and the California Clean Air Act. In that capacity, the District has prepared plans to attain Federal and State ambient air quality standards.

As presented in Chapter 8, the District has established thresholds of significance for criteria pollutant emissions, which are based on District New Source Review (NSR) offset requirements for stationary sources. Stationary sources in the District are subject to some of the toughest regulatory requirements in the nation. Emission reductions achieved through implementation of District offset requirements are a major component of the District's air quality plans. Thus, projects with emissions below the thresholds of significance for criteria pollutants would be determined to "Not conflict or obstruct implementation of the District's air quality plan".

7.13 Violate any Air Quality Standard or Contribute Substantially to an Existing or Projected Air Quality Violation?

Determination of whether project emissions would violate any ambient air quality standard is largely a function of air quality dispersion modeling. If project emissions would not exceed State and Federal ambient air quality standards at the project's property boundaries, the project would be considered to not violate any air quality standard or contribute substantially to an existing or projected air quality violation.

The need to perform an air quality dispersion modeling analysis for any project (urban development, commercial, or industrial projects) is determined on a case-by-case basis depending on the level of emissions associated with the proposed project. If such modeling is found necessary, the project consultant should check with the District to determine the appropriate model and input data to use in the analysis. Specific information for assessing significance, including screening tools and modeling guidance is available on-line at the District's website www.valleyair.org.

7.14 Result in a Cumulatively Considerable Net Increase of any Criteria Pollutant?

CEQA defines cumulative impacts as two or more individual effects which, when considered together, are either significant or "cumulatively considerable", meaning they add considerably to a significant environmental impact. An adequate cumulative impact analysis considers a project over time and in conjunction with other past, present, and reasonably foreseeable future projects whose impacts might compound those of the project being assessed.

By its very nature, air pollution is largely a cumulative impact. The nonattainment status of regional pollutants is a result of past and present development. Future attainment of

State and Federal ambient air quality standards is a function of successful implementation of the District's attainment plans. Consequently, the District's application of thresholds of significance for criteria pollutants is relevant to the determination of whether a project's individual emissions would have a cumulatively significant impact on air quality.

A Lead Agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program, including, but not limited to an air quality attainment or maintenance plan that provides specific requirements that will avoid or substantially lessen the cumulative problem within the geographic area in which the project is located [CCR §15064(h)(3)].

Thus, if project specific emissions exceed the thresholds of significance for criteria pollutants the project would be expected to result in a cumulatively considerable net increase of any criteria pollutant for which the District is in non-attainment under applicable Federal or State ambient air quality standards. This does not imply that if the project is below all such significance thresholds, it cannot be cumulatively significant. The thresholds of significance are presented in Chapter 8.

7.15 Expose Sensitive Receptors to Substantial Pollutant Concentrations?

Determination of whether project emissions would expose sensitive receptors to substantial pollutant concentrations is a function of assessing potential health risks.

Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors. When evaluating whether a development proposal has the potential to result in localized impacts, Lead Agency staff need to consider the nature of the air pollutant emissions, the proximity between the emitting facility and sensitive receptors, the direction of prevailing winds, and local topography.

Lead Agencies are encouraged to use the screening tools for Toxic Air Contaminant presented in section 6.5 (Potential Land Use Conflicts and Exposure of Sensitive Receptors) to identify potential conflicts between land use and sensitive receptors and include the result of their analysis in the referral document.

7.16 Create Objectionable Odors Affecting a Substantial Number of People?

Due to the subjective nature of odor impacts, the number of variables that can influence the potential for an odor impact, and the variety of odor sources, there are no quantitative or formulaic methodologies to determine the presence of a significant odor impact.

Rather, the District recommends that odor analyses strive to fully disclose all pertinent information.

The intensity of an odor source's operations and its proximity to sensitive receptors influences the potential significance of odor emissions. The District has identified some common types of facilities that have been known to produce odors in the San Joaquin Valley. These are presented in Chapter 8 along with a reasonable distance from the source within which, the degree of odors could possibly be significant.

7.17 Notice of Intent to Adopt a Negative or Mitigated Negative Declaration

A negative declaration (ND) or mitigated negative declaration (MND) for a project subject to CEQA shall be prepared when:

1. There is no substantial evidence, in light of the whole record before the agency, that the project may have a significant effect on the environment, or
2. Revisions in the project plans or proposals made by or agreed to by the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effects would occur, and there is no substantial evidence, in light of the whole record before the agency, that the project as revised may have a significant effect on the environment (CCR §15070).

CEQA Guidelines require the Lead Agency to provide a Notice of Intent to Adopt a negative declaration or mitigated negative declaration to the public, responsible agencies, trustee agencies, and the county clerk of each county within which the proposed project is located (CCR §15072 (a)). At a minimum, the comment period for proposed negative or mitigated negative declarations is 20-days (CCR §15073 (a)). When a proposed negative declaration or mitigated negative declaration and initial study are submitted to the State Clearinghouse for review by State agencies, the public review period shall not be less than 30 days (CCR §15073 (a)).

The basic information required by CEQA Guidelines §15071 consists of:

- A brief description of the project, including a commonly used name for the project, if any;
- The location of the project, preferably shown on a map, and the name of the project proponent;
- A proposed finding that the project will not have a significant effect on the environment;
- An attached copy of the Initial Study documenting reasons to support the finding; and
- Mitigation measures, if any, included in the project to avoid potentially significant effects.

In addition to the basic information required by CEQA, the District recommends that it be provided with copies of all technical analyses that relate to air quality, including but not limited to traffic analyses, growth impact projections, health risk assessments, sensitive receptor locations, characterization of construction related emissions, and characterization of stationary, mobile sources and area source emissions.

To facilitate the District's assessment of the adequacy of the determination that a project would not result in a significant impact on air quality the District recommends that it be provided with copies, in electronic format, of all supporting modeling files for risk assessments and characterization of criteria pollutant emissions.

7.18 Notice of Preparation of Environmental Impact Report

Within established exceptions, a Lead Agency shall prepare an Environmental Impact Report (EIR) if there is substantial evidence that any aspect of a project, either individually or cumulatively, may cause a significant effect on the environment, regardless of whether the overall effect of the project is adverse or beneficial (CCR §15063(b)(1)). Upon determination to prepare an EIR, the Lead Agency shall provide each Responsible and Trustee Agency a Notice of Preparation (NOP) stating that an EIR will be prepared. The Lead Agency may begin work on the draft EIR immediately without awaiting responses to the Notice of Preparation. However, the draft EIR cannot be circulated until after the close of the 30-day comment period for the NOP has closed.

A Notice of Preparation shall provide Responsible and Trustee Agencies with sufficient information describing the project and the potential environmental effects to enable the Responsible Agencies to make a meaningful response. At a minimum, the Notice of Preparation shall include a description of the project, identify the project location, and identify probable environmental effects (CCR §15082).

The District recommends that in addition to the basic information required by CEQA, the Notice of Preparation include relevant information concerning proximity to sensitive receptors, and proximity to existing emission sources.

7.19 Disclosure of Significant Environmental Impacts

Disclosure of environmental impacts should include relevant specifics of the area, resources involved, physical changes, alterations to ecological systems, changes induced in population distribution, population concentration, and the human use of the land (including commercial and residential development). Health and safety problems caused by the physical changes shall also be discussed (CCR §15126.2).

Project specific air pollutant emissions can result from both construction and operational activities. Specific sources of air pollution emissions include on-road and off-road motor

vehicles, off-road equipment, natural gas and electricity usage, architectural coatings and solvents, fugitive emissions, area source emissions, and emissions from various commercial and industrial operations. The environmental assessment should discuss air quality impacts from all identifiable emission sources.

The environmental review should also analyze any significant environmental effects the project might cause by bringing development and people into the area affected. For example, an Environmental Impact Report (EIR) on a subdivision that would locate residences in close proximity to a source of toxic air contaminants (TACs), such as a freeway, should identify the health risk hazard to future occupants of the subdivision. Please consult section 6.5 (Potential Land Use Conflicts and Exposure of Sensitive Receptors) for a detailed discussion regarding assessing both Type A (New project impacts existing receptors) and Type B (New project impacted by existing toxic sources) projects.

To assist Lead Agencies in assessing project specific impacts on air quality, the Air Quality Section of Appendix G of the CEQA Guidelines (*Environmental Checklist Form*) contains a list of air quality effects that may be deemed potentially significant:

1. Conflict with or obstruct implementation of the applicable air quality plan;
2. Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
3. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standards (including releasing emissions which exceed quantitative thresholds for ozone precursors);
4. Expose sensitive receptors to substantial pollutant concentrations; or
5. Create objectionable odors affecting a substantial number of people.

For some impacts listed above, the criteria to be applied are straight forward, but for others, interpretation is required. To bring consistency to the process of analyzing project specific impacts on air quality and to assist Lead Agencies in preparing environmental assessments which meet the standards of adequacy as established under CEQA, the District has developed various screening tools to streamline the process of determining if a project has the potential to exceed District adopted thresholds of significance.

The most current screening tools are available on the District's website:
www.valleyair.org/ceqa

7.20 Consideration and Discussion of Mitigation Measures

CEQA establishes a duty for public agencies to avoid or minimize environmental damage where feasible. A public agency should not approve a project as proposed if there are feasible alternatives or mitigation measures available that would substantially lessen any significant effects that the project would have on the environment. Mitigation measures are not required for effects which are not found to be significant (CCR §15126.4(a)(3)). Mitigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments. In the case of the adoption of a plan, policy, regulation, or other public project, mitigation measures can be incorporated into the plan, policy, regulation, or project design (CCR §15126.4(a)(2)).

Mitigation includes the following:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
3. Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
5. Compensating for the impact by replacing or providing substitute resources or environments.

In deciding whether changes in a project are feasible, an agency may consider specific economic, environmental, legal, social, and technological factors (CCR §15021). When considering alternatives and mitigation measures, a Responsible Agency is more limited than a Lead Agency. A Responsible Agency has responsibility for mitigating or avoiding only the direct or indirect environmental effects of those parts of the project which it decides to carry out, finance, or approve (CCR §15096(g)).

7.21 Mitigation Monitoring and Reporting

CEQA requires that when a public agency makes findings that changes or alterations have been incorporated into the project which mitigate or avoid the significant effects identified in an EIR, or an MND, the agency must also adopt a program for reporting and monitoring mitigation measures that were adopted or made conditions of project approval. This requirement is intended to assure that mitigation measures included in a certified EIR or MND are indeed implemented. Monitoring for the measures recommended in this document is best accomplished by the agency with land use approval. A Mitigation Monitoring and Reporting Program should include the following components:

- a description of each mitigation measure adopted by the Lead Agency;
- the party responsible for implementing each mitigation measure;
- a schedule for the implementation of each mitigation measure;
- the agency or entity responsible for monitoring mitigation measure implementation;
- criteria for assessing whether each measure has been implemented;
- enforcement mechanism(s).

7.22 CEQA Streamlining

The District encourages Lead Agencies to use the streamlining opportunities provided within CEQA. The use of master EIRs, tiered EIRs, subsequent EIRs/Negative Declarations, etc. allows Lead Agencies to focus on regional and general air quality impacts early in the planning process. However, project specific impacts, particularly potential risks to sensitive receptors, cannot be fully assessed until later in the process when project specific details are known. A project that is ordinarily insignificant in its impact on the environment may, in a particularly sensitive environment, be significant. CEQA provides that a categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances (CCR §15300.2(c)). Therefore, the District recommends that projects which would normally be approved, based on a previously approved environmental document, be screened to identify project specific potential impacts to nearby sensitive receptors.

7.23 Relationship between CEQA and NEPA

Some projects subject to CEQA may also require compliance under Federal environmental law, namely the National Environmental Policy Act (NEPA). Both NEPA and CEQA have similar goals. They require agencies to determine whether a proposed action or project may have a significant impact on the environment, and to determine the appropriate level of environmental review.

NEPA and CEQA are similar, both in intent and in the review process (the analyses, public engagement, and document preparation) that they dictate. Importantly, both statutes encourage a joint Federal and state review where a project requires both Federal and state approvals. Indeed, in such cases a joint NEPA-CEQA analysis may be appropriate to avoid redundancy, improve efficiency and interagency cooperation, and be easier for applicants and citizens to navigate.

When NEPA and CEQA apply, agencies must comply by using a Categorical Exclusion/Categorical Exemption, Environmental Assessment and Finding of No Significant Impact (or Mitigated Finding of No Significant Impact)/ Initial Study and

Negative Declaration (or Mitigated Negative Declaration), or an Environmental Impact Statement/Environmental Impact Report. Under certain circumstances, the CEQA Guidelines allow public agencies to use a NEPA document rather than prepare a Negative Declaration, Mitigated Negative Declaration or Environmental Impact Report.

Despite the similarities between NEPA and CEQA, there are several differences that require careful coordination between the Federal and state agencies responsible for complying with NEPA and CEQA. Conflict arising from those differences can create unnecessary delay, confusion, and legal vulnerability. In general, NEPA differs from CEQA in that it does not require a separate discussion of mitigation measures, or growth inducing impacts. These points of analysis need to be added before an Environmental Impact Statement (EIS) required under NEPA can be used as an EIR. If the NEPA and CEQA Lead Agencies will not be combining documents into one, the District recommends that the consultation notices for each document reference the other agency's contact information, including contact name and phone number.

This guidance document can also be used to prepare a NEPA or joint CEQA-NEPA analysis, unless noted otherwise. See PRC §§21083.5, 21083.6, and 21083.7 and CCR §§15220 - 15228 for more information on combined EIR-EIS projects.

CHAPTER 8

ASSESSING AIR QUALITY IMPACTS

8.1 Introduction

This chapter provides general guidance on assessing significance of project-related impacts on air quality.

Specific information for assessing significance, including screening tools and modeling guidance is available at the District's website: www.valleyair.org/ceqa

The Air Quality Section of Appendix G of the CEQA Guidelines (Environmental Checklist Form) contains a list of effects to be assessed using the significance criteria established by the applicable air quality management or air pollution control district to determine if a project would:

a. Conflict with or obstruct implementation of the applicable air quality plan,
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation,
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors),
d. Expose sensitive receptors to substantial pollutant concentrations, or
e. Create objectionable odors affecting a substantial number of people

To assess the air quality impact using these five effects per CEQA guidelines, the District has established significance thresholds to assist Lead Agencies in determining whether a project may have a significant air quality impact during the initial study. If the project exceeds the significance threshold established for an effect, the project would be considered to have a significant impact on air quality. If, during the preparation of the Initial Study, the Lead Agency finds that any of the following thresholds may be exceeded and cannot be mitigated, then a determination of significant air quality impact must be made and an EIR is required.

While CEQA Guidelines state that an ironclad definition of a significant effect is not possible because the significance of an effect may vary with the setting, the District has determined that the setting, as referred to in CEQA, can be defined for air quality. Under California state law, the SJVAB is defined as a distinct geographic area with a critical air pollution problem for which ambient air quality standards have been promulgated to protect public health. As such, the District resolves that significance thresholds established herein are based on scientific and factual data.

Therefore, the District recommends that the Lead Agencies apply the adopted significance thresholds when evaluating project specific impacts on air quality within the San Joaquin Valley. If the Lead Agency determines the proposed project would exceed

any of the significance thresholds, then an environmental document should be prepared. However, it is recognized that the final determination of whether a project would have a significant effect on air quality is ultimately within the purview of the Lead Agency pursuant to CEQA Guidelines (CCR §15064(c)).

The District identifies thresholds that separate a project's short-term emissions from its long-term emissions. The short-term emissions are mainly related to the construction phase of a project and are recognized to be short in duration. The long-term emissions are mainly related to the activities that will occur indefinitely as a result of project operations. In addition, CEQA states that another condition that could establish a project as having a significant effect on the environment is effects that are considered "cumulatively considerable." Thresholds for project construction impacts, project operations, and cumulative impacts are discussed below.

This chapter along with the thresholds of significance also presents District Rules and Regulation in relation to assessing the project-related impacts. The District recommends that any air quality assessment reflect emission reductions achieved through compliance with District rules and regulations.

8.2 District Rules and Regulations

Project subject to District rules and regulation would reduce its impacts on air quality through compliance with regulatory requirements. In general, a regulation is a collection of rules, each of which deals with a specific topic. For example, Regulation II (Permits) deals with permitting emission sources and includes rules such as District permit requirements (Rule 2010), New and Modified Stationary Source Review (Rule 2201), and implementation of Emission Reduction Credit Banking (Rule 2301). The following is a list of common rules and regulation that can be applicable to a project.

Current District rules can be found online:
www.valleyair.org/rules/1ruleslist.htm.

8.2.1 District Regulation II (Permits)

District Regulation II (Permits) applies to permitted emission sources and includes rules such as District permit requirements (Rule 2010), New and Modified Stationary Source Review (Rule 2201), and implementation of Emission Reduction Credit Banking (Rule 2301).

Many industrial projects and some commercial projects require District permits. Rule 2010 states that "any person who plans to or does operate, construct, alter, or replace any source of emission of air contaminants" must obtain approval of the Air

Pollution Control Officer and receive an Authority to Construct and a Permit to Operate.

Examples of air contaminant emitting equipment and processes include (but are not limited to) the following:

- Agricultural products processing
- Bulk material handling
- Chemical blending, mixing, manufacturing, storage, etc.
- Combustion equipment (boilers, engines, heaters, incinerators, etc.)
- Metals etching, melting, plating, refining, etc.
- Plastics & fiberglass forming and manufacturing
- Petroleum production, manufacturing, storage, and distribution
- Rock & mineral mining and processing
- Solvent use (degreasing, dry-cleaning, etc.)
- Surface coating and preparation (painting, blasting, etc.)

District Regulation II ensures that stationary source emissions will be reduced or mitigated to below the District's significance thresholds. However, the Lead Agency can, and should, make an exception to this determination if special circumstances suggest that the emissions from any permitted or exempt source may cause a significant air quality impact. For example, if a source may emit objectionable odors, then odor impacts on nearby receptors should be considered a potentially significant air quality impact.

District implementation of New Source Review (NSR) ensures that there is no net increase in emissions above specified thresholds from New and Modified Stationary Sources for all nonattainment pollutants and their precursors. Furthermore, in general, permitted sources emitting more than the NSR Offset Thresholds for any criteria pollutant must offset all emission increases in excess of the thresholds. However, under certain circumstances, the District may be precluded by state law or other District rule requirements from requiring a stationary source to offset emissions increases.

CEQA also requires that the project description include a list of agencies that are expected to use the environmental document in their decision-making, and a list of the approvals for which the environmental document will be used. If the project will require a permit from the District, this should be cited in the project description section of the CEQA document.

8.2.2 District Regulation IV (Prohibitions)

District Regulation IV (Prohibitions) is comprised of prohibitory rules that are written to achieve emission reductions from specific source categories or from all sources. These rules are applicable to existing sources (retrofit requirements) as well as new sources. Examples of source specific prohibitory rules include Rule 4570 (Confined Animal Facilities), Rule 4623 (Storage of Organic Liquids), and Rule 4901 (Wood burning Fireplaces and Wood Burning Heaters). The above list of rules is neither exhaustive nor exclusive. Within the environmental assessment, it is not necessary to identify all prohibitory rules that would apply to a specific project. However, applicants are encouraged to contact the District's Small Business Assistance Office to identify District rules or regulations that apply to the project or to obtain information about District permit requirements. By phone at: Fresno (559) 230-5888; Bakersfield (661) 392-5665; Modesto (209) 557-6446.

8.2.3 District Regulation VIII (Fugitive PM_{10} Prohibition)

The purpose of Regulation VIII (Reg. VIII) is to reduce ambient concentrations of fine particulate matter (PM_{10}) by requiring actions to prevent, reduce or mitigate anthropogenic fugitive dust emissions. Reg. VIII requires property owners, contractors, developers, equipment operators, farmers and public agencies to control fugitive dust emissions from specified outdoor fugitive dust sources, including:

- Construction sites
- Excavation, Demolition, and other earthmoving activities
- Bulk material handling, storage and transport
- Carryout and Trackout
- Vacant land
- Paved and unpaved roads
- Unpaved vehicle traffic areas

Regulation VIII specifies the following measures to control fugitive dust:

- Apply water to unpaved surfaces and areas
- Use non-toxic chemical or organic dust suppressants on unpaved roads and traffic areas
- Limit or reduce vehicle speed on unpaved roads and traffic areas
- Maintain areas in a stabilized condition by restricting vehicle access

- Install wind barriers
- During high winds, cease outdoor activities that disturb the soil.
- Keep bulk materials sufficiently wet when handling
- Store and handle materials in a three-sided structure
- When storing bulk materials, apply water to the surface or cover the storage pile with a tarp
- Don't overload haul trucks. Overloaded trucks are likely to spill bulk materials
- Cover haul trucks with a tarp or other suitable cover. Or, wet the top of the load enough to limit visible dust emissions
- Clean the interior of cargo compartments on emptied haul trucks prior to leaving a site
- Prevent trackout by installing a trackout control device
- Clean up trackout at least once a day. If along a busy road or highway, clean up trackout immediately
- Monitor dust-generating activities and implement appropriate measures for maximum dust control

For projects in which construction related activities would disturb equal to or greater than 1-acre of surface area, the District recommends that demonstration of receipt of a District approved Dust Control Plan or Construction Notification form, before issuance of the first grading permit, be made a condition of project approval.

It should be noted that although compliance with District Regulation VIII substantially reduces project specific fugitive dust emissions, it may not be sufficient to reduce project specific emissions to less than significant levels. Furthermore, District Regulation VIII does not reduce construction exhaust emissions.

8.2.4 District Rule 9510 (Indirect Source Review)

District Rule 9510 (ISR) is intended to reduce a project's impact on air quality through project design elements or mitigation by payments of applicable off-site mitigation fees. Compliance with Rule 9510 will reduce construction exhaust NOx and PM_{10} emissions by 20 percent and 45 percent respectively. Compliance with Rule 9510 will reduce operational emissions of NOx and PM_{10} emissions by 33.3 percent and 50 percent respectively.

Individual development projects would be subject to ISR requirements if upon full build-out the project would include or exceed any one of the following:

- 50 dwelling units;
- 2,000 square feet of commercial space;
- 25,000 square feet of light industrial space;
- 100,000 square feet of heavy industrial space;

- 20,000 square feet of medical office space;
- 39,000 square feet of general office space;
- 9,000 square feet of educational space;
- 10,000 square feet of government space;
- 20,000 square feet of recreational space; or
- 9,000 square feet of space not identified above

The ISR rule also applies to any transportation or transit project where construction exhaust emissions equal or exceed two (2.0) tons NOx or two (2.0) tons of PM_{10}.

For projects subject to District Rule 9510, the District recommends that demonstration of compliance with District Rule 9510, including payment of all applicable fees before issuance of the first building permit, be made a condition of project approval.

Information on District Rule 9510 can be found on the District's website:
www.valleyair.org/ISR/ISRHome.htm

It should be noted that although compliance with District Rule 9510 substantially reduces project specific impacts on air quality, it may not be sufficient to reduce project specific emissions to less than significant levels.

8.2.5 District Rule 9410 (Employer Based Trip Reduction)

The eTRIP Rule (Rule 9410, Employer Based Trip Reduction), requires larger employers to establish an Employer Trip Reduction Implementation Plan (eTRIP). An eTRIP is a set of measures that encourages employees to use alternative transportation and ridesharing for their morning and evening commutes. Each measure contributes to a workplace where it is easier for employees to choose to use ridesharing or alternative transportation. Through this rule, single-occupancy vehicle trips are reduced, thus reducing emissions of oxides of nitrogen (NOx), volatile organic compounds (VOC) and particulate matter (PM).

Detailed information regarding the eTrip rule can be found at
www.valleyair.org/Programs/Rule9410TripReduction/eTRIP_main.htm

8.3 Thresholds of Significance – Criteria Pollutant Emissions

As of the date of this document, the District's current adopted thresholds of significance for criteria pollutant emissions and their application is presented in the following table.

Table 2: Air Quality Thresholds of Significance – Criteria Pollutants

Pollutant/Precursor	Construction Emissions	Operational Emissions	
		Permitted Equipment and Activities	Non-Permitted Equipment and Activities
	Emissions (tpy)	*Emissions (tpy)*	*Emissions (tpy)*
CO	100	100	100
NOx	10	10	10
ROG	10	10	10
SOx	27	27	27
PM_{10}	15	15	15
$PM_{2.5}$	15	15	15

Check for updated thresholds of significance at www.valleyair.org/ceqa

The significance of the impacts of the emissions from construction, operational non-permitted equipment and activities, and operational permitted equipment and activities are evaluated separately. The thresholds of significance are based on a calendar year basis. For construction emissions, the annual emissions are evaluated on a rolling 12-month period.

A project evaluation should characterize emissions associated with the following:

Construction related emissions

- Grading, excavation, road building, and other earth moving activities
- Travel by construction equipment, especially on unpaved surfaces
- Exhaust from construction equipment
- Architectural coatings
- Asphalt paving
- Demolition and renovation of buildings
- Off-road construction equipment

Operational related emissions

- Permitted equipment and activities (Stationary Source Equipment)
- Non-permitted equipment and activities
- Mobile sources (on-site and on-road)
- Non-permitted activities

8.3.1 Basis for Air Quality Thresholds of Significance

The District has determined that use of District Rule 2201 (New Source Review - NSR) Offset thresholds as the District thresholds of significance for criteria pollutants under CCR §15064.7 is an appropriate and effective means of promoting consistency in significance determinations within the environmental review process and is applicable to both stationary and non-stationary emissions sources. The general term, "stationary sources," refers to facilities that are subject to Air District air quality permitting. "Stationary source projects" are proposals that include, at least in part, equipment or activities that are subject to District air quality permitting. Board-adopted revisions to criteria pollutant offset thresholds in the District NSR Rule serve as board-adopted revisions to the District CEQA significance thresholds for criteria pollutants.

As presented in Chapter 3, at the Federal level, the District is designated as extreme nonattainment for the 8-hour ozone standard and is designated nonattainment for Federal $PM_{2.5}$ standards. Consistent with Clean Air Act requirements, the District has adopted attainment plans that demonstrate how the District will attain and maintain the National Ambient Air Quality Standards. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee to the US EPA. The Clean Air Act requires EPA to review each plan and any plan revisions and to approve the plan or plan revisions if consistent with the Clean Air Act.

NSR is a major component of the District's attainment strategy as it relates to growth. It applies to new and modified stationary sources of air pollution. NSR provides mechanisms, including emission trade-offs, by which Authorities to Construct such sources may be granted, without interfering with the attainment or maintenance of Ambient Air Quality Standards. District implementation of NSR ensures that there is no net increase in emissions above specified thresholds from new and modified Stationary Sources for all nonattainment pollutants and their precursors.

Under NSR, all new permitted sources (emission units) with emission increases exceeding two (2) pounds per day, for any criteria pollutant is required to implement best available control technology (BACT). As defined in District Rule 2201, BACT is:

The most stringent emission limitation or control technique of the following:

1. Achieved in practice for such category and class of source;
2. Contained in any State Implementation Plan approved by the Environmental Protection Agency for such category and class of source. A specific limitation or control technique shall not apply if the owner of the proposed emissions unit demonstrates to the satisfaction of the APCO that such a limitation or control technique is not presently achievable; or
3. Contained in an applicable federal New Source Performance Standard; or
4. Any other emission limitation or control technique, including process and equipment changes of basic or control equipment, found by the APCO to be cost effective and technologically feasible for such class or category of sources or for a specific source.

Furthermore, all permitted sources emitting more than the New Source Review Offset Thresholds for any criteria pollutant must offset all emission increases in excess of the thresholds.

The District's thresholds of significance for criteria pollutants are applied to evaluate regional impacts of project specific emissions of air pollutants. Regional impacts of a project can be characterized in terms of total annual emissions of criteria pollutants and their impact on the District's ability to reach attainment.

The District's attainment plans demonstrate that project specific emissions below the District's offset thresholds will have a less than significant impact on air quality. Thus, the District concludes that use of District NSR Offset thresholds as the District thresholds of significance for criteria pollutants under CCR §15064.7 is an appropriate and effective means of promoting consistency in significance determinations within the environmental review process and are applicable to both stationary and non-stationary emissions sources. Board-adopted revisions to criteria pollutant offset thresholds in the District NSR Rule serve as board-adopted revisions to the District CEQA thresholds of significance for criteria pollutants.

As of this writing, the current NSR offset threshold for $PM_{2.5}$ is greater than the PM_{10} offset threshold. Since the thresholds of significance are based on the NSR offset thresholds, this would result in a $PM_{2.5}$ threshold that is higher than the PM_{10} threshold. In practice this is not possible since $PM_{2.5}$ is a subset of PM_{10}. Therefore, the $PM_{2.5}$ threshold of significance is based on the PM_{10} NSR offset threshold rather than the $PM_{2.5}$ NSR offset threshold.

8.3.2 Basis for Separate Construction and Operational Emission Thresholds

Emissions occurring in the construction phase of a project are evaluated separately from emissions occurring in the operational phase. The reason for this separation is that construction produces only temporary impacts while the operational phase will produce emissions indefinitely into the future. Although construction activities can produce substantial emissions and can represent a significant air quality impact, the effect is not permanent. In addition, construction emissions and operational emissions generally do not occur at the same time.

Also, measures to reduce and mitigate impacts from short-term activities differ from those applicable to long-term activities.

8.3.3 Basis for Separate Permitted and Non-Permitted Operational Emission Thresholds

Operational emissions from permitted equipment and activities are evaluated separately from non-permitted equipment and activities.

The District considered several options for assessing significance of operational emission impacts from permitted and non-permitted equipment and activities. Using emissions of NOx as an example, the optional paths can be described as follows:

Option 1: Establish a single threshold equal to the sum of the individual threshold of significance for permitted and non-permitted equipment and activities. For example, for NOx, the threshold of significance would be 20 tons year.

Option 2: Establish a single threshold of significance equal to the individual threshold of significance for permitted and non-permitted equipment and activities. For example, for NOx, the threshold of significance would be 10 tons per year applied to the sum of permitted and non-permitted equipment and activities

Option 3: Establish separate thresholds of significance for permitted and non-permitted equipment and activities, equal to its respective individual threshold of significance. For example, for NOx, the threshold of significance would be respectively 10 tons per year each for permitted and for non-permitted equipment and activities.

Option 4: Establish separate thresholds of significance for permitted and non-permitted equipment and activities, at some level below its respective individual threshold of significance. For example, for NOx, the threshold of significance would be less than 10 tons per year each for permitted and for non-permitted equipment and activities.

Option 1 is rejected because projects having only non-permitted emissions would be allowed 20 tons per year of NOx emissions before being determined to have a significant impact and required to implement all feasible mitigations. Option 1 was further rejected for projects having only permitted emissions because allowing 20 tons per year of NOx emissions before being found to have a significant impact and required to implement all feasible mitigations is contrary to the rationale that arrived at the establishment of the 10 ton per year NOx significance level for permitted sources: namely, district ozone and particulate attainment plans that demonstrate the expectation of attaining clean air standards while requiring mitigation for project increases above 10 tons per year of NOx emissions from a stationary source.

Option 2 is similar to Option 1, but establishes a threshold of 10 tons per year of NOx which is applied to the sum of permitted and non-permitted emissions. This approach is more environmentally protective than Option 1, because of the lower threshold. Option 2 would be acceptable for projects with emissions limited to permitted sources only. Only 10 tons of NOx emissions would be allowed before triggering a finding of significance and requirement of all feasible mitigations. That level of emissions increase is consistent with emissions accounted for in District attainment plans.

Similarly, Option 2 would be acceptable for projects with emissions limited to non-permitted sources only. Only 10 tons of NOx emissions would be allowed before triggering a finding of significance and requirement of all feasible mitigation. That level of emissions increase is consistent with emissions accounted for in District attainment plans.

However, Option 2 is not acceptable for projects that involve both permitted and non-permitted sources. For example, if project-specific emissions include 2 tons per year mobile source emissions, a combined threshold of 10 tons per year would limit stationary source impacts to no more than 8 tons per year before triggering a finding of significance and requirement of all feasible mitigations. However, the District's attainment plans demonstrate that project specific-emissions of 10 tons per year of NOx from a permitted source, without mitigation, will not prevent the District from achieving attainment of ambient air quality standards. Because District's attainment plans do not justify a finding of significance at emissions levels lower than 10 tons of NOx emissions per year of unmitigated emissions, a lower threshold cannot be established. Because a combined threshold of 10 tons per

year effectively reduces the threshold for permitted sources to some level below the demonstrated 10 ton level, Option 2 is rejected.

Option 3 is the method of determining significance that the District has been implementing for a number of years. As demonstrated, Option 3 is a more environmental and health protective threshold than a combined 20 ton per year threshold, maintains consistency with the basis of the District's 10 ton threshold for permitted sources, and is consistent with District attainment plans.

Option 4, establishing separate thresholds for permitted emissions and for non-permitted emissions at some level lower than 10 tons of NOx per year, is rejected for the same reason as Option 2. District attainment plans provide the basis for thresholds of significance, and the attainment plans allow 10 tons of emissions from stationary permitted sources before requiring mitigation.

For the reasons discussed above, the District implements Option 3 when determining significance impact.

Furthermore, measures taken to reduce and mitigate impacts from permitted equipment and activities differ from those applicable to non-permitted equipment and activities.

8.3.4 Screening Tools: Small Project Analysis Level (SPAL)

Determination of whether a project would exceed the applicable thresholds of significance for criteria pollutants requires quantification of project specific emissions. To streamline the process of assessing significance of criteria pollutant emissions from commonly encountered projects, the District has developed the screening tool, Small Project Analysis Level (SPAL). Using project type and size, the District has pre-quantified emissions and determined a size below which it is reasonable to conclude that a project would not exceed applicable thresholds of significance for criteria pollutants.

The District pre-calculated the emissions on a large number and types of projects to identify the level at which they have no possibility of exceeding the emissions thresholds. The information is provided in terms of vehicle trips required to exceed the SPAL threshold for five general land use categories. Sizes of various specific development types meeting SPAL are also provided. For a multi-use project, if its combined trip generation rate exceeds the lowest applicable trip threshold from, an air quality analysis should be prepared.

Note that even if a project is on the SPAL list, it does not relieve the Lead Agency from assessing a project for other potential significant air quality impacts. Some industrial and commercial projects may have impacts related to toxic air contaminants, hazardous materials, or odors. Projects containing sensitive

receptors such as residential subdivisions, schools, hospitals, and so on must be assessed for exposure to pollutants from existing or planned industrial and commercial development. Any project that includes demolition or renovation of existing buildings needs to contact the District. When a project falls under the SPAL, the Lead Agency should use the information in the initial study checklist, or whatever format used, to justify a finding of less than significant air quality impacts. The initial study should also verify that no sensitive receptors would be exposed to substantial pollutant concentrations as a result of the project.

Project size, as identified in the SPAL, is not a threshold of significance. SPAL is a screening tool. The Lead Agency has the responsibility to identify and avoid potential land use conflicts, such as potential exposure of sensitive receptors to sources of toxic air contaminants, sources of hazardous materials, and potential odors.

The District concludes that use of the screening tool as an appropriate and effective means of promoting consistency in significance determinations within the environmental review process.

The most current SPAL is available at
www.valleyair.org/ceqa

8.3.5 Construction Emissions

Emissions from construction activities are relatively short-term. However, on a regional level, even short-term activities can have significant impacts on air quality. Construction emissions consist mainly of exhaust emissions (NOx and PM) from construction equipment and other mobile sources, and fugitive dust (PM) emissions from earth moving activities. Construction activities also result in area source emissions such as emissions from paving and architectural coatings.

An Initial Study should evaluate emissions from construction activities. When considering the impact of construction emissions on air quality, on-site and on-road (off-site) mobile source emissions should also be assessed in the evaluation of construction related emissions. In addition, a Lead Agency should consider the extent to which compliance with District Regulation VIII and District Rule 9510 (see section 8.2 - District Rules and Regulations) will reduce fugitive dust and construction exhaust emissions.

The quantity of criteria pollutant emissions is proportionate to the size of the construction project. For large construction projects, compliance with District Regulation VIII and Rule 9510 may not reduce project specific construction emissions to below the District's thresholds of significance. As presented in

section 8.3.4 (Screening Tools: Small Project Analysis Level (SPAL)), to streamline the process of assessing the significance of the impact of criteria pollutant emissions from common projects, the District has developed the screening tool, *Small Project Analysis Level* (SPAL). Using project type and size, the District has pre-quantified emissions and determined a size below which it is reasonable to conclude that a project would not exceed applicable thresholds of significance for criteria pollutants.

If the initial study demonstrates that construction emissions would be less than significant based one SPAL screening levels, quantification of construction emissions is not necessary. However, to meet the standards of adequacy for disclosure of potential environmental impacts and mitigation, the District recommends that the Lead Agency's environmental document include a narrative that identifies the main sources of construction emissions and include sufficient discussion of applicable District rules and regulation and SPAL values to support the conclusion that criteria pollutant emissions from construction activities would have a less than significant impact on air quality.

If the initial study does not demonstrate that construction emissions would be less than significant, quantification of construction emissions is recommended. Because mitigation measures differ for mobile source and fugitive dust emissions, the District recommends that construction exhaust emissions and fugitive dust emissions be quantified separately. However, when determining significance of PM emissions, construction exhaust PM and fugitive dust PM is summed. A project would be determined to have a significant, short-term impact on air quality if any criteria pollutant exceeds its respective threshold of significance.

Demolition and Renovations

Demolition and renovation of buildings also generate PM_{10} emissions, and is of particular concern if the building(s) contain any asbestos-bearing materials. Buildings often include building materials containing asbestos. Airborne asbestos fibers pose a serious health threat if adequate control techniques are not carried out when the material is disturbed. The potential for asbestos emissions must also be considered. The demolition or renovation of asbestos containing building materials is subject to the limitations of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations as listed in the Code of Federal Regulations requiring notification and inspection. Most demolitions and many renovations are subject to a CAL-OSHA Certified asbestos inspection prior to start of activity. For asbestos, size or complexity of the project does not matter. However, the Lead Agency can also manually quantify PM_{10} emissions from demolition using the following emission factor: 0.00042 lb-PM_{10} per cubic feet of building volume. Project proponents needs to contact the District if their project includes demolition or renovation of existing buildings.

8.3.6 Operational Emissions – Permitted Equipment and Activities

The District's permitting process typically ensures that emissions of criteria pollutants from permitted equipment and activities at stationary sources are reduced or mitigated to below the District's thresholds of significance. District implementation of New Source Review (NSR) generally ensures that there is no net increase in emissions above specified thresholds from new and modified Stationary Sources for all nonattainment pollutants and their precursors. Permitted sources emitting more than the NSR Offset Thresholds for any criteria pollutant must, in general, offset all emission increases in excess of the thresholds. However, under certain circumstances, the District may be precluded by state law or other District rule requirements from requiring a stationary source to offset emissions increases.

Although permitted equipment or activities located at stationary sources will generally have a less than significant impact on air quality, to meet the standards of adequacy for disclosure of potential environmental impacts and mitigation, the Lead Agency's environmental document (Negative Declarations, Mitigated Negative Declarations, and Environmental Impact Reports) should include quantification and analysis of criteria pollutant emissions from permitted sources and activities for the purposes of determining significance.

8.3.7 Operational Emissions – Non-Permitted Equipment and Activities

Permit Exempt Equipment

Equipment at stationary sources that is exempt from District permit requirements because they fall below the District's emission thresholds for requiring permits is considered to have a less than significant impact on air quality. As such, there is no need to quantify emissions from these sources.

Mobile Sources

The majority of non-stationary source operational emissions results from mobile source activities, including both on-site and on-road motor vehicle use. For industrial projects, onsite mobile sources commonly include off-road vehicles, such as forklifts and tractors and on-road passenger vehicle use. Off-site mobile sources commonly include heavy-duty vehicles used to transport raw material and ship finished goods and light-duty vehicle use associated with employee trips. For commercial projects, mobile source activities include receipt of goods, and customer and employee trips. For development projects, mobile source activities commonly include vehicular travel from home to work, home to shop, and deliveries.

Other Non-Permitted Equipment and Activities

In addition to mobile source emissions, operational emissions from other non-permitted equipment and activities commonly include emissions from energy use, such as space heating, use of consumer products, and landscape maintenance. Although uncommon, there are source specific non-permitted activities, such as mining operations, that could have a significant impact on air quality.

Quantification

An Initial Study should evaluate emissions from all non-permitted equipment and activities, including all on-site and on-road (off-site) mobile source emissions. Emission levels from non-permitted equipment and activities are a function of project type and size. For example non-permitted equipment and activities would be different for a regional distribution versus a residential development project. As presented in Chapter 7, to streamline the process of assessing significance of criteria pollutant emissions from common projects, the District has developed the screening tool, *Small Project Analysis Level* (SPAL). Using project type and size, the District has pre-quantified emissions and determined a size below which it is reasonable to conclude that operational emissions from a project would not exceed applicable thresholds of significance for criteria pollutants.

If the initial study demonstrates that operational emissions from non-permitted equipment (excluding emissions from permit-exempt equipment) and activities would be less than significant based on SPAL screening levels, quantification of emissions from these sources may not be necessary. However, to meet the standards of adequacy for disclosure of potential environmental impacts and mitigation, the District recommends that the Lead Agency's environmental document include an narrative that identifies the main sources of non-permitted emissions and include sufficient discussion of District SPAL values to support the conclusion that criteria pollutant emissions from non-permitted emission sources would have a less than significant impact on air quality.

If the initial study does not demonstrate that emissions from non-permitted equipment (excluding emissions from permit-exempt equipment) and activities would be less than significant, quantification of those emissions is recommended. Because mitigation measures differ for mobile sources versus other non-permitted operational activities, the District recommends that mobile source (both exhaust emissions and fugitive dust emissions) be quantified separate from other non-permitted sources or activities. However, emissions from all non-permitted equipment and activities are summed by criteria pollutant when determining significance. A project would be determined to have a significant, long-term impact on air quality if any criteria pollutant resulting from non-permitted equipment and activities exceeds its respective threshold of significance.

8.4 Thresholds of Significance – Ambient Air Quality

The thresholds of significance for Ambient Air Quality are based on the California Ambient Air Quality Standard (CAAQS) and National Ambient Air Quality Standard (NAAQS). A project would be considered to have a significant impact if its emissions are predicted to cause or contribute to a violation of an ambient air quality standard by exceeding any of the following:

1. Any of the CAAQS, or
2. Any of the NAAQS, and if available, the associated Significant Impact Level (SIL).

The ambient air quality standards are listed in the following table.

The most current ambient air quality standards are available online at
www.arb.ca.gov/research/aaqs/aaqs2.pdf or
www.arb.ca.gov/research/aaqs/aaqs.htm

The most current SILs are listed in Attachment B of District Policy APR 1925 at
http://www.valleyair.org/policies_per/Policies/APR-1925.pdf

Table 3: Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentration[3]	Method[4]	Primary[3,5]	Secondary[3,6]	Method[7]
Ozone (O3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	--	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.075 ppm (147 µg/m^3)		
Respirable Particulate Matter (PM_{10})	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		--		
Fine Particulate Matter ($PM_{2.5}$)	24 Hour	--		35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	15 µg/m^3		
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	--	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	--	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		--	--	
Nitrogen Dioxide (NO_2)[8]	1 Hour	0.18 ppm (339 µg/m^3)	Gas Phase Chemiluminescence	100 ppb (188 µg/m^3)	--	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)		53 ppb (100 µg/m^3)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[9]	1 Hour	0.25 ppm (655 µg/m^3)	Ultraviolet Fluorescence	75 ppb (196 µg/m^3)		Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	--		--	0.5 ppm (1300 µg/m^3)	
	24 Hour	0.04 ppm (105 µg/m^3)		0.14 ppm (for certain areas)[9]	--	
	Annual Arithmetic Mean	--		0.030 ppm (for certain areas)[9]	--	
Lead[10,11]	30 Day Average	1.5 µg/m^3	Atomic Absorption	--	--	High Volume Sampler and Atomic Absorption
	Calendar Quarter	--		1.5 µg/m^3 (for certain areas)[11]	Same as Primary Standard	
	Rolling 3-Month Average	--		0.15 µg/m^3		
Visibility Reducing Particles[12]	8 Hour	See footnote 12	Beta Attenuation and Transmittance through Filter Tape	**No National Standard**		
Sulfates	24 Hour	25 µg/m3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

1. California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM10, PM2.5, and visibility reducing particles), are values that are not to be exceeded. All others are not to be equaled or

exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact the U.S. EPA for further clarification and current national policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent measurement method which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the U.S. EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the U.S. EPA.

8. To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the national standards are in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national standards to the California standards the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

9. On June 2, 2010, a new 1-hour SO2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

Note that the 1-hour national standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the 1-hour national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

10. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

11. The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

12. In 1989, the ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

8.4.1 Basis for Threshold

State and Federal ambient air quality standards have been established to protect public health and welfare from the adverse impacts of air pollution. The District concludes that use of the CAAQS/NAAQS to establish thresholds of significance under CEQA Guidelines §15064.7 is appropriate. In addition, using those standards promotes consistency in assessing significance of project specific impacts within the environmental review process.

Because of scientific advancements and potential changes in attainment status, CAAQS/NAAQS are subject to change. Revisions to CAAQS/NAAQS as adopted upon promulgation by the state of California and/or the Federal government will serve as revisions to the District's CEQA thresholds of significance for ambient air quality.

8.4.2 Ambient Air Quality Screening Tools

Impacts on air quality result from emissions generated during short-term activities (construction) and long-term activities (operations). Construction-related emissions consist mainly of exhaust emissions (NOx and PM) from construction equipment and other mobile sources, and fugitive dust (PM) emissions from earth moving activities. Operational emissions are source specific and consist of permitted equipment and activities and non-permitted equipment and activities.

When assessing the significance of project-related impacts on air quality, it should be noted that the impacts may be significant when on-site emission increases from construction activities or operational activities exceed the 100 pounds per day screening level of any criteria pollutant after implementation of all enforceable mitigation measures. Under such circumstance, the District recommends that an ambient air quality analysis be performed. An ambient air quality analysis uses air dispersion modeling to determine if emission increases from a project will cause or contribute to a violation of the ambient air quality standards.

More information on ambient air quality and associated modeling can be found online at http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm

8.4.3 Ambient Air Quality Analysis - Stationary Source Projects

The general term, "stationary sources," refers to facilities that are subject to District air quality permitting. "Stationary source projects" are proposals that include, at least in part, equipment or activities that are subject to District air quality permitting.

Construction Emissions

The District recommends that an ambient air quality analysis be performed when the increase in on-site emissions from construction activities exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Operational Emissions – Permitted Equipment and Activities

The District recommends that an ambient air quality analysis be performed when the increase in on-site operational emissions from permitted equipment and activities exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Operational Emissions - Non-Permitted Equipment and Activities

The District recommends that an ambient air quality analysis be performed when the increase in on-site operational emissions from non-permitted equipment and activities exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Ambient Air Quality Analysis

If an ambient air quality analysis is performed, the analysis should include emissions from both project specific permitted and non-permitted equipment and activities. The District recommends consultation with District staff to determine the appropriate model and input data to use in the analysis. Specific information for assessing significance, including screening tools and modeling guidance is available on-line at the District's website, www.valleyair.org/ceqa.

8.4.4 Ambient Air Quality Analysis – Development Projects

The general term, "stationary sources," refers to facilities that are subject to District air quality permitting. "Non-stationary source projects" are proposals that do not include any equipment or activities that are subject to District air quality permitting. An example is development projects.

The District applies the following guidance in determining whether an ambient air quality analysis should be conducted for development projects. For a typical development project, the need to perform an ambient air quality analysis is determined on a case-by-case basis, depending on project size.

The ISR rule is the District's groundbreaking regulation that requires developers to reduce emissions from residential and commercial development projects.

Compliance with ISR reduces criteria pollutant emissions from both construction and operation of development projects occurring within the San Joaquin Valley.

The District ISR rule exempts small development projects (see Table 4) from project-specific mitigation requirements. The District performed extensive analysis to identify small projects for which additional mitigation is not feasible. For instance, the exemptions include small residential housing developments of less than 50 units and commercial developments of less than 2,000 square feet.

All projects on the exemption list emit less than 2 tons per year of either PM_{10} or NOx, which is substantially lower than the District's 10-ton per year significance thresholds. Furthermore, as the tailpipe emissions from motor vehicles continue to decline, these projects will emit even less today than was estimated in 2005 when this rule was adopted. In addition, two tons per year is expected to result in daily emissions of less than the 100 lb/day screening level for either NOx or PM10 that the District has concluded that projects under the ISR exemption thresholds will have a less than significant impact on air quality.

Consequently, projects below ISR applicability thresholds are not expected to exceed the thresholds of significance for criteria pollutants emissions (see Section 8.3). In addition, projects below the ISR applicability thresholds are not expected to violate any air quality standards or contribute substantially to an existing or projected air quality violation and will not exceed the thresholds of significance for ambient air quality. In this case, the District concludes no emission calculation is needed and no ambient air quality analysis is required.

To meet the standards for adequacy for disclosure of potential environmental impacts and mitigation, the District recommends that the Lead Agency's environmental document include a qualitative assessment of why the project would not violate any air quality standard or contribute substantially to an existing or projected air quality violation. The District recommends that the narrative include sufficient detail of the proposed project size and type and applicability of the ISR rule to provide decision makers and the public with information enabling them to make an informed decision regarding the environmental consequences of criteria pollutant emissions from the proposed development project.

For projects equal to or above the applicability thresholds, the District recommends that emissions from the project be quantified to determine if an ambient air quality analysis is needed.

Table 4: AAQA Analysis Screening Levels For Development Project

Development Project Type	Space/Size
Residential	50 dwelling units
Commercial	2,000 square feet
Light Industrial	25,000 square feet
Heavy Industrial	100,000 square feet
Medical Office	20,000 square feet
General Office	39,000 square feet
Educational	9,000 square feet
Governmental	10,000 square feet
Recreational	20,000 square feet
Transportation/Transit	Construction exhaust emissions equal or exceed two (2.0) tons NOx or two (2.0) tons of PM_{10}*

* The District has established guidance when determining Indirect Source Review applicability for transportation projects. Projects in which construction of a new paved surface equals to or is less than 1/8 (0.125) miles in length are considered to have emissions below two tons NOx and two tons PM10. This applicability guidance is subject to change.

Project Construction Emissions

Compliance with Rule 9510 frequently reduces project specific emissions but may not be sufficient to reduce the project impact to less than significant levels. For large development projects, additional mitigation may be required and an Initial Study should be conducted to evaluate emission increases resulting from construction activities related to the project.

The District recommends that an ambient air quality analysis be performed when emissions of any criteria pollutant related to construction activities exceed the 100 pounds per day screening level, after compliance with Rule 9510 requirements and implementation of all enforceable mitigation measures.

If such ambient air quality analysis is determined to be necessary, the District recommends consultation with District staff to determine the appropriate model and input data to use in the analysis.

More information on ambient air quality and associated modeling can be found online at http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm

Project Operational Emissions

Compliance with Rule 9510 frequently reduces project specific emissions but may not be sufficient to reduce the project impact to less than significant levels. For large development projects, additional mitigation may be required and an Initial Study should be conducted to evaluate emission increases resulting from the project operational activities.

The District recommends that an ambient air quality analysis be performed for all criteria pollutants when emissions of any criteria pollutant resulting from project operational activities exceed the 100 pounds per day screening level, after compliance with Rule 9510 requirements and implementation of all enforceable mitigation measures.

If such ambient air quality analysis is determined to be necessary, the District recommends consultation with District staff to determine the appropriate model and input data to use in the analysis.

More information on ambient air quality and associated modeling can be found online at http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm

8.4.5 Ambient Air Quality - Carbon Monoxide Hot Spot from Mobile Sources

Emissions and ambient concentrations of carbon monoxide have decreased greatly in the recent past. These improvements are due largely to the introduction of lower emitting motor vehicles and cleaner burning fuels. The last exceedance of either the state or national CO standard recorded at any of the SJVAB's monitoring stations was in 1991. At present, all areas within the SJVAPCD have attained the federal CO standard and are attainment or unclassified for the state CO standard.

Despite the progress and success in achieving CO standards, localized CO concentrations still warrant concern in the SJV and should still be assessed in environmental documents. The reasons for this are twofold. First, state and federal laws require the SJVAB to attain and maintain ambient air quality standards. The District must ensure that increased motor vehicle use and congestion do not nullify the great strides that have been made with respect to ambient concentrations of CO. Secondly, the District must safeguard against localized high concentrations of CO that may expose nearby sensitive receptors that may not be recorded at a given monitoring sites. Because elevated CO concentrations are often localized, heavy traffic volumes and congestion can lead to high levels of CO, or CO "hotspots", while concentrations at the closest air quality monitoring station may be below state and federal standards.

Determining Significance of CO Impacts – Preliminary Screening

Based on the CO Protocol Analysis developed by the California Department of Transportation (CalTrans), and due to the fact that increased CO concentrations are usually associated with roadways that are congested and with heavy traffic volume, the District has established that preliminary screening can be used to determine with fair certainty that the effect a project has on any given intersection would not result in a CO hotspot. Therefore, the District has established that if neither of the following criteria are met at all intersections affected by the developmental project, the project will result in no potential to create a violation of the CO standard:

- A traffic study for the project indicates that the Level of Service (LOS) on one or more streets or at one or more intersections in the project vicinity will be reduced to LOS E or F; or

- A traffic study indicates that the project will substantially worsen an already existing LOS F on one or more streets or at more or more intersections in the project vicinity.

If either of the above criteria can be associated with any intersection affected by the project, the applicant/consultant would need to conduct a CO analysis to determine a project's significance.

Determining Significance of CO Impacts – CO Analysis

Even if the two above criteria are met, the project's influence on any given intersection may still not create a violation of the CO NAAQS/CAAQS standard thereby showing a less than significant effect on the air quality of the area. Prior to conducting a full CO air quality model, the effect of the project can still be determined to be less than- significant by conducting an analysis using a protocol developed by the Institute of Transportation Studies at University of California, Davis entitled Transportation Project-Level Carbon Monoxide Protocol. This is a project-level protocol for use by agencies to evaluate the potential local level CO impacts of a project. If the results of this analysis demonstrate no potential for significance, the Lead Agency should include a description of the Protocol Analysis results in a report to the District. If the results demonstrate that the project will potentially have a significant effect on any intersection, the Lead Agency should conduct a CO analysis.

8.5 Thresholds of Significance – Toxic Air Contaminants

The District's current thresholds of significance for toxic air contaminant (TAC) emissions from the operations of both permitted and non-permitted sources are combined and presented in the following table.

Table 5: Air Quality Thresholds of Significance – Toxic Air Contaminants

Carcinogens	Maximally Exposed Individual risk **equals or exceeds 10 in one million**
Non-Carcinogens	**Acute**: Hazard Index **equals or exceeds 1** for the Maximally Exposed Individual
	Chronic: Hazard Index **equals or exceeds 1** for the Maximally Exposed Individual

Carcinogenic (cancer) risk is expressed as cancer cases per one million. Non-carcinogenic (acute and chronic) hazard indices (HI) are expressed as a ratio of expected exposure levels to acceptable exposure levels.

The significance of the impacts of TAC emissions from both permitted and non-permitted equipment and activities is evaluated under a single threshold, for example 10 in one million.

The most current thresholds of significance and risk assessment methodologies are available at www.valleyair.org/ceqa

8.5.1 Definition of Toxic Air Contaminants

TACs as defined by the California Health & Safety Code (CH&SC) §44321 are listed in Appendices AI and AII in AB 2588 Air Toxic "Hot Spots" and Assessment Act's Emissions Inventory Criteria and Guideline Regulation document. Potential health impacts from TACs are generally categorized into two groups:

1) Carcinogenic (cancer causing) effects; and
2) Non-carcinogenic (non-cancer causing) effects

The non-carcinogenic effects can be further divided into long-term (chronic) health effects such as birth defects, neurological damage, or genetic damage; and short-term (acute) effects such as eye irritation, respiratory irritation, and nausea.

The California TAC list identifies about 700 plus pollutants. Carcinogenic and/or non-carcinogenic toxicity criteria have been established for a subset of these pollutants by the Office of Environmental Health Hazard Assessment (OEHHA), as required by CH&SC §44360.

TACs used in determining the potential exposure to the public should not be confused with the 189 Hazardous Air Pollutants (HAP) listed in the Clean Air Act.

8.5.2 Basis for Risk Thresholds

The District's risk management objectives for permitting and CEQA are as follows:

- Minimize health risks from new and modified sources of air pollution.
- Health risks from new and modified sources shall not be significant relative to the background risk levels and other risk levels that are typically accepted throughout the community.
- Avoid unreasonable restrictions on permitting.

A key factor in establishing the District's risk thresholds was the background risk levels. The 10 in a million risk threshold was established in 1995. According to the 2009 California Almanac of Emissions and Air Quality, the background cancer risk in 1990 was estimated at about 1,200 in a million. The District's comprehensive regulatory and incentive-based programs, combined with state and federal air toxic control regulations, have significantly reduced the public's exposure to air toxics over the past two decades. The cancer risk using current risk assessment methodologies has dropped from about 1,200 in a million in 1990 to under 200 in a million today.

To provide some context and appreciation for the District's threshold of significance for risk assessment, the following is a list of risks associated with other known activities (risk of occurrence in an individual's lifetime):

Occurrence	Lifetime Risk
Contracting cancer (from all sources)	250,000 in a million
Dying of cancer	140,000 in a million
Dying in a car accident	12,000 in a million
Dying from a fall	4,600 in a million
Dying from excessive heat	73 in a million
Being struck by lighting	7.4 in a million

As shown above, the District's threshold is very conservative in protecting public health. For instance, the chance of contracting cancer from an approvable project with risk less than 10 in a million is, on the face of it, less than significant when

compared to the 250,000 in a million overall chance of contracting cancer from all sources.

Therefore, the District concludes that use of the same risk thresholds in the District's risk management policy is appropriate to determine significance within the environmental review process. Revisions to the risk thresholds in the District's risk management policy will serve as revisions to the District CEQA thresholds of significance for toxic air contaminants.

8.5.3 Basis for Health Risk Assessment Methodology

The OEHHA Risk Assessment Guidelines are the standards for estimating health risks. OEHHA is responsible for developing and providing toxicological and medical information relevant to decisions involving public health to state and local government agencies. Historically, state laws have required OEHHA to develop Risk Assessment Guidelines for estimating health risk associated with various sources of air pollution. Furthermore, the Children's Environmental Health Protection Act (SB 25, Escutia, 1999) requires OEHHA to biennially review risk assessment methods for air toxics, and related information, to ensure that they adequately protect infants and children.

The District's risk management policy works in conjunction with the OEHHA Risk Assessment Guidelines. The District's risk management policy further clarifies and provides guidance on the appropriate options to use, such as a longer exposure period and more conservative air dispersion modeling.

District staff members are considered leading statewide experts in the field of health risk assessment and have developed significant resources from guidance documents to database tools to assist other agencies, consultants, and regulated sources.

Therefore, the District concludes that use of its risk management policy and the OEHHA Risk Assessment Guidelines is appropriate in determining significance within the environmental review process. Revisions to the OEHHA Risk Assessment Guidelines and/or the District's risk management policy will serve as revisions to the District CEQA risk assessment methodology.

The latest policy is available at
www.valleyair.org/ceqa

8.6 Thresholds of Significance – Odors

While offensive odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress among the public and often resulting in citizen complaints to local governments and the District.

The project should be evaluated to determine the likelihood that the project would result in nuisance odors. Any project with the potential to frequently expose members of the public to objectionable odors should be deemed to have a significant impact. Nuisance odors may be assessed qualitatively taking into consideration of project design elements and proximity to off-site receptors that potentially would be exposed objectionable odors.

Due to the subjective nature of odor impacts, the number of variables that can influence the potential for an odor impact, and the variety of odor sources, there are no quantitative or formulaic methodologies to determine if potential odors would have a significant impact. Rather, projects must be assessed on a case-by-case basis.

Lead Agencies should consider all available pertinent information to qualitatively determine if a significant impact is likely to occur. Lead Agencies should disclose applicable information regarding the characteristics of the buffer zone between the sensitive receptor(s) and the odor source(s), local meteorological conditions, and the nature of the odor source. Consideration of such parameters assists in evaluating the potential for odor impacts as a result of the proposed project. To the extent feasible, the analysis of potential odor impacts should be based on District's experience and data regarding similar facilities in similar settings. Lead Agencies should contact the District's for information regarding specific facilities and categories of facilities, and associated odor complaint records.

Odor impacts on residential areas and other sensitive receptors, such as hospitals, day-care centers, schools, etc., warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, worksites, and commercial areas. An analysis of potential odor impacts should be conducted for the following two situations:

1. Generators – projects that would potentially generate odorous emissions proposed to locate near existing sensitive receptors or other land uses where people may congregate, and
2. Receivers – residential or other sensitive receptor projects or other projects built for the intent of attracting people locating near existing odor sources.

The intensity of an odor source's operations and its proximity to sensitive receptors influences the potential significance of odor emissions. The District has identified some common types of facilities that have been known to produce odors in the San Joaquin Valley Air Basin. These are presented in Table 6 (*Screening Levels For Potential Odor*

*Sources***)** along with a reasonable distance from the source within which, the degree of odors could possibly be significant.

Table 6 (*Screening Levels for Potential Odor Sources*), can be used as a screening tool to qualitatively assess a project's potential to adversely affect area receptors. This list of facilities is not all-inclusive. The Lead Agency should evaluate facilities not included in the table or projects separated by greater distances if warranted by local conditions or special circumstances. If the proposed project would result in sensitive receptors being located closer than the screening level distances, a more detailed analysis should be provided.

Table 6: Screening Levels for Potential Odor Sources

Type of Facility	Distance
Wastewater Treatment Facilities	2 miles
Sanitary Landfill	1 mile
Transfer Station	1 mile
Composting Facility	1 mile
Petroleum Refinery	2 miles
Asphalt Batch Plant	1 mile
Chemical Manufacturing	1 mile
Fiberglass Manufacturing	1 mile
Painting/Coating Operations (e.g. auto body shops)	1 mile
Food Processing Facility	1 mile
Feed Lot/Dairy	1 mile
Rendering Plant	1 mile

The most current screening tools are available on-line at the District's website
www.valleyair.org/ceqa

The Lead Agency should prepare a more detailed analysis for any project that would result in an odor source and sensitive receptors being located closer to one another than the distances indicated in Table 6. When projects trigger the screening level distances in Table 6, the Lead Agency or consultant should contact the District's Compliance Division for information regarding odor complaints.

Existing Odor Sources

For projects involving a new receptor being located near an existing odor source(s), the District's Compliance Division should be contacted. The Compliance Division will provide information on odor complaints logged for the facility(ies) for the previous three years. Odor complaints should be mapped in relation to the odor source to establish a general boundary of any existing impacts. The location of the proposed project should be identified. For projects involving new receptors locating near an existing odor source where there is currently no nearby development and for new odor sources locating near existing receptors, the analysis should be based on a review of odor complaints for similar facilities. In assessing potential odor impacts, consideration also should be given to local meteorological conditions, particularly the intensity and direction of prevailing winds.

Because offensive odors rarely cause any physical harm and no requirements for their control are included in state or federal air quality regulations, the District has no rules or standards related to odor emissions, other than its nuisance rule. Any actions related to odors are based on citizen complaints to local governments and the District.

Lead Agencies can also make a determination of significance based on a review of District complaint records. For a project locating near an existing source of odors, the impact is potentially significant when the project site is at least as close as any other site that has already experienced significant odor problems related to the odor source. Significant odor problems are defined as:

- More than one confirmed complaint per year averaged over a three year period, or
- Three unconfirmed complaints per year averaged over a three-year period.

An unconfirmed complaint means that either the odor/air contaminant release could not be detected, or the source/facility cannot be determined. Because of the subjective nature of odor impacts and the lack of quantitative or formulaic methodologies, the significance determination of potential odor impacts should be considered on a case-by-case basis.

8.7 Thresholds of Significance – Accidental Releases

The California Emergency Management Agency (CalEMA) develops regulations for the California Accidental Release Prevention (CalARP) Program. The purpose of the CalARP program is to prevent accidental releases of substances that can cause serious harm to the public and the environment, to minimize the damage if releases do occur, and to satisfy community right-to-know laws. The CalARP program is implemented at the local level by the Certified Unified Program Agencies which may be the county health department, local Office of Emergency Services, or local fire department. The California Environmental Protection Agency has a section of its website devoted to CUPAs

(www.calepa.ca.gov/CUPA) that includes a directory. The CUPA for the area where a project is located should be contacted for the specific requirements.

The District has no responsibility for accidental releases under the CalARP program. Therefore, the District has not established a Threshold of Significance. The determination of significance for potential impacts from accidental releases of acutely hazardous air pollutants should be made in consultation with the local administering agency of the Risk Management Prevention Program. The county health department, Office of Emergency Services, or local fire department is usually the administering agency.

8.8 Thresholds of Significance – Cumulative Impacts

8.8.1 Introduction

By its very nature, air pollution has a cumulative impact. The District's nonattainment status is a result of past and present development within the San Joaquin Valley Air Basin (SJVAB). Furthermore, attainment of ambient air quality standards can be jeopardized by increasing emissions-generating activities in the region. No single project would be sufficient in size, by itself, to result in nonattainment of the regional air quality standards. Instead, a project's emissions may be individually limited, but cumulatively considerable when taken in combination with past, present, and future development within the San Joaquin Valley Air Basin.

When assessing whether there is a new significant cumulative effect, the Lead Agency shall consider whether the incremental effects of the project are cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects [CCR §15064(h)(1)].

Per CEQA Guidelines §15064(h)(3) a Lead Agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program, including, but not limited to an air quality attainment or maintenance plan that provides specific requirements that will avoid or substantially lessen the cumulative problem within the geographic area in which the project is located.

8.8.2 District Attainment Plans

As presented in Chapter 3, at the Federal level, the District is designated as extreme nonattainment for the 8-hour ozone standard and is designated nonattainment for Federal $PM_{2.5}$ standards. Consistent with Clean Air Act requirements, the District has adopted attainment plans that demonstrate how the District will attain and maintain the National Ambient Air Quality Standards. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee to the US EPA. The Clean Air Act requires EPA to review each plan and any plan revisions and to approve the plan or plan revisions if consistent with the Clean Air Act.

Each attainment plan includes a comprehensive and exhaustive list of regulatory and incentive-based measures to reduce emissions of ozone and particulate matter precursors throughout the Valley. Consistent with the direction of each plan, the Governing Board adopted regulatory measures that, in the majority of cases, exceed the plan commitment for a given source category, especially through the implementation of the Confined Animal Facilities Rule (4570), Phase II of the Stationary Internal Combustion Engines Rule (4702), Stationary Gas Turbines Rule (4703), and multiple rules for Boilers, Steam Generators, and Process Heaters (4306, 4307, 4320).

Many of the rules implemented through the Extreme Ozone Attainment Demonstration Plan and 2007 Ozone Plan, such as the Indirect Source Review (ISR) rule, are the first of their type in the nation, or are deemed the most stringent in the nation. The District's (ISR) Rule bridges the gap between regulations and incentives to maximize reductions while minimizing socioeconomic impacts. The ISR rule requires developers of new development projects to reduce emissions during both the construction and operational phases of the project. The District works closely with developers to maximize on-site emissions reductions. However, if developers are not able to fully achieve required reductions through on-site measures, fees may be collected to fund off-site emission reduction projects.

The District's strategy to reduce emissions also includes the proactive use of incentives to obtain reductions that would otherwise not be cost-effective for industry or are outside the District's regulatory authority. The path towards attainment is being further accelerated by Valley industry and municipal investments in cleaner technologies and emissions reductions implemented at the state and local level. These included over 20 regulations developed by the California Air Resources Board (ARB) in the last 3 years, numerous transportation control measures implemented by the metropolitan planning organizations, and many measures implemented by the federal government that were not included in either ozone attainment plan.

The District expects air quality to continue to improve as recent regulations are fully implemented, new control technologies are developed, and increased partnership between government and private entities occurs through programs such as Healthy Air Living, the Fast Track Action Plan, Regional Energy Efficiency Strategy, and the Technology Advancement Program.

8.8.3 State Implementation Plan

The District's attainment plans are a regional component of the State Implementation Plan (SIP). The SIP includes annual increases in air pollutant emissions resulting from regional growth (including construction-generated emissions) anticipated according to local land use plans (e.g., general plans, regional transportation plans). The SIP also assumes the incremental increase in emissions will be partially offset through the implementation of stationary, area, and indirect source control measures contained within the SIP.

The SIP is the State of California's plan for attaining the National Ambient Air Quality Standards (NAAQS). The contents of a typical SIP fall into several categories:

- State-adopted control measures which consists of either rules/regulations or source-specific requirements (e.g., orders and consent decrees);
- State-submitted comprehensive air quality plans, such as attainment plans, maintenance plans, rate of progress plans, and transportation control plans demonstrating how these state regulatory and source-specific controls, in conjunction with federal programs, will bring and/or keep air quality in compliance with federal air quality standards;
- State- submitted "non-regulatory" requirements, such as emission inventories, small business compliance assistance programs; statutes demonstrating legal authority, monitoring networks, etc.); and
- Additional requirements promulgated by EPA (in the absence of a commensurate State provision) to satisfy a mandatory section 110 or part D (Clean Air Act) requirement.

8.8.4 Cumulative Impact - Criteria Pollutants

If a project is significant based on the thresholds of significance for criteria pollutants, then it is also cumulatively significant. This does not imply that if the project is below all such significance thresholds, it cannot be cumulatively significant.

For instance, another measure of a project's individual significance contained in the GAMAQI is the impact on criteria pollutant concentrations in the ambient air. If the concentration exceeds any of the federal health-based ambient air concentration standards or causes a worsening of areas already exceeding those standards, the project is considered to be individually significant. Lead Agencies

should also consider the cumulative impact of multiple simultaneously proposed projects, located within the same area. If the combined impacts of such projects cause or worsen an exceedance of the concentration standards, the project would have a cumulatively significant impact under CEQA.

For example, simultaneous proposals for two 3 ton per year NOx sources located in the same area are each below the 10 ton per year criteria pollutant significance threshold. In this hypothetical example, analysis of each project's impact on ambient air quality shows that they do not individually cause an exceedance of any ambient air quality standard. However, when their combined emissions are considered, air quality modeling determines that their combined impacts cause an exceedance. In this hypothetical case, each of these projects would be considered to have a cumulatively significant impact.

Stationary Source Emissions - Permitted Equipment and Activities

As discussed in section 8.3.1 (Basis for Air Quality Thresholds of Significance), the District's thresholds of significance for criteria pollutants are based on District rule 2201 (New Source Review) offset requirements. Furthermore, New Source Review (NSR) is a major component of the District's attainment strategy. NSR provides mechanisms, including emission trade-offs, by which Authorities to Construct such sources may be granted, without interfering with the attainment or maintenance of Ambient Air Quality Standards. District implementation of NSR ensures that there is no net increase in emissions above specified thresholds from new and modified Stationary Sources for all nonattainment pollutants and their precursors. In fact, permitted emissions above offset thresholds equivalent to the District's thresholds of significance for criteria pollutants are mitigated to below the thresholds, and the District's attainment plans show that this level of emissions increase will not interfere with attainment or maintenance of ambient air quality standards.

The District's attainment plans demonstrate that project-specific net emissions increase below New Source Review (NSR) offset requirements will not prevent the District from achieving attainment. Consequently, emission impacts from sources permitted consistent with NSR requirements are not individually significant and are not cumulatively significant.

Stationary Source Emissions - Non-permitted Equipment and Activities

When determining cumulative significance, air quality impacts from all non-permitted equipment and activities emissions sources are to be considered when determining if project-specific emissions impacts would be individually significant.

The District concludes that when activities and emissions from non-permitted sources are individually significant when above the District's criteria pollutant thresholds of significance, they are also cumulatively significant.

Development Projects

Nearly all development projects within the San Joaquin Valley Air Basin have the potential to generate air pollutants, making it more difficult to attain State and Federal ambient air quality standards. Land use decisions and project design elements such as preventing urban sprawl, encouraging mix-use development, and project designs that reduce vehicle miles traveled (VMT) have proven to benefit air quality.

As discussed above, the SIP accounts for annual increases in air pollutant emissions resulting from regional growth (including construction-generated emissions) anticipated according to local land use plans (e.g., general plans, regional transportation plans). In addition to the State's strategies for reducing air impacts from future growth and development, the District's attainment plans include innovative strategies, such as the District's highly successful Emissions Reduction Incentive Program (ERIP), Rule 9410 (eTRIP), Healthy Air Living, and District Rule 9510 (Indirect Source Review).

The District's Indirect Source Review (ISR) Rule establishes a link between regulations and incentives to maximize reductions while minimizing socioeconomic impacts. The ISR Rule requires developers of new development projects to reduce emissions during both the construction and operational phases of the project. The District works closely with developers to maximize on-site emissions reductions. However, if developers are not able to fully achieve required reductions through on-site measures, fees may be collected to fund off-site emission reduction projects which result in real emission reductions throughout the San Joaquin Valley Air Basin.

As such, any proposed development project that would individually have a significant air quality impact would also be considered to have a significant cumulative air quality impact.

8.8.5 Cumulative Impact: Carbon Monoxide

Cumulative carbon monoxide impacts are accounted for in the CO hotspot analysis described earlier in this chapter. The CALINE4 model uses background concentrations that include CO contributions from other sources. Traffic levels used in the model should include all reasonably foreseeable projects that will contribute traffic to the intersections and road segments being analyzed.

8.8.6 Cumulative Impact: Toxic Air Contaminants (TAC) Emissions

Impacts from hazardous air pollutants are localized impacts. As presented above in section 8.3 (Thresholds of Significance - Toxic Air Contaminants), the District has established thresholds of significance for TACs that are extremely conservative and protective of health impacts on sensitive receptors. Because impacts from TACs are localized and the thresholds of significance for TACs have been established at such a conservative level, risks over the individual thresholds of significance are also considered cumulatively significant. No other cumulative risk thresholds apply.

8.9 Thresholds of Significance – Greenhouse Gas Emissions

This section is included here for informational purposes. The District's policies on addressing GHG emissions in CEQA were adopted through a separate process and are available at www.valleyair.org/Programs/CCAP/CCAP_idx.htm.

On December 17, 2009, the District's Governing Board adopted the District Policy: *Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency*. The District's Governing Board also approved the guidance document: *Guidance for Valley Land-Use Agencies in Addressing GHG Emission Impacts for New Projects Under CEQA.* In support of the policy and guidance document, District staff prepared a staff report: *Addressing Greenhouse Gas Emissions Under the California Environmental Quality Act*. These documents adopted in December of 2009 continue to be the relevant policies to address GHG emissions under CEQA. As these documents may be modified under a separate process, the latest versions should be referenced to determine the District's current guidance at the time of analyzing a particular project.

These documents and the supporting staff reports are available at the District's website:
www.valleyair.org/Programs/CCAP/CCAP_idx.htm
Check this location for the latest District policies on addressing GHG emissions in CEQA.

8.9.1 Development of District Guidelines on Addressing GHG

By enacting SB 97 in 2007, California's lawmakers expressly recognized the need to analyze greenhouse gas emissions as a part of the CEQA process. SB 97 required OPR to develop, and the Natural Resources Agency to adopt, amendments to the CEQA Guidelines addressing the analysis and mitigation of greenhouse gas emissions. Those CEQA Guidelines amendments clarified several points, including the following:

- Lead Agencies must analyze the greenhouse gas emissions of proposed projects, and must reach a conclusion regarding the significance of those emissions. [See CCR §15064.4];
- When a project's greenhouse gas emissions may be significant, Lead Agencies must consider a range of potential mitigation measures to reduce those emissions. [See CCR §15126.4(c)];
- Lead Agencies must analyze potentially significant impacts associated with placing projects in hazardous locations, including locations potentially affected by climate change. [See CCR §15126.2(a)];
- Lead Agencies may significantly streamline the analysis of greenhouse gases on a project level by using a programmatic greenhouse gas emissions reduction plan meeting certain criteria. [See CCR §15183.5(b)];
- CEQA mandates analysis of a proposed project's potential energy use (including transportation-related energy), sources of energy supply, and ways to reduce energy demand, including through the use of efficient transportation alternatives. (See CEQA Guidelines, Appendix F.)

It is widely recognized that no single project could generate enough GHG emissions to noticeably change the global climate temperature. However, the combination of GHG emissions from past, present and future projects could contribute substantially to global climate change. Thus, project specific GHG emissions should be evaluated in terms of whether or not they would result in a cumulatively significant impact on global climate change. GHG emissions, and their associated contribution to climate change, are inherently a cumulative impact issue. Therefore, project-level impacts of GHG emissions are treated as one-in-the-same as cumulative impacts.

In summary, the staff report evaluates different approaches for assessing significance of GHG emission impacts. As presented in the report, District staff reviewed the relevant scientific information and concluded that the existing science is inadequate to support quantification of the extent to which project specific GHG emissions would impact global climate features such as average air temperature, average rainfall, or average annual snow pack. In other words, the District was not able to determine a specific quantitative level of GHG emissions increase, above which a project would have a significant impact on the environment, and below which would have an insignificant impact. This is readily understood, when one considers that global climate change is the result of the sum total of GHG emissions, both manmade and natural that occurred in the past; that is occurring now; and will occur in the future.

In the absence of scientific evidence supporting establishment of a numerical threshold, the District policy applies performance based standards to assess project-specific GHG emission impacts on global climate change. The determination is founded on the principal that projects whose emissions have been reduced or mitigated consistent with the California Global Warming Solutions Act of 2006, commonly referred to as "AB 32", should be considered to have a less

than significant impact on global climate change. For a detailed discussion of the District's establishment of thresholds of significance for GHG emissions, and the District's application of said thresholds, the reader is referred to the above referenced staff report, District Policy, and District Guidance documents.

As presented in Figure 6 (*Process of Determining Significance of Greenhouse Gas Emissions*), the policy provides for a tiered approach in assessing significance of project specific GHG emission increases.

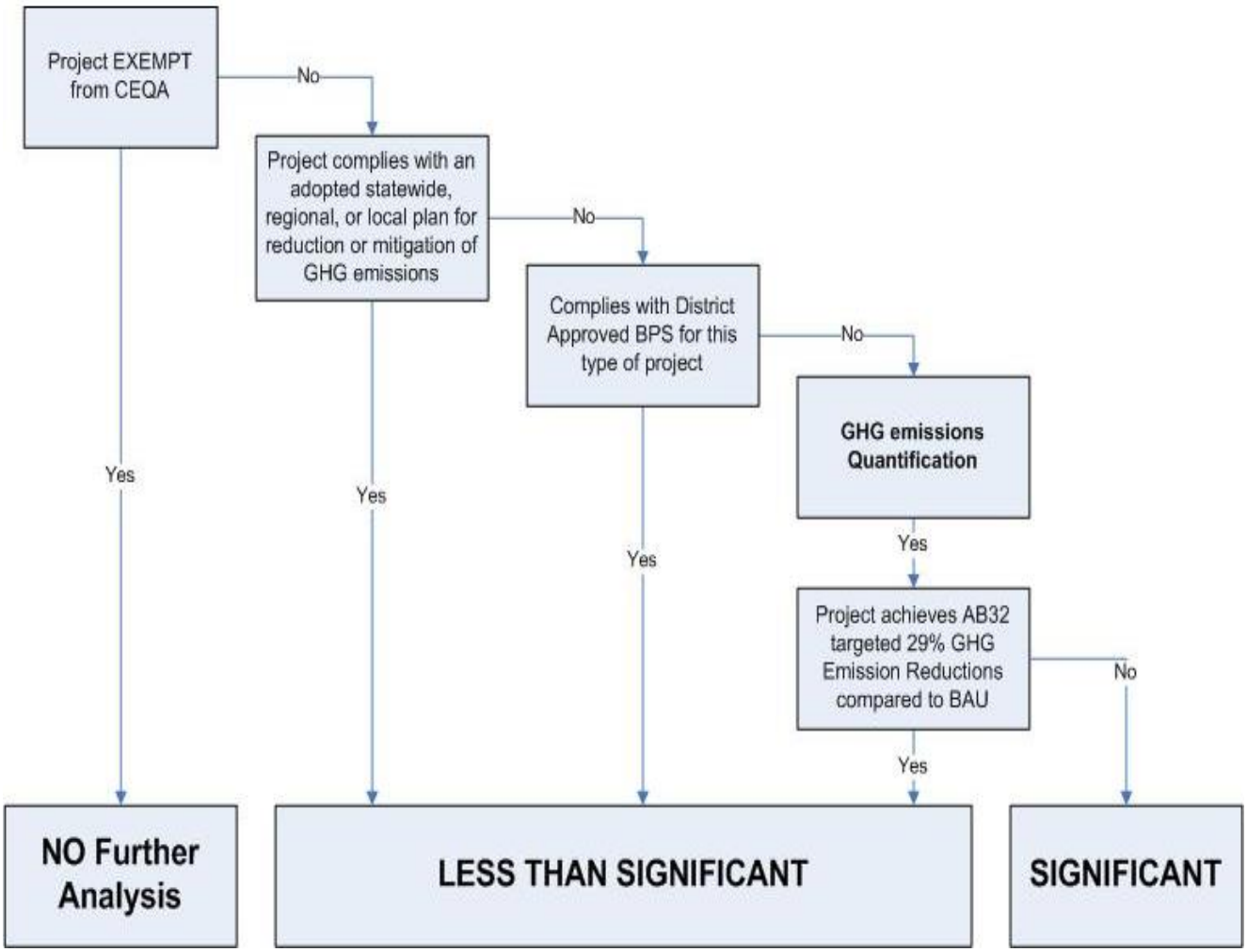
- Projects complying with an approved GHG emission reduction plan or GHG mitigation program which avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions. Such plans or programs must be specified in law or approved by the Lead Agency with jurisdiction over the affected resource and supported by a CEQA compliant environmental review document adopted by the Lead Agency. Projects complying with an approved GHG emission reduction plan or GHG mitigation program would not be required to implement Best Performance Standards (BPS).

- Projects implementing BPS would not require quantification of project specific GHG emissions. Consistent with CEQA Guideline, such projects would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects not implementing BPS would require quantification of project specific GHG emissions and demonstration that project specific GHG emissions would be reduced or mitigated by at least 29%, compared to Business as Usual (BAU), including GHG emission reductions achieved since the 2002-2004 baseline period, consistent with GHG emission reduction targets established in ARB's AB 32 Scoping Plan. Projects achieving at least a 29% *GHG emission reduction compared to BAU would be determined to have a less than significant individual and cumulative impact for GHG.*)

The District guidance for development projects also relies on the use of BPS. For development projects, BPS includes project design elements, land use decisions, and technologies that reduce GHG emissions. Projects implementing any combination of BPS, and/or demonstrating a total 29 percent reduction in GHG emissions from business-as-usual (BAU), would be determined to have a less than cumulatively significant impact on global climate change.

Figure 6: Process of Determining Significance of Greenhouse Gas Emissions



CHAPTER 9

MITIGATION MEASURES

9.1 Introduction

CEQA requires Lead Agencies to mitigate or avoid significant environmental impacts associated with discretionary projects. Environmental documents for projects that have any significant environmental impacts must identify all feasible mitigation measures or alternatives to reduce the impacts below a level of significance. If after the identification of all feasible mitigation measures, a project is still deemed to have significant environmental impacts, the Lead Agency can approve a project, but must adopt a Statement of Overriding Consideration to explain why further mitigation measures are not feasible and why approval of a project with significant unavoidable impacts is warranted.

By definition, air quality mitigation measures must go beyond existing regulations. Regulatory programs are in place at the federal, state, and air district level to reduce air pollutant emissions from nearly all sources, yet they are not always sufficient to eliminate all air quality impacts. For example, the ARB motor vehicle program has dramatically reduced average tailpipe emissions from the vehicle fleet. However, motor vehicle emissions will be a major source of Valley pollution problems in the foreseeable future due to growth in the number of vehicles and in miles traveled.

A public agency shall provide that measures to mitigate or avoid significant effects on the environment are fully enforceable through permit conditions, agreements, or other measures. Conditions of project approval may be set forth in referenced documents which address required mitigation measures or, in the case of the adoption of a plan, policy, regulation, or other public project, by incorporating the mitigation measures into the plan, policy, regulation, or project design.

Some examples the District considers to be feasible mitigation in light of existing regulations and research are included.

More measures are available on the District's website at:
http://www.valleyair.org/transportation/GAMAQI-Mitigation-Measures.pdf

The District recognizes that the final determination of feasibility will fall to the Lead Agency. In selecting appropriate air quality mitigation measures, the District advocates the following criteria:

Criteria required by CEQA:

- Mitigations shall be enforceable by permit conditions, legally binding agreements, or other measures (Public Resources Code §21081.6)
- Mitigation measures shall be capable of being monitored and enforced;

Recommended criteria:

- Mitigation measures should coincide with the level and timing of an impacts;
- The agency responsible should have adequate resources to implement the mitigation;
- Mitigation measures should be carried out within a reasonable period. Mitigation measures taking more than five years should contain interim targets;
- Mitigation measures benefits should be quantified with methods acceptable to the District

9.2 Voluntary Emission Reduction Agreement

Design elements, mitigation measures, and compliance with District rules and regulations may not be sufficient to reduce project-related impacts on air quality to a less than significant level. In such situations, project proponents may enter into a Voluntary Emission Reduction Agreement (VERA) with the District to reduce the project related impact on air quality to a less than significant level. A VERA is a mitigation measure by which the project proponent provides pound-for-pound mitigation of air emissions increases through a process that funds and implements emission reduction projects. A VERA can be implemented to address impacts from both construction and operational phases of a project.

To implement a VERA, the project proponent and the District enter into a contractual agreement in which the project proponent agrees to mitigate project specific emissions by providing funds to the District. The District's role is to administer the implementation of the VERA consisting of identifying emissions reductions projects, funding those projects and verifying that emission reductions have been successfully achieved. The VERA implementation process also provides opportunity for the project proponent to identify specific emission reduction projects to be administered by the District. The funds are disbursed by the District in the form of grants. Types of emission reduction projects that have been funded in the past include electrification of stationary internal combustion engines (such as agricultural irrigation pumps), replacing old heavy-duty trucks with new, cleaner, more efficient heavy-duty trucks, and replacement of old farm tractors.

The District verifies the actual emission reductions that have been achieved as a result of completed grant contracts, monitors the emission reduction projects, and ensures the enforceability of achieved reductions. The initial agreement is generally based on the projected maximum emissions increases as calculated by a District approved air quality impact assessment, and contains the corresponding fiscal obligation. However, the District has designed flexibility into the VERA such that the final mitigation can be based on actual emissions related to the project as determined by actual equipment used, hours of operation, etc. After the project is mitigated, the District certifies to the Lead Agency that the mitigation is completed, providing the Lead Agency with an enforceable mitigation

measure demonstrating that project specific emissions have been mitigated to less than significant.

To ensure all feasible mitigation measures are incorporated into the project to reduce project air quality impact to less than significant, the District recommends the project proponent (and/or Lead Agency) engage in discussion with the District to have the VERA adopted by the District prior to the finalization of the environmental document. This process will allow the environmental document to appropriately characterize the project emissions and demonstrate that the project impact on air quality will be mitigated to less than significant under CEQA as a result of the implementation of the adopted VERA.

The District has been developing and implementing VERA contracts with project proponents to mitigate project specific emissions since 2005. It is the District's experience that implementation of a VERA is a feasible mitigation measure, which effectively achieves the emission reductions required by a Lead Agency, including mitigation of project-related impacts on air quality by supplying real and contemporaneous emissions reductions.

Therefore, Lead Agencies should require the project proponent to negotiate a VERA with the District prior to the Lead Agency's final approval of the CEQA document. This allows the Lead Agency to disclose to the public the certainty that the VERA is assuring full mitigation of air quality impacts as specified in the environmental review document or equivalent documentation certified by the Lead Agency.

9.2.1 Pollutant-by-Pollutant vs. Net Zero

Under a VERA, two mitigation approaches are available: "pollutant-by-pollutant" and "net zero".

Pollutant-by-Pollutant Mitigation

The mitigation of project emissions impacts "pollutant-by-pollutant" means that each NOx, VOC and PM_{10} project emission will be mitigated individually to their respective significance threshold level.

Net Zero Mitigation

The mitigation of project emissions impacts to "net zero" means that the sum of NOx, VOC and PM_{10} combined project emissions will be fully mitigated by the sum of NOx, VOC and PM_{10} combined emission reductions achieved under the VERA. The "net zero" concept is limited to the three pollutants NOx, VOC and PM_{10}, due to their strong interrelatedness. NOx is the driving pollutant for both the wintertime PM problem and the summertime ozone problem (in combination with VOC). The District considers "net zero" mitigation to result in a less than significant air quality impact for these three pollutants combined.

Recommended Approach

The District strongly recommends the "net-zero" approach. This method results in a significantly larger amount of NOx reduction, which is the primary driver to the formation of ozone and PM in the Valley.

9.2.2 Indirect Source Review and VERA

The District Rule 9510 (ISR) is a regulatory requirement while a VERA is a potentially feasible mitigation measure for projects subject to CEQA requirements. The emission reductions achieved under ISR are intended to satisfy ISR regulatory requirements. Even though compliance with District Rule 9510 substantially reduces project specific impacts on air quality, it may not be sufficient to reduce project specific emissions to less than significant levels under CEQA.

In contrast, VERAs provide emission reductions that can be used to satisfy both ISR and CEQA requirements. Entering into a VERA does not exempt a project from ISR requirements, but the emission reductions achieved under a VERA can be applied towards satisfying ISR emission reduction requirements.

For example, providing 1 ton of emission reduction under a VERA results in 1 ton of emission reduction for CEQA mitigation purposes and contributes to 1 ton of emission reduction for ISR purposes. In most cases, a VERA achieving a "net zero" mitigation provides sufficient emission reductions to also satisfy ISR emission reduction requirements.

9.3 Mitigating Criteria Pollutants Emission Impacts

9.3.1 Project Construction Emission Impacts

Although the impacts from construction-related air pollutant emissions are temporary in duration, in some cases, such emissions can represent a significant air quality impact. Construction activities such as grading, excavation, and travel on unpaved surfaces can generate substantial amounts of fugitive dust, and can lead to elevated concentrations of PM_{10}. Emissions from construction-related equipment engines also can contribute to elevated concentrations of PM_{10} as well as increased emissions of ozone precursors.

Fugitive Dust

The recommended approach to mitigating fugitive dust emissions from construction-related activities focuses on a consideration of whether all feasible control measures are being implemented. District fugitive dust rules, collectively known as Regulation VIII, contain a series of requirements. The purpose of Regulation VIII is to reduce the amount of PM_{10} entrained into the atmosphere as a result of emissions generated from anthropogenic (man-made) fugitive dust sources. Compliance with Regulation VIII does not constitute mitigation because it is already required by law. The District provides Enhanced and Additional Control Measures that will provide a greater degree of PM_{10} reduction than required by Regulation VIII. Entering into a VERA with the District is also an approach to address mitigation of fugitive dust emissions. The District will recommend a VERA and these enhanced and additional measures when project conditions warrant; e.g. potential for impacting sensitive receptors, construction sites of significant size, or any other conditions that may warrant additional emission reductions necessary to minimize dust emissions to less than significant levels.

Exhaust Emissions – Construction Activities

Lead Agencies should also seek to reduce emissions from construction-related equipment exhaust. Feasible mitigation of construction exhaust emission includes use of construction-related equipment powered by engines meeting, at a minimum, Tier II emission standards, as set forth in §2423 of Title 13 of the California Code of Regulations, and Part 89 of Title 40 Code of Federal Regulations, and limitations of hours of activities. Lead Agencies can impose additional mitigation measures as conditions of project approval such as requirements for the project proponent to enter into a VERA with the District.

9.3.2 Project Operational Emission Impacts

Operational Emissions – Permitted Equipment and Activities

All permitted sources emitting more than the NSR Offset Thresholds for any criteria pollutant must offset all emission increases in excess of the thresholds. However, under certain circumstances, the District may be precluded by state law or other District rule requirements from requiring a stationary source to offset emissions increases. In such cases, the District will advise Lead Agencies of the need to impose additional mitigation measures as conditions of project approval, such as a requirement for the project proponent to enter into a Voluntary Emission Reduction Agreement (VERA) with the District.

Operational Emissions – Non-Permitted Equipment and Activities

Operational emissions from non-permitted equipment and activities are caused by mobile sources (on-site and on-road), combustion of fuels for space heating, cooking, and landscape maintenance, etc.

For industrial projects, onsite mobile sources commonly include off-road vehicles, such as forklifts and tractors, and on-road passenger vehicles use. Off-site mobile sources commonly include heavy-duty vehicles used to transport raw material and ship finished goods and light-duty vehicle use associated with employee trips. For commercial projects, mobile source activities include receipt of goods, and customer and employee trips. For development projects, mobile source activities commonly include vehicular travel from home to work, home to shop, and deliveries.

Mobile sources

Mitigation measures identified by the District to reduce operational air quality impacts from mobile sources are discussed below. Several examples of general approaches can be taken to reduce emissions from motor vehicles:

- Reduce vehicle trips. These measures reduce air pollutant emissions by entirely eliminating some of the vehicle trips associated with a project. An example is the provision of bicycle facilities to encourage bicycle use instead of driving.

- Reduce vehicle miles traveled. These measures reduce emissions by reducing the length of vehicle trips associated with a project. An example is satellite offices/telecommuting centers provided to reduce the length of employee commute trips.

- Use of low emission vehicles. These measures are not intended to reduce trips or VMT, but rather promote the use of fuels that are less polluting than gasoline or diesel. Less use of fuels results in less emission released into the atmosphere. For example,
    - Replace diesel fleet with alternative fuel engine technology and infrastructure;
    - Retrofit existing equipment to reduce emissions using methods such as particulate filters, oxidation catalysts, or other approved technologies;
    - Repower/Retrofit heavy-duty diesel fleet with cleaner diesel engine technology and/or diesel particulate filter after-treatment technology;
    - Replace diesel fleet vehicles with cleaner fueled low emission vehicles (i.e. school buses, buses, on- and off- road heavy duty vehicles, lighter duty trucks and passenger vehicles)

- Voluntary Emission Reduction Agreement. As discussed above, this is an agreement entered by the project proponent and the District by which the project proponent provides pound-for-pound mitigation of air emissions increases through a process that funds and implements emission reduction projects, and has found to be a feasible mitigation measure for many development projects.

More measures are available on the District's website at:
http://www.valleyair.org/transportation/GAMAQI-Mitigation-Measures.pdf

The District recommends that Lead Agencies use each of the above categories of measures where appropriate. However, caution should be used when selecting some types of measures. In general, measures that reduce vehicle trips entirely achieve the greatest emission reductions. This is because vehicle emissions are highest during the first several miles of a trip. Measures to reduce VMT are most effective when the trips reduced are long such that cold start emissions are less important. PM_{10} emission reductions are better achieved by reducing VMT. This is because PM_{10} emissions (due to entrained road dust) are more directly correlated to VMT.

Area sources

Area sources are sources that individually emit small quantities of air pollutants, but which cumulatively may represent significant quantities of emissions. Water heaters, fireplaces, wood heaters, lawn maintenance equipment, and application of paints and lacquers are examples of area source emissions. Mitigation measures include the following examples:

- Provide electric maintenance equipment
- Eliminate or limit the amount of traditional fireplaces installed (i.e., natural gas fireplaces/inserts or at least EPA certified wood stoves or inserts instead of open hearth fireplaces)
- Use solar or low-emission water heaters

More measures are available on the District's website at:
http://www.valleyair.org/transportation/GAMAQI-Mitigation-Measures.pdf

9.4 Mitigating Hazardous Air Pollutants

Specific mitigation measures should be identified and considered for those projects that may release toxic or hazardous air pollutants to the atmosphere in amounts that have the potential be injurious to nearby populations. Such mitigation measures should consider both routine and non-routine toxic air pollutant releases. Mitigation measures may involve handling, storage, and disposal methods that minimize release of the subject substances to the atmosphere. In some cases, air pollution control devices or process operation modifications can be employed. Furthermore, facilities that may release toxic or hazardous substances to the atmosphere should not be located adjacent to sensitive receptors such as residences, schools, day-care centers, extended-care facilities, and hospitals.

Lead Agencies should also be aware that many facilities such as dry cleaners and gasoline stations produce toxic emissions, but under most circumstances, existing controls reduce impacts to less than significant levels.

Facilities and equipment that require permits from the District are screened for risks from toxic emissions and those exceeding thresholds are subject to detailed health risk assessments. Projects exceeding deminimus levels are required to install Toxic Best Available Control Technology (T-BACT) to reduce risks to below significance. If a significant impact remains after T-BACT is implemented, the permit may not be issued unless it meets the discretionary approval criteria of the District Risk Management Policy for Permitting New and Modified Sources.

Projects where significant numbers of diesel powered vehicles will be operating such as truck stops, transit centers, and warehousing may create risks from toxic diesel particulate emissions. These facilities and vehicles are not subject to District permit and so may need mitigation measures adopted by the Lead Agency to reduce this impact. Measures such as limiting idling, electrifying truck stops to power truck auxiliary equipment, use of diesel particulate filters, and use of alternative fuel heavy-duty trucks have been required by some jurisdictions.

9.5 Mitigating Odor Impacts

Appendix G (Environmental Checklist Form) of the state CEQA Guidelines specifies that the Lead Agency determines whether a project would “create objectionable odors affecting a substantial number of people.”

Projects that have a significant odor impact because they place sources of odors and members of the public near each other should establish a buffer zone to reduce odor impacts to a less than significant level. The dimensions of the buffer zone must ensure that the encroaching project does not expose the public to nuisance levels of odorous emissions.

In establishing the appropriate dimensions of the buffer zone, the Lead Agency should consider actions currently being taken at the facility to control odors, as well as any future actions to which the facility is firmly committed. A safety margin also should be considered in establishing a buffer zone to allow for future expansion of operations at the source of the odors.

In order to reduce the dimensions of the buffer zone, add-on control devices (e.g. filters or incinerators) and/or process modifications implemented at the source of the odors may be feasible, depending on the specific nature of the facility. Lead Agencies should consult the District for further information regarding add-on controls and process modifications to control odors. Odor mitigation measures that are targeted at the *receptors* (e.g. residential areas) that rely on sealing buildings, filtering air, or disclosure statements are not appropriate mitigation measures to be used in place of buffer zones or technical controls.

For some projects, operational changes, add-on controls, or process changes, such as carbon absorption, incineration, or relocation of stacks/vents can reduce odorous emissions. In many cases, however, the most effective mitigation strategy is to provide a sufficient distance, or buffer zone, between the source and the receptor(s). Recent experience has shown that locating upwind from an odor source does not necessarily eliminate potential problems. Even places with reliable prevailing winds experience days with light and variable winds and days with winds opposite prevailing winds related to the passage of storms. Residents in these upwind areas while exposed less frequently may be more sensitive to the odors.

9.6 Mitigating Air Quality Impacts from General and Area Plan Level

Selecting mitigation measures appropriate for a particular project can be a complex task. The complexity arises from several factors. CEQA applies to a wide variety of projects. Complete general plan updates covering thousands of acres are discretionary projects and so are parcel maps and even site plans in some jurisdictions. The general plan often only identifies the eventual use of a parcel of land in vague terms. The site plan review may occur too late in the process and affect too small of an area to allow effective mitigation measures to be identified. In addition, differences in conditions at a site greatly influence the effectiveness of mitigation measures. The overall approach recommended by the District is to use policy statements, design standards, and community-wide programs at the general plan/specific plan level, and site specific measures when the site specific uses are proposed.

As discussed in Chapter 6, the District has prepared a guidance document on these issues entitled *Air Quality Guidelines for General Plans* (AQGGP). The AQGGP document provides guidance to local officials and staff on developing and implementing

local policies and programs to improve air quality to be included in local jurisdictions' general plans

There is no definitive line between plan and project. For example, in some cases, a developer will file a general plan amendment, zone change, and subdivision map or site plan simultaneously. In other cases, the general plan amendment is filed first and the other actions are filed later pending approval of the plan amendment. Some specific plans provide a high level of design detail and some land use approvals for individual parcels provide few details of the final use. This being the case, mitigation measures for each project are best identified on a project-by-project basis.

Agencies preparing new or updated plans for their communities have special responsibilities for mitigating air quality impacts. Large scale plans and policy documents often set the pattern of new development for the next twenty or more years. Land use patterns can be laid out in ways that produce more or less air pollution. Policies can be set in motion that encourage or discourage air quality friendly development. The District encourages local agencies to view their general plans, community plans, and specific plans as opportunities to improve the Valley's air quality.

9.7 Air Quality Design Guidelines

The District encourages cities and counties to adopt air quality friendly design guidelines as part of a general plan implementation strategy. Most current design practices can be improved upon. The District recommends the following websites to get ideas and concepts on what constitutes land use and design strategies that would be beneficial for air quality:

- The Local Government Commission's Center for Livable Communities (www.lgc.org/center)
- Walkable Communities, Inc. (www.walkable.org)

Design guidelines can be voluntary suggestions for developers or they can be standards adopted by ordinance that must be followed. The choice is up to the local jurisdiction. Numerous examples of design guidelines with air quality benefits are also available from California communities including Sacramento, San Diego, Modesto, and Merced.

Some examples of design guidelines are:

- Adopt air quality enhancing design guidelines/standards
- Designate pedestrian/transit oriented development areas on general plan/specific plan/ planned development land use maps
- Adopt ordinance limiting wood burning appliances/fireplace installations
- Fugitive dust regulation enforcement coordinated with the District

- Energy efficiency incentive programs
- Coordinate location of land uses to separate odor generators and sensitive receptors
- Provide traffic flow improvements for areas impacted by the project
- Provide on-site improvement: bikeways, transit infrastructure, pedestrian enhancements

More design guidelines are available at www.valleyair.org/ceqa/designguidelines

9.8 Quantifying Mitigation Measures

The effectiveness of proposed mitigation measures should be quantified when feasible. Because the measures' effectiveness will depend greatly on the specific characteristics of the project and its setting, this quantification should be based on a project-specific analysis.

When quantifying project emissions, the latest approved models by the District should always be used for air quality analysis. Models are subject to change. At the time of writing, the model available is the California Emissions Estimator Model (CalEEMod). CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and greenhouse gas (GHG) emissions associated with both construction and operations from a variety of land use projects. The model quantifies direct emissions from construction and operations (including vehicle use), as well as indirect emissions, such as GHG emissions from energy use, solid waste disposal, vegetation planting and/or removal, and water use.

The model is available at www.caleemod.com and at
http://www.valleyair.org/ISR/ISRResources.htm#Models
Assistance with operating the model is available by contacting the District at
(559) 230-6000, or hramodeler@valleyair.org

In some cases, it simply may not be possible to quantify the effect of proposed mitigation measures. It may be that the specific conditions surrounding a particular project are so unique as to render extrapolation from other examples unreliable. A proposed measure may be innovative, with little precedent. The combined effects of a package of measures may be too difficult to quantify. While a certain degree of professional judgment is usually involved in estimating the effectiveness of mitigation measures, excessively speculative estimates should be avoided. If the Lead Agency cannot quantify mitigation effectiveness with a reasonable degree of certainty, the environmental document should at least address effectiveness qualitatively. If the Lead Agency makes a finding that non quantified mitigation measures reduce an impact to a level of insignificance, the environmental document should provide a detailed justification of that conclusion.

Recirculated
Draft Environmental Impact Report

SCH# 2009051005

Volume 1

Chapters 1 through 10

99 HOUGHTON INDUSTRIAL PARK PROJECT
By McIntosh & Associates

General Plan Amendment 1, 143-07;
Zone Change Case 2, Map 143-07;
Conditional Use Permit 5, Map 143-07;
Ag Preserve No. 13 – Excl.

Kern County
Planning and Natural Resources Department
Bakersfield, California

October 2019

Lorelei H. Oviatt, AICP, Director
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Email: planning@co.kern.ca.us
Web Address: http://pcd.kerndsa.com/

PLANNING AND NATURAL RESOURCES DEPARTMENT

Planning
Community Development
Administrative Operations

November 1, 2019

File: GPA 1, ZCC 2, Map 143-07;
CUP 5, Map 143-07;
Ag Preserve No. 13 – Excl.

ADDRESSEE LIST (See Distribution List)

Re: Recirculated Draft Environmental Impact Report for the 99 Houghton Industrial Park Project by McIntosh & Associates (PP16132)

Dear Interested Party:

The 99 Houghton Industrial Park Project Environmental Impact Report was originally circulated for public comment from February 13, 2018, with a comment closing date of April 2, 2018, by the Kern County Planning Department acting as the lead agency. On March 13, 2018, prior to the end of the original comment period, the project was formally withdrawn from circulation. The County has received and considered written comments that were received after the close of the public comment period. County staff has determined that changes should be made in the Draft EIR that was originally circulated for public comment. In some cases changes have been made to the project and in some cases new or revised information or analysis has been included in the Recirculated Draft EIR.

The Guidelines adopted by the Governor's Office of Planning and Research for the California Environmental Quality Act (Guidelines) provide that a lead agency is required to recirculate an environmental impact report when *significant new information* is added to an EIR after public review of the Draft EIR has begun. New information can include changes in the project description, changes in the environmental setting, as well as other additional data or information. This information may relate to new environmental impacts, severity of such impacts, alternatives or mitigation. Recirculation of an EIR is covered by CEQA Guidelines Section 15088.5.

As mandated by State law, the minimum public review period for this document is 45 days. CEQA Guidelines Section 15088.5 (f) (1) provides that when an Environmental Impact Report (EIR) is substantially revised and the entire EIR is circulated, Kern County, as lead agency, may require that reviewers submit new comments, and the lead agency need not respond to those comments received during the earlier circulation period. Kern County will therefore respond in the Final Recirculated EIR only to new comments received regarding this Recirculated Draft EIR received during this comment period

The Recirculated Draft Environmental Impact Report (RDEIR) was prepared for the above-noted land use applications to allow for the development of an industrial park on approximately 314 acres in unincorporated Kern County. The proposed project requires a General Plan Amendment (GPA) to the Land Use Element; a Zone Change (ZCC); a Conditional Use Permit (CUP); and a petition for Exclusion from the County's Agricultural Preserve No. 13. The project site is generally bounded by South Union Avenue on the east, State Route 99 on the west, DiGiorgio Road to the north, and Houghton Road to the south.

The Kern County Planning and Natural Resources Department, as Lead Agency, has determined that preparation of an Environmental Impact Report would be appropriate for the referenced project. Enclosed is a copy of the Recirculated Draft EIR.

If we have not received a reply from you by **December 16, 2019, at 5:00 P.M.**, we will assume that you have no comments regarding this Draft EIR.

Should you have any questions regarding this project, please do not hesitate to contact me at (661) 862-5015 or via email at CRojas@kerncounty.com

Sincerely,

Carlos E. Rojas, Planner III
Advanced Planning Division

GPA # 1 Map # 143-07
ZCC # 2 Map # 143-07
CUP # 5 & 6 Map # 143-07
es (10/10/2019)
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AGENCIES

City of Arvin
P.O. Box 548
Arvin, CA 93203

Bakersfield City Planning Dept
1715 Chester Avenue
Bakersfield, CA 93301

Bakersfield City Public Works Dept
1501 Truxtun Avenue
Bakersfield, CA 93301

California City Planning Dept
21000 Hacienda Blvd.
California City, CA 93515

Delano City Planning Dept
P.O. Box 3010
Delano, CA 93216

City of Maricopa
P.O. Box 548
Maricopa, CA 93252

City of McFarland
401 West Kern Avenue
McFarland, CA 93250

City of Ridgecrest
100 West California Avenue
Ridgecrest, CA 93555

City of Shafter
336 Pacific Avenue
Shafter, CA 93263

City of Taft
Planning & Building
209 East Kern Street
Taft, CA 93268

City of Tehachapi
Attn: John Schlosser
115 South Robinson Street
Tehachapi, CA 93561-1722

City of Wasco
764 E Street
Wasco, CA 93280

Inyo County Planning Dept
P.O. Drawer "L"
Independence, CA 93526

Kings County Planning Agency
1400 West Lacey Blvd, Bldg 6
Hanford, CA 93230

Los Angeles Co Reg Planning Dept
320 West Temple Street
Los Angeles, CA 90012

San Bernardino Co Planning Dept
385 North Arrowhead Avenue, 1st Floor
San Bernardino, CA 92415-0182

San Luis Obispo Co Planning Dept
Planning and Building
976 Osos Street
San Luis Obispo, CA 93408

Santa Barbara Co Resource Mgt Dept
123 East Anapamu Street
Santa Barbara, CA 93101

Tulare County Planning & Dev Dept
5961 South Mooney Boulevard
Visalia, CA 93291

Ventura County RMA Planning Div
800 South Victoria Avenue, L1740
Ventura, CA 93009-1740

U.S. Bureau of Land Management
Caliente/Bakersfield
3801 Pegasus Drive
Bakersfield, CA 93308-6837

U. S. Fish & Wildlife Service
Division of Ecological Services
2800 Cottage Way #W-2605
Sacramento, CA 95825-1846

Environmental Protection Agency
Region IX Office
75 Hawthorn Street
San Francisco, CA 94105

U.S. Dept of Agriculture/NRCS
5080 California Avenue, Ste 150
Bakersfield, CA 93309-0711

State Air Resources Board
Stationary Resource Division
P.O. Box 2815
Sacramento, CA 95812

So. San Joaquin Valley Arch Info Ctr
California State University of Bkfd
9001 Stockdale Highway
Bakersfield, CA 93311

Caltrans/Dist 6
Planning/Land Bank Bldg.
P.O. Box 12616
Fresno, CA 93778

State Clearinghouse
Office of Planning and Research
1400 - 10th Street, Room 222
Sacramento, CA 95814

State Dept of Conservation
Director's Office
801 "K" Street, MS 24-01
Sacramento, CA 95814-3528

State Dept of Conservation
Division of Oil & Gas
4800 Stockdale Highway, Ste 108
Bakersfield, CA 93309

State Dept of Conservation
Division of Oil & Gas
801 "K" Street, MS 20-20
Sacramento, CA 95814-3530

State Dept of Conservation
Office of Land Conservation
801 "K" Street, MS 18-01
Sacramento, CA 95814

California State University
Bakersfield - Library
9001 Stockdale Highway
Bakersfield, CA 93309

California Fish & Wildlife
1234 East Shaw Avenue
Fresno, CA 93710

State Dept of Food & Agriculture
1220 "N" Street
Sacramento, CA 95814

California Highway Patrol
Planning & Analysis Division
P.O. Box 942898
Sacramento, CA 94298-0001

Integrated Waste Management
P.O. Box 4025, MS #15
Sacramento, CA 95812-4025

California Regional Water Quality
Control Board/Central Valley
Region
1685 E Street
Fresno, CA 93706-2020

CalRecycle
Dept of Resources, Recycling, and
Recovery
1001 "I" Street
Sacramento, CA 95812

Kern County
Agriculture Department

Kern County Administrative Officer

Kern County Public Works
Department/
Building &
Development/Floodplain

Kern County Public Works
Department/
Building & Development/Survey

Kern County
Env Health Services Department

Kern County Fire Dept
David Witt, Interim Fire Chief

Kern County Fire Dept
Cary Wright, Fire Marshall

Kern County Library/Beale
Local History Room

Kern County Library/Beale
Andie Sullivan

Kern County Parks & Recreation

Kern County Sheriff's Dept
Administration

Kern County Public Works
Department/
Building &
Development/Development Review

Kern County Public Works
Department/Operations &
Maintenance/Regulatory
Monitoring & Reporting

Gulf Oil Expl & Prod Co
P.O. Box 1392
Bakersfield, CA 93302

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5801 Sundale Avenue
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General Shafter School Dist
1825 Shafter Road
Bakersfield, CA 93313

Panama-Buena Vista School Dist
4200 Ashe Road
Bakersfield, CA 93313

Kern County Superintendent of
Schools
Attention Mary Baker
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Bakersfield, CA 93301

KernCOG
1401 19th Street - Suite 300
Bakersfield, CA 93301

Local Agency Formation
Comm/LAFCO
5300 Lennox Avenue, Suite 303
Bakersfield, CA 93309

San Joaquin Valley
Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, CA 93726

AT&T California
OSP Engineering/Right-of-Way
4540 California Avenue, 4th Floor
Bakersfield, CA 93309

Boron Chamber of Commerce
27217 Carmichael Street
Boron, CA 93516

Defenders of Wildlife/
Kim Delfino, California Dir
980 - 9th Street, Suite 1730
Sacramento, CA 95814

Sierra Club/Kern Kaweah Chapter
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Bakersfield, CA 93385

Southern California Gas Co
Transportation Dept
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Chatsworth, CA 91313-6511

David Laughing Horse Robinson
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Bakersfield, CA 93390

Santa Rosa Rancheria
Ruben Barrios, Chairperson
P.O. Box 8
Lemoore, CA 93245

Tubatulabals of Kern County
Attn: Robert Gomez, Chairperson
P.O. Box 226
Lake Isabella, CA 93240

Kern Delta Water Dist
501 Taft Highway
Bakersfield, CA 93307

Kern Mosquito Abatement Dist
4705 Allen Road
Bakersfield, CA 93314

Kern Audubon Society
Attn: Harry Love, President
13500 Powder River Avenue
Bakersfield, CA 93314

Center on Race, Poverty
& the Environment
Attn: Marissa Alexander
1999 Harrison Street – Suite 650
San Francisco, CA 94612

California Farm Bureau
2300 River Plaza Drive, NRED
Sacramento, CA 95833

Southern California Edison
2244 Walnut Grove, Ave, GO-1
Quad 2C
Rosemead, CA 91770

Verizon California, Inc.
Attention Engineering Department
520 South China Lake Boulevard
Ridgecrest, CA 93555

Kern Valley Indian Council
Attn: Robert Robinson,
Chairperson
P.O. Box 401
Weldon, CA 93283

Tejon Indian Tribe
Kathy Morgan, Chairperson
1731 Hasti-acres Drive, Suite 108
Bakersfield, CA 93309

Tule River Indian Tribe
Neal Peyron, Chairperson
P.O. Box 589
Porterville, CA 93258

Kern County Water Agency
P.O. Box 58
Bakersfield, CA 93302-0058

Adams, Broadwell, Joseph &
Cardozo
Attention: Janet M. Laurain
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080

Los Angeles Audubon
926 Citrus Avenue
Los Angeles, CA 90036-4929

Center on Race, Poverty
& the Environmental/
CA Rural Legal Assistance
Foundation
1012 Jefferson Street

Pacific Gas & Electric Co
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Southern California Gas Co
1510 North Chester Avenue
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Chumash Council of Bakersfield
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Nature Conservancy West Reg Office
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San Francisco, CA 94105

A E Corporation
Planning Department
901 Via Piemonte, 5th Floor
Ontario, CA 91764

Vestas
1417 NW Everett Street
Portland, OR 97209

Smart Growth – Tehachapi Valleys
P.O. Box 1894
Tehachapi, CA 93581

Lozeau Drury LLP
1939 Harrison Street, Suite 150
Oakland, CA 94612

Kern River Groundwater Sustainability Agency
1600 Truxtun Avenue
Bakersfield, CA 93301

California Department of Public Health
Drinking Water Field Operations
P.O. Box 100

Southern California Edison
P.O. Box 410
Long Beach, CA 90801

RECIRCULATED
DRAFT ENVIRONMENTAL IMPACT REPORT
NOTICE OF AVAILABILITY FOR PUBLIC REVIEW

This is to advise that the Kern County Planning and Natural Resources Department has prepared an Environmental Impact Report (EIR) for the project identified below. As mandated by State law, the minimum public review period for this document is 45 days. CEQA Guidelines Section 15088.5 (f) (1) provides that when an Environmental Impact Report (EIR) is substantially revised and the entire EIR is circulated, Kern County, as lead agency, may require that reviewers submit new comments, and the lead agency need not respond to those comments received during the earlier circulation period. Kern County will therefore respond in the Final Recirculated EIR only to new comments received regarding this Recirculated Draft EIR received during this comment period. The document and documents referenced in the Recirculated Draft EIR are available for review at the Planning and Natural Resources Department, 2700 "M" Street, Suite 100, Bakersfield, CA 93301 or on the Departmental website **(https://kernplanning.com/planning/environmental-documents/).**

A public hearing has been scheduled with the Kern County Planning Commission to receive comments on the document on: **February 27, 2020** at 7:00 p.m. or soon thereafter, Chambers of the Board of Supervisors, First Floor, Kern County Administrative Center, 1115 Truxtun Avenue, Bakersfield, California.

The comment period for this document closes on **December 16, 2019**. Testimony at future public hearings may be limited to those issues raised during the public review period either orally or submitted in writing by 5:00 p.m. the day the comment period closes.

Project Title: 99 Houghton Industrial Park Project; General Plan Amendment No. 1, Map 143-07; Zone Change Case No. 2, Map 143-07; Conditional Use Permit No. 5, Map 143-07; Ag Preserve No. 13 – Excl.

Project Location: Bounded by South Union Avenue on the east, State Route 99 on the west, DiGiorgio Road to the north, and Houghton Road to the south.

Project Description: The project proponent is requesting: (a) one (1) General Plan Amendment from map code designation R-IA (Resource – Intensive Agriculture) to LI (Light Industrial) on 108 acres, SI (Service Industrial) on 159 acres, HC (Highway Commercial) on 9.01 acres, GC (General Commercial) on 22 acres of the proposed site; (b) one (1) change in zone classification from the existing A (Exclusive Agriculture) to M-1 PD (Light Industrial Precise Development Combining) on 108 acres, M-2 PD (Medium Industrial) on 159 acres, CH PD (Highway Commercial) on 25 acres and C-2 PD (General Commercial) on 22 acres of the proposed site; (c) One Conditional Use Permit for the construction of a Sewage Treatment Plant (19.38.030.H) in an M-2 (Medium Industrial) District; (d) an exclusion of 257.57 acres from the boundaries of Agricultural Preserve No. 13. The propose project would allow the development of an industrial park with a maximum of 4,613,004 square feet of net building area.

Anticipated Significant Impacts on Environment: Agricultural Resources, Air Quality, Greenhouse Gases, Noise and Transportation

Document can be viewed online at: https://kernplanning.com/planning/environmental-documents/

For further information, please contact: Carlos E. Rojas, Planner 3 ((661) 862-5015) or email CRojas@kerncounty.com

LORELEI OVIATT, AICP, Director
Planning and Natural Resources Department

To be published once only on next available date and as soon as possible

BAKERSFIELD CALIFORNIAN

CER:sc (02/01/18)

County Clerk (2) (with fee)
Environmental Status Board
Sierra Club/Kern Kaweah
Chapter LiUNA/Arthur Izzo
Supervisorial District No. 4
California Native Plant Society/Kern Chapter
Kern County Archaeological Society
Native American Heritage Pres. Council/Kern
County Center on Race, Poverty and Environment (2)

GPA # 1 Map # 143-07
ZCC # 2 Map # 143-07
CUP # 5 & 6 Map # 143-07
es (10/10/2019)
I:\Planning\WORKGRPS\WP\LABELS\147-07gpa1zcc2cup5cup6_Property Owners.docx

PROPERTY OWNERS

18538107007
AYON ALFREDO
14201 COSTAJO RD
BAKERSFIELD CA 933139500

18516005000
BALL FAMILYS TRUST
12825 S UNION AV
BAKERSFIELD CA 933079025

18518016008 **DUP**
BALL FAMILYS TRUST
12825 S UNION AV
BAKERSFIELD CA 933079025

18415070008
BUGNI JIMMY R FAMILY TRUST
3053 CURNOW RD
BAKERSFIELD CA 93313

18519002000
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CALI ESTATES LLC
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18538105001
HARARI ENTERPRISES LLC
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BEVERLY HILLS CA 902113564

18538111008
HAYCOCK DUSTIN N & STEPHANIE
13031 THOROUGHBRED ST
BAKERSFIELD CA 933139604

18518031001
HOOLEY REBECCA
11509 MARAZZON HILL CT
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18538124006
HYLTON JEANNE C
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BAKERSFIELD CA 933139604

18518010000
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12336 S UNION AV
BAKERSFIELD CA 933079023

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LAMB DAN E & SUSAN A LAMB TRUST
409 LAMB AV
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18518038002 **DUP**
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BAKERSFIELD CA 933078812

18518021002
LAMB LEWIS KEITH & MICKEY SUE TRUST
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18515004004
MADRUGA FAMILY TRUST
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SAN FRANCISCO CA 941051004

18515001005
PACIFIC TEL & TEL CO
140 NEW MONTGOMERY ST # 818
SAN FRANCISCO CA 941053705

18538101009
PANAMA M U LLC
1470 W HERNDON # 100
FRESNO CA 93711

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5021 E BEAR MOUNTAIN BL
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BAKERSFIELD CA 933079760

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4021 S FAIRFAX RD
BAKERSFIELD CA 933078912

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # 2009051005

Project Title: 99 Houghton Industrial Park Project by McIntosh & Associates

Lead Agency: Kern County Planning Department | Contact Person: Carlos E. Rojas

Mailing Address: 2700 "M" Street Suite 100 | Phone: (661) 862-5015

City: Bakersfield | Zip: 93301-2323 | County: Kern

Project Location: County: Kern | City/Nearest Community: City of Bakersfield

Cross Streets: South Union and DiGiorgio | Zip Code: 93307

Lat. / Long.: 35° 14′ 39″ N / 119° 0’ 44″ W | Total Acres: 314.31

Assessor's Parcel No.: 185-140-08 | Section: 7 | Twp.: 31S | Range: 28E | Base: MDB&M

Within 2 Miles: State Hwy #: 99 | Waterways: N/A

Airports: N/A | Railways: N/A | Schools: General Shafter Elem

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Document Type:

CEQA: ☐ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☒ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) ☐ Other Recirculated

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other

Local Action Type:

☐ General Plan Update ☒ General Plan Amendment ☐ General Plan Element ☐ Community Plan

☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan

☒ Rezone ☐ Prezone ☒ Use Permit ☐ Land Division (Subdivision, etc.)

☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☒ Ag Preserve No. Excl.

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☒ Industrial: Sq.ft. 4,613,004 Acres 314 Employees ____
☐ Educational ____
☐ Recreational ____

☐ Water Facilities: Type ____ MGD ____
☐ Transportation: Type ____
☐ Mining: Mineral ____
☐ Power: Type ____ MW ____
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type ____
☐ Other: ____

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☒ Agricultural Land ☒ Air Quality ☒ Archeological/Historical ☒ Biological Resources ☐ Coastal Zone ☒ Drainage/Absorption ☒ Economic/Jobs ☐ Other

☒ Fiscal ☒ Flood Plain/Flooding ☒ Forest Land/Fire Hazard ☒ Geologic/Seismic ☒ Minerals ☒ Noise ☒ Population/Housing Balance ☒ Public Services/Facilities

☒ Recreation/Parks ☒ Schools/Universities ☒ Septic Systems ☒ Sewer Capacity ☒ Soil Erosion/Compaction/Grading ☒ Solid Waste ☒ Toxic/Hazardous ☒ Traffic/Circulation

☒ Vegetation ☒ Water Quality ☒ Water Supply/Groundwater ☐ Wetland/Riparian ☒ Wildlife ☒ Growth Inducing ☒ Land Use ☒ Cumulative Effects

---

Present Land Use/Zoning/General Plan Designation:

Agriculture**.** *Zoning:* A (Exclusive Agriculture); *Kern County General Plan:* R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial) 4.3

Project Description: *(please use a separate page if necessary)* The project proponent is requesting: (a) One General Plan Amendment from map code designation R-IA (Resource – Intensive Agriculture) to LI (Light Industrial) on 108 acres, SI (Service Industrial) on 159 acres, HC (Highway Commercial) on 9.01 acres, GC (General Commercial) on 22 acres of the proposed site; (b) one change in zone classification from the existing A (Exclusive Agriculture) to M-1 PD (Light Industrial Precise Development Combining) on 108 acres, M-2 PD (Medium Industrial) on 159 acres, CH PD (Highway Commercial) on 25 acres and C-2 PD (General Commercial) on 22 acres of the proposed site; (c) One Conditional Use Permit for the construction of a Sewage Treatment Plant (19.38.030.H) in an M-2 (Medium Industrial) District; (d) an exclusion of 257.57 acres from the boundaries of Agricultural Preserve No. 13. The propose project would allow the development of an industrial park with a maximum of 4,613,004 square feet of net building area.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

_____	Air Resources Board	_____	Office of Emergency Services
_____	Boating & Waterways, Department of	_____	Office of Historic Preservation
__S__	California Highway Patrol	_____	Office of Public School Construction
_____	CalFire	_____	Parks & Recreation
__S__	Caltrans District # 6 & 9	_____	Pesticide Regulation, Department of
_____	Caltrans Division of Aeronautics	_____	Public Utilities Commission
_____	Caltrans Planning (Headquarters)	__S__	Regional WQCB # _____
_____	Central Valley Flood Protection Board	_____	Resources Agency
_____	Coachella Valley Mountains Conservancy	_____	S.F. Bay Conservation & Development Commission
_____	Coastal Commission	_____	San Gabriel & Lower L.A. Rivers and Mtns Conservancy
_____	Colorado River Board	_____	San Joaquin River Conservancy
_____	Conservation, Department of	_____	Santa Monica Mountains Conservancy
_____	Corrections, Department of	_____	State Lands Commission
_____	Delta Protection Commission	_____	SWRCB: Clean Water Grants
_____	Education, Department of	_____	SWRCB: Water Quality
_____	Energy Commission	_____	SWRCB: Water Rights
__S__	Fish & Game Region # Fresno	_____	Tahoe Regional Planning Agency
_____	Food & Agriculture, Department of	_____	Toxic Substances Control, Department of
_____	General Services, Department of	_____	Water Resources, Department of
_____	Health Services, Department of		
_____	Housing & Community Development	_____	Other _____
_____	Integrated Waste Management Board	_____	Other _____
__S__	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date November 1, 2019 Ending Date December 16, 2019

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: _____/S/_____ **Date:** 11/1/19

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Recirculated
Draft Environmental Impact Report

SCH# 2009051005

Volume 1

99 HOUGHTON INDUSTRIAL PARK PROJECT
By McIntosh & Associates

General Plan Amendment 1, 143-07;
Zone Change Case 2, Map 143-07;
Conditional Use Permit 5, Map 143-07;
Ag Preserve No. 13 – Excl.

Kern County Planning and Natural Resources Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2370
(661) 862-8600

Technical Assistance by:

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555 Capitol Mall, Suite 300
Sacramento, CA 95814
(916) 858-5800

October 2019

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Chapter 1
Executive Summary

Chapter 1
Executive Summary

1.1 Introduction

This Recirculated Draft Environmental Impact Report (RDEIR) has been prepared to identify and evaluate the potential environmental impacts associated with the implementation of the 99 Houghton Industrial Park Project (proposed Project), an industrial development of 314.30 acres of land within the unincorporated area of Kern County, California County (Figure 1-1, *Regional Vicinity*). The proposed Project encompasses approximately 314 acres, and is located north of Houghton Road, east of State Route 99 (SR-99), west of South Union Avenue, and south of DiGiorgio Road, in Kern County (Figure 1-2, *Project Vicinity*) The proposed Project would allow for development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. A private package sewer treatment plant is proposed to provide sewer services for the Project site.

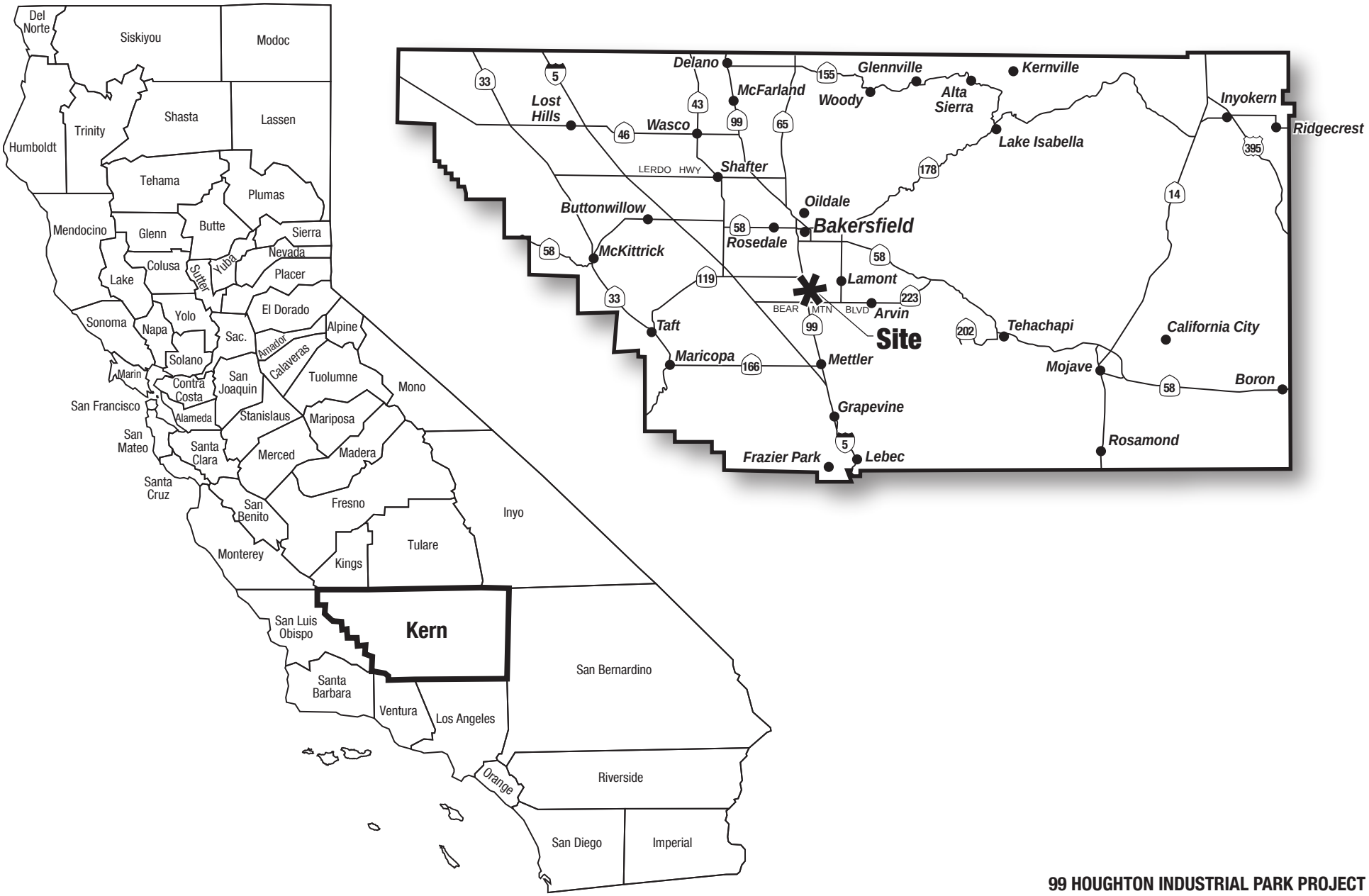
This Recirculated Draft Environmental Impact Report (RDEIR) has been prepared by Kern County as the Lead Agency under the California Environmental Quality Act (CEQA). The RDEIR provides information about the environmental setting and impacts of the project and alternatives. It informs the public about the project and its impacts and provides information to meet the needs of local, State, and federal permitting agencies that are required to consider the project. The RDEIR will be used by Kern County to determine whether to approve the general plan amendment (GPA), zone change (ZCC), conditional use permit (CUP), and Agricultural Preserve Exclusion for the project.

This Executive Summary summarizes the requirements of the CEQA Statutes and Guidelines, provides an overview of the project and alternatives, identifies the purpose of the RDEIR, outlines the potential impacts of the project and the recommended mitigation measures, and discloses areas of controversy and issues to be resolved.

Project Summary

The proposed Project consists of medium to light industrial development of 314.30 acres of land within the unincorporated area of Kern County, California. The proposed Project includes a GPA to modify the existing Metropolitan Bakersfield General Plan land use designations, a change in zone classification and the Exclusion from Agricultural Preserve No. 13. The RDEIR, once certified, will be used to satisfy the CEQA requirements for the following discretionary and ministerial approvals by the County:

1. Consideration and certification of a final Environmental Impact Report (FEIR) with appropriate State CEQA Guidelines Sections 15091 Findings, 15093 Statement of Overriding Considerations, and the mitigation measures monitoring reporting program by the Kern County Planning Commission and Kern County Board of Supervisors;



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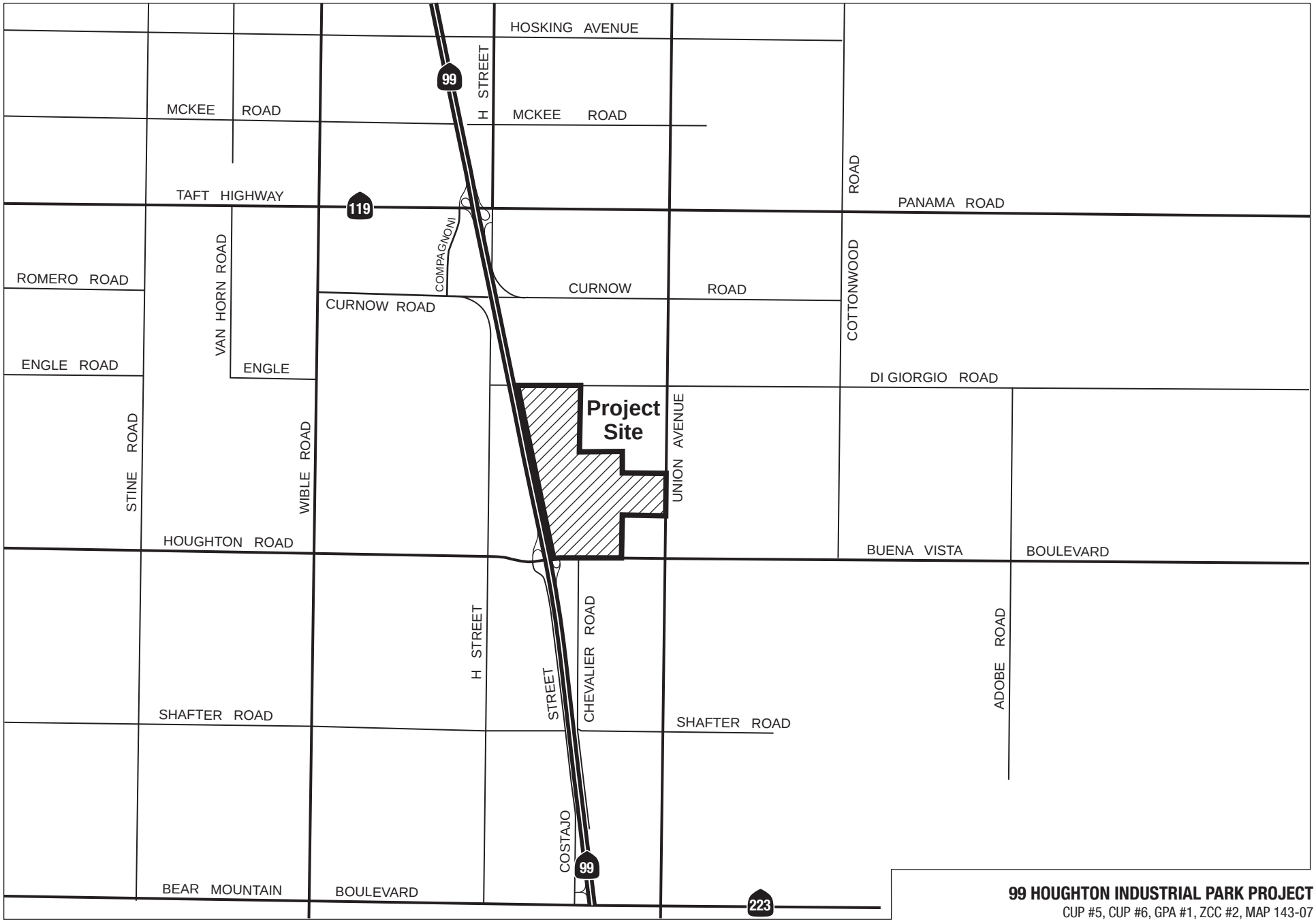
Regional Vicinity

Figure 1-1



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Project Vicinity

Figure 1-2

2. Approval by the Kern County Board of Supervisors for a general plan amendment for the proposed Project site, to amend the existing land use designation from R-IA (Resource – Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), HC (Highway Commercial), and GC (General Commercial);

3. Approval by the Kern County Board of Supervisors for a zone change (ZCC) for the Project site, to remove the existing A (Exclusive Agriculture) zoning classification and rezone the Project site M-1PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial Precise Development Combining), and C-2 PD (General Commercial Precise Development Combining);

4. Approval by the Kern County Board of Supervisors for a conditional use permit (CUP) for a Sewer Treatment Plant;

~~5. Approval by the Kern County Board of Supervisors for a conditional use permit (CUP) for a Water Treatment Plant;~~

5. Exclusion of the Project site from Agricultural Preserve No. 13;

~~6. Approval by the Kern County Board of Supervisors and processing of a parcel map(s);~~

~~7. Kern County Public Works Department – construction, grading, and building permits;~~

~~8. Kern County Environmental Health Services Division – Water well permits, if applicable;~~

~~9. Kern County Fire Department – Fire Safety Plan; and~~

~~10. Kern County Permit for Occupancy.~~

1.3 Purpose and Use of the Recirculated Draft EIR

This document is the Recirculated DEIR for the 99 Houghton Industrial Park. The 99 Houghton Industrial Park Project Environmental Impact Report was originally circulated for public comment from February 13, 2018, with a comment closing date of April 2, 2018, by the Kern County Planning Department acting as the lead agency. On March 13, 2018, prior to the end of the original comment period, the project was formally withdrawn from circulation. The County has received and considered written comments that were received after the close of the public comment period.

County staff has determined that changes should be made in the Draft EIR that was originally circulated for public comment. In some cases changes have been made to the project and in some cases new or revised information or analysis has been included in the Recirculated Draft EIR.

The Guidelines adopted by the Governor's Office of Planning and Research for the California Environmental Quality Act (Guidelines) provide that a lead agency is required to recirculate an environmental impact report when *significant new information* is added to an EIR after public

review of the Draft EIR has begun. New information can include changes in the project description, changes in the environmental setting, as well as other additional data or information. This information may relate to new environmental impacts, severity of such impacts, alternatives or mitigation. Recirculation of an EIR is covered by CEQA Guidelines Section 15088.5.

As mandated by State law, the minimum public review period for this document is 45 days. CEQA Guidelines Section 15088.5 (f) (1) provides that when an Environmental Impact Report (EIR) is substantially revised and the entire EIR is circulated, Kern County, as lead agency, may require that reviewers submit new comments, and the lead agency need not respond to those comments received during the earlier circulation period. Kern County will therefore respond in the Final Recirculated EIR only to new comments received regarding this Recirculated Draft EIR received during this comment period

~~This Draft EIR was prepared to evaluate the potential environmental impacts associated with the proposed Project. This report also identifies mitigation measures and alternatives to the proposed Project that may reduce or eliminate impacts. This Draft EIR has been prepared pursuant to CEQA.~~

1.4 Project Overview

Local and Regional Setting

The proposed Project is situated in the southern San Joaquin Valley in Kern County, California. Kern County is California's third-largest county in land area encompassing approximately 8,202 square miles. The geography of the county is diverse, containing mountainous areas, agricultural lands, and desert areas. The dominant land uses within the county are related to agricultural and resource extraction, although over the last few decades, urban development has occurred in and around the County's 11 incorporated cities. Bakersfield is the county's largest city, with an estimated population of 389,211 [California Department of Finance (CDOF) 2019].

The Project site is located within the sphere of influence to the City, in southeast Metropolitan Bakersfield, governed by the Metropolitan Bakersfield General Plan. The proposed Project is generally located north of Houghton Road, east of State Route 99 (SR-99), west of South Union Avenue, and south of DiGiorgio Road. South Union Avenue, Houghton Road, and the DiGiorgio Road alignment provide the primary access to and from the proposed Project. The proposed Project is located within a portion of Section 7, Township 31 South, Range 28 East, Mount Diablo Base and Meridian (MDBM). In general, the Project site is surrounded by vacant land, actively cultivated and fallow agricultural land, and limited residential uses.

Surrounding Land Uses

The general area of the proposed Project site is surrounded by cultivated and fallow agricultural land and limited residential, commercial and industrial land uses.

Project Objectives

The CEQA Guidelines (Section 15124[b]) require that the project description contain a statement of objectives that includes the underlying purpose of the project. The applicant's objectives for the proposed Project are as follows:

- Facilitate quality development that is consistent with and implements the goals of the Kern County General Plan and Metropolitan Bakersfield General Plan.
- To develop the site consistent with the provisions of the Kern County Zoning Ordinance, Land Division Ordinance, and Development Standards.
- Assure adequate planning for all community facilities including circulation improvements, drainage facilities, water, and wastewater facilities.
- Ensure that the project, in and of itself, does not contribute to the conversion of adjacent agricultural areas.
- Cluster commercial retail uses that provide goods and services near an interchange with SR-99 to accommodate interstate freight and reduce traffic congestion and air emissions.
- Accommodate new development that channels land uses in a phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.
- Address community circulation, both vehicular and pedestrian, utilizing available capacity with the existing circulation system, and provide fair-share system improvements to deficient intersections or road segments.
- Facilitate a planned development and related in-line tenants consistent with the market objectives of the applicant and its tenants.
- Accommodate growth within the proposed project while balancing environmental considerations.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.
- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.
- Provide new industrial development that captures the economic demands generated by the marketplace.
- Provide new development that will assist the County of Kern in obtaining fiscal balance in the years and decades ahead.

Proposed Project Characteristics

The Project site would be developed with approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. A private package sewer treatment plant is proposed to provide sewer services for the Project site.

Proposed General Plan Amendment

The Project proposes to amend the MBGP land use designations from R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial), to LI (Light Industrial), SI (Service Industrial), HC (Highway Commercial), and GC (General Commercial) (refer to Figure 1-3, *Existing General Plan Land Use Designations* and Figure 1-4, *Proposed General Plan Land Use Designations*). Approximately 108 acres would be amended to LI, approximately 159 acres would be amended to SI, approximately 9.01 acres would be amended to HC (Highway Commercial), and approximately 22 acres would be amended to GC (General Commercial). The Project site contains 15.99 acres of HC (Highway Commercial) that would remain unchanged. The LI designation is characterized by unobtrusive industrial activities that can be located in close proximity to residential and commercial uses with a minimum of environmental conflicts. The SI designation is characterized by industrial activities which involve outdoor storage or use of heavy equipment (MBGP 2007).

Proposed Zone Change

The Project proposes a Zone Change from A (Exclusive Agriculture) to M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining). Approximately 108 acres would be amended to M-1 PD, approximately 159 acres would be amended to M-2 PD, approximately 22 acres would be amended to C-2 PD, and approximately 25 acres would be amended to CH PD; refer to Figure 1-5, *Existing Zoning*, and Figure 1-6, *Proposed Zoning*, for a graphical representation of the proposed Project zone changes. As discussed in further detail below, all zones would be amended to contain the PD (Precise Development) Combining District overlay. The C-2 zoning classification is typically characterized by regional shopping centers and heavy commercial uses while CH zoning classification is typically characterized by gas stations, restaurants, and motels. The purpose of the M-1 zoning classification is to designate areas for wholesale commercial, storage, trucking, assembly-type manufacturing, and other similar industrial uses. The M-2 zoning designation is typically characterized by general manufacturing, processing, and assembly activities. The purpose of the PD Combining District is to designate areas with unique site characteristics or environmental conditions or areas surrounded by sensitive land uses to ensure that development in such areas is compatible with such constraints.

Precise Development Plans

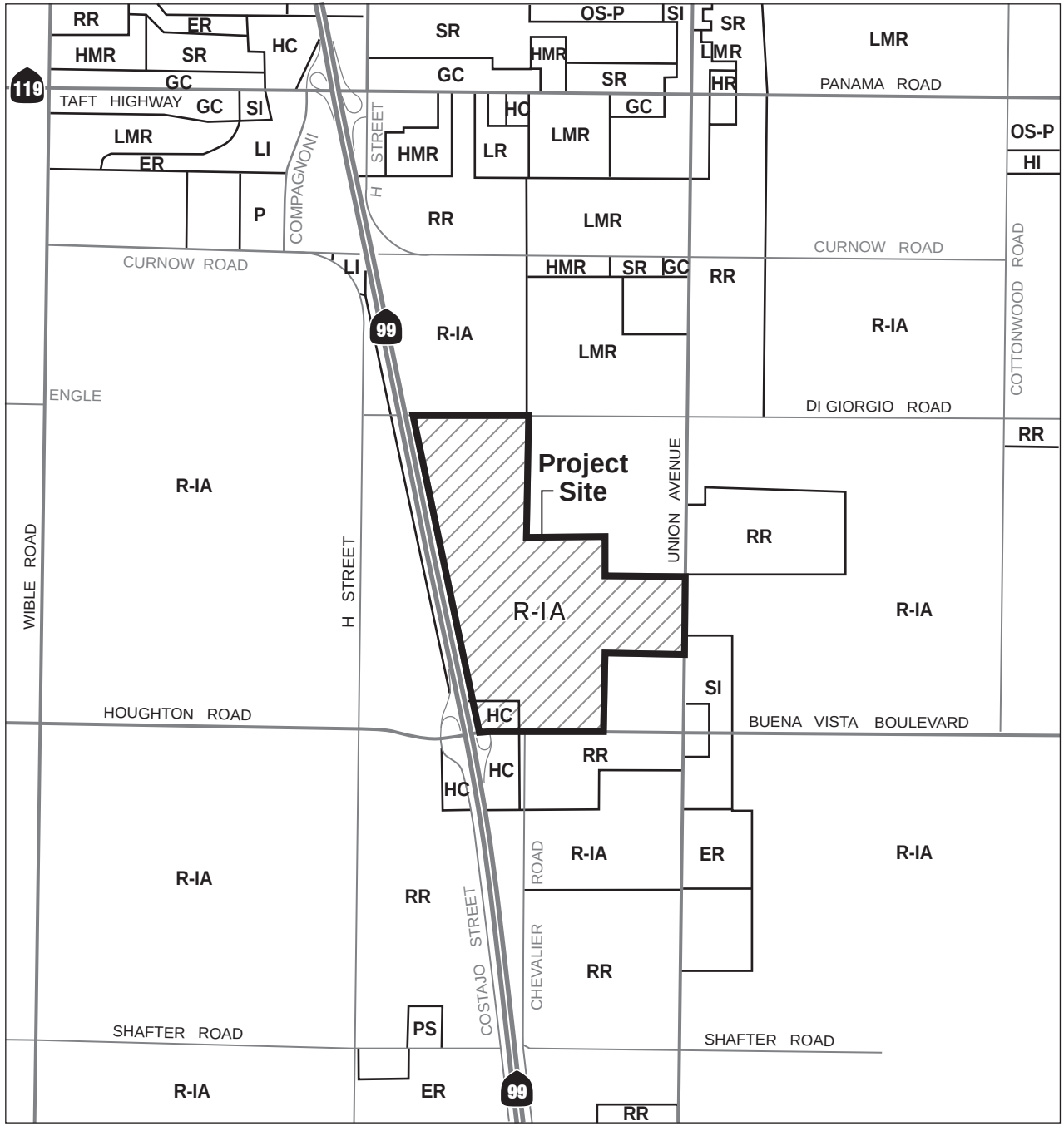
Included with the proposed zone change to C-2, CH, M-1, and M-2 is the Precise Development (PD) Combining District. The purpose of the Precise Development (PD) Combining District is to designate areas with unique site characteristics or environmental conditions or areas surrounded by sensitive land uses to ensure that development in such areas is compatible with such constraints.

All development in the PD Combining District shall be subject as a minimum to Special Development Standards as specified in Chapter 19.80 of the Kern County Zoning Ordinance; however, a Special Development Standard Plan Review shall not be required. The regulations established by the PD District shall be in addition to the regulations of the base district with which the PD District is combined.

Given the uncertainty regarding the specific use to be developed on site at this time, the PD Combining District is being included in the proposed zone change request. Implementation of the PD Combining District will ensure that as development of the site moves forward, the Kern County Planning and Natural Resources Department and the community at large will have the opportunity to publicly review site specific proposals to ensure compliance with the environmental impact report, the specific development standards and overall compatibility with the surrounding uses. Implementation of the site is expected to be processed under a Master Precise Development Plan.

Agricultural Preserve – Exclusion

An agricultural preserve defines the boundary of an area within the County that meets the criteria for property owners to enter into Williamson Act Land Use Contracts and Farmland Security Zone Contracts. Only land within an agricultural preserve is eligible for such contracts. The Kern County Board of Supervisor policy has established the criteria for inclusion into a preserve as land having a General Plan resource designation (RI–A) and having a zoning designation of A (Exclusive Agriculture). If approved, the requested MBGP designations of LI and SI would require the exclusion of approximately 257.57 acres from Agricultural Preserve No. 13 (refer to Figure 1-7, *Agricultural Preserve No. 13 Map*).



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Land Use Designations

R-IA	Resource - Intensive Agriculture
LMR	Low Medium Residential
HMR	High Medium Residential
RR	Rural Residential
ER	Estate Residential
SR	Suburban Residential
GC	General Commercial
HC	Highway Commercial
LI	Light Industrial
SI	Service Industrial
HI	Heavy Industrial
OS-P	Parks and Recreation Facilities
PS	Public and Private Schools
P	Publicly Owned Facilities

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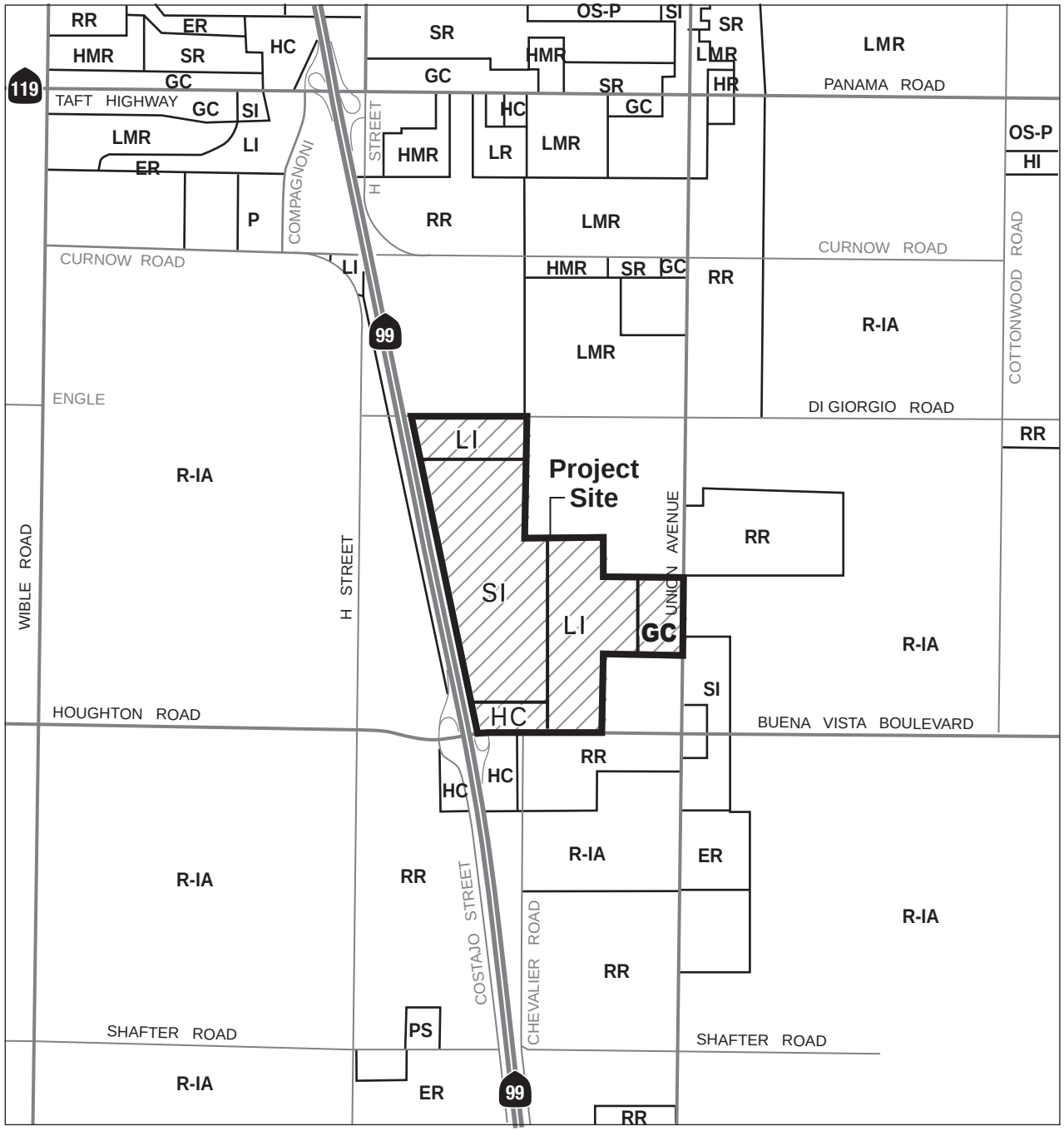
AGRICULTURAL PRESERVE #13 EXCLUSION

Existing General Plan Land Use Designations

Figure 1-3



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Land Use Designations

R-IA	Resource - Intensive Agriculture
LMR	Low Medium Residential
HMR	High Medium Residential
RR	Rural Residential
ER	Estate Residential
SR	Suburban Residential
GC	General Commercial
HC	Highway Commercial
LI	Light Industrial
SI	Service Industrial
HI	Heavy Industrial
OS-P	Parks and Recreation Facilities
PS	Public and Private Schools
P	Publicly Owned Facilities

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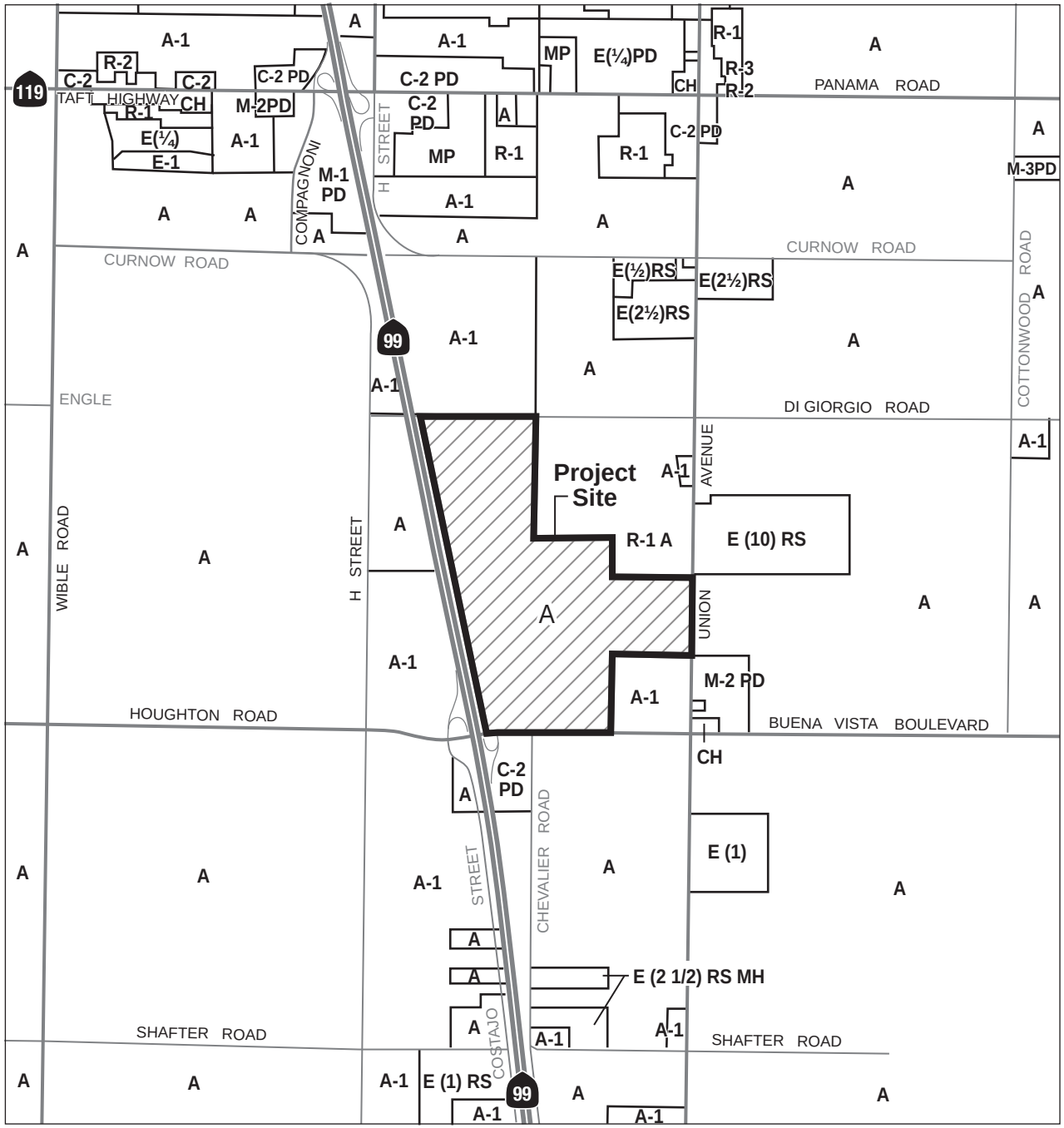
AGRICULTURAL PRESERVE #13 EXCLUSION

Proposed General Plan Land Use Designations

Figure 1-4



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Zoning Districts

A	Exclusive Agriculture
A-1	Limited Agriculture
C-2 PD	General Commercial, Precise Development Combining
C-2	General Commercial
CH	Highway Commercial
E (1/4)	Estate .25 Acres
E (1/2) RS	Estate .5 Acres, Residential Suburban Combining
E (1)	Estate 1 Acre
E (10) RS	Estate 10 Acres, Residential Suburban Combining
E (2 1/2) RS	Estate 2.5 Acre, Residential Suburban Combining
M-2 PD	Medium Industrial, Precise Development Combining
M-3 PD	Heavy Industrial, Precise Development Combining
MP	Mobile Home Park
R-1	Low Density Residential

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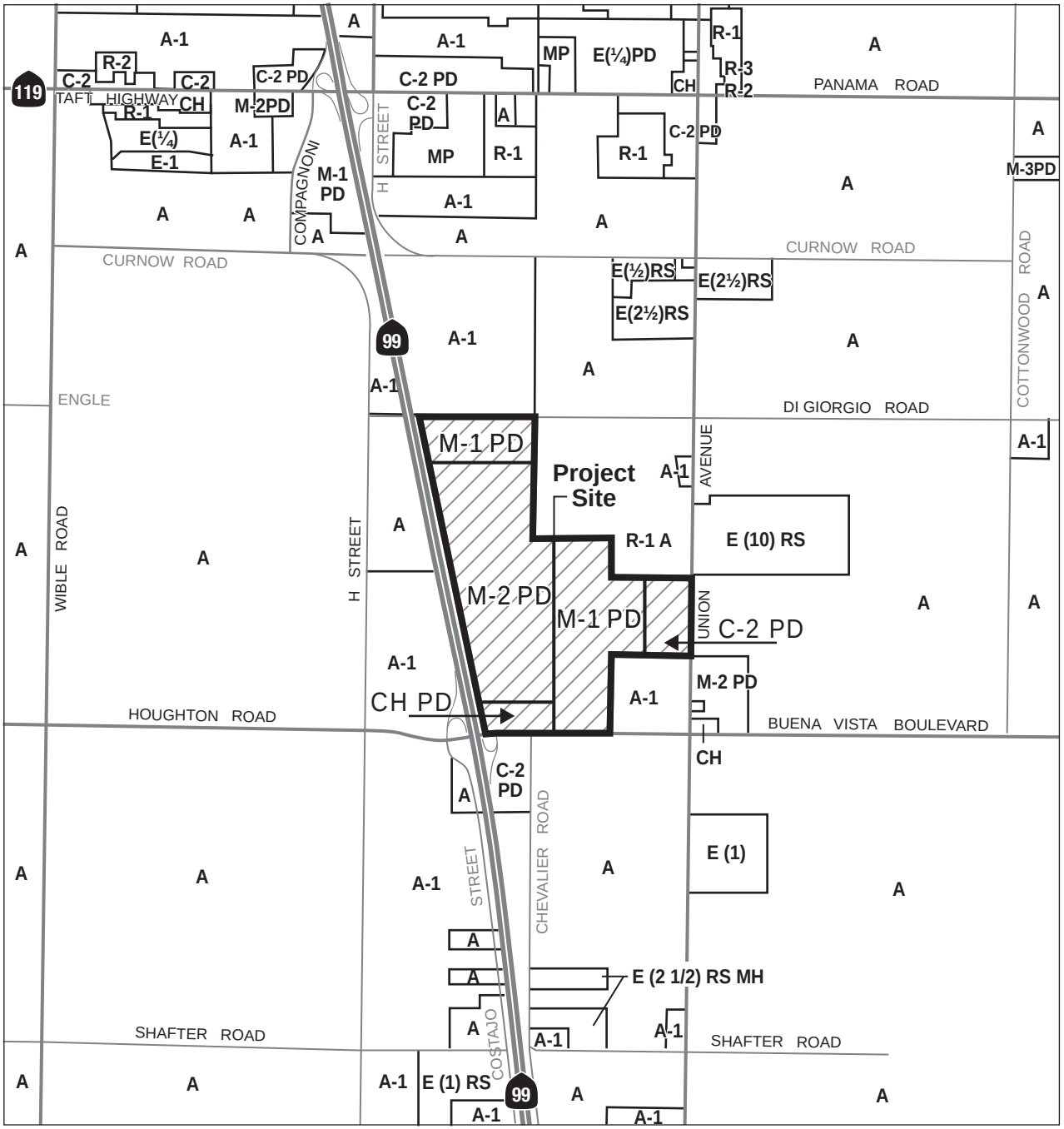
AGRICULTURAL PRESERVE #13 EXCLUSION

Existing Zoning

Figure 1-5



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Zoning Districts

A	Exclusive Agriculture
A-1	Limited Agriculture
C-2 PD	General Commercial, Precise Development Combining
C-2	General Commercial
C-2 PD	General Commercial Precise Development Combining
CH	Highway Commercial
CH PD	Highway Commercial Precise Development Combining
E (1/4)	Estate .25 Acres
E (1/2) RS	Estate .5 Acres, Residential Suburban Combining
E (1)	Estate 1 Acre
E (10) RS	Estate 10 Acres, Residential Suburban Combining
E (2 1/2) RS	Estate 2.5 Acre, Residential Suburban Combining
M-1	Light Industrial
M-1 PD	Light Industrial, Precise Development Combining
M-2	Medium Industrial
M-2 PD	Medium Industrial, Precise Development Combining
M-3 PD	Heavy Industrial, Precise Development Combining
MP	Mobile Home Park
R-1	Low Density Residential

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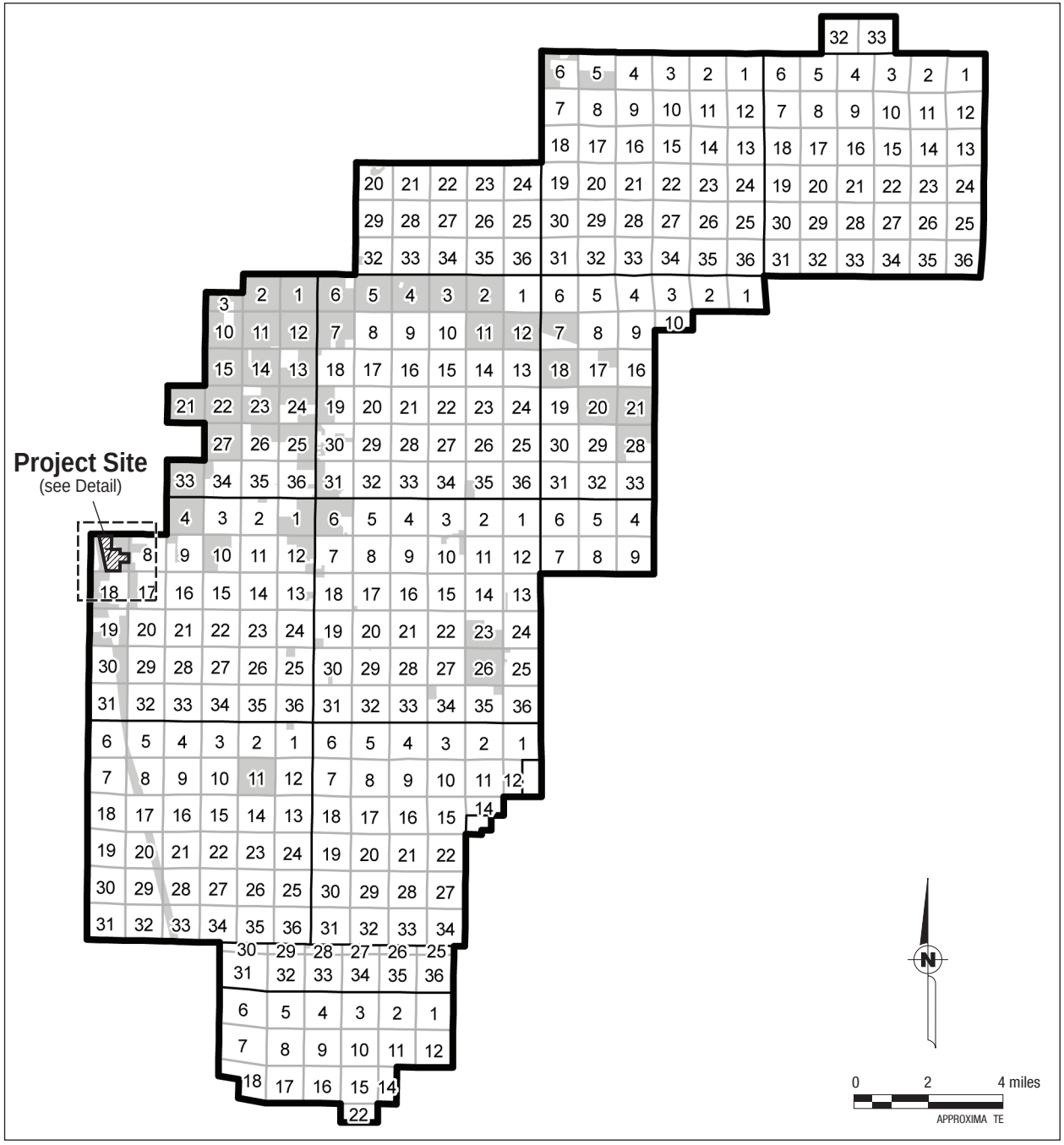
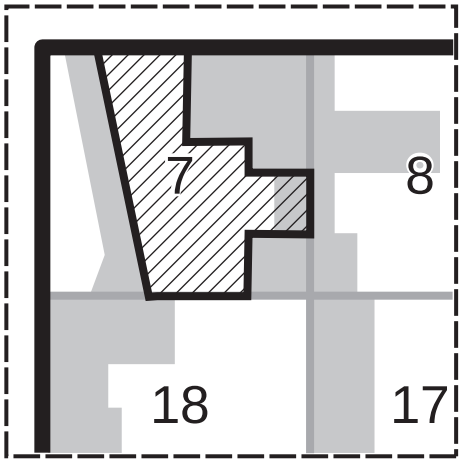
AGRICULTURAL PRESERVE #13 EXCLUSION

Proposed Zoning

Figure 1-6





Project Site Detail

LEGEND

- 99 Houghton Project Site
- Agricultural Preserve 13
- Townships
- PLSS Sections
- Portion Excluded From Agricultural Preserve

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CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Agricultural Preserve No. 13 Map

Figure 1-7

Proposed Discretionary Action and Required Approvals

This Recirculated Draft EIR, once certified, will be used to satisfy the CEQA requirements for the following discretionary and ministerial approvals:

Kern County:

- Consideration and Certification of a Final Environmental Impact Report (FEIR) with appropriate findings State CEQA Guidelines Section 15091 Findings, 15093 Statement of Overriding Considerations, and the mitigation measures monitoring reporting program by the Kern County Planning Commission and Kern County Board of Supervisors
- Approval by the Kern County Board of Supervisors for a GPA for the proposed Project site, to amend the existing land use designation from R-IA (Resource – Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), HC (Highway Commercial), and GC (General Commercial)
- Approval by the Kern County Board of Supervisors for a ZCC for the Project site, to remove the existing A (Exclusive Agriculture) zoning classification and rezone the Project site M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining)
- Approval by the Kern County Board of Supervisors for a CUP for a Sewer Treatment Plant
- ~~Approval by the Kern County Board of Supervisors for a CUP for a Water Treatment Plant~~
- Exclusion of the Project site from Agricultural Preserve No. 13

1.5 Environmental Impacts

Section 15128 of the State CEQA Guidelines requires that an EIR contain a statement briefly indicating the reasons that various, possible new significant effects of a project were determined not to be significant and were therefore not discussed in detail in the RDEIR. The County has engaged the public and sought community participation in the scoping process for the environmental document. Comments received during scoping have been considered in the process of identifying issue areas that should receive attention in the EIR. The contents of this Recirculated Draft EIR were established based on the Notice of Preparation/Initial Study (NOP/IS) prepared in accordance with the State CEQA Guidelines, as well as public and agency input received during the scoping process.

Impacts Not Further Considered

Those specific issues that are found to have no impact or less-than-significant impacts during preparation of the NOP/IS do not need to be addressed further in this RDEIR. The findings of the NOP/IS and the results of scoping were the basis of the determination that this Recirculated Draft EIR would contain a comprehensive analysis of all environmental issues identified in the Kern

County CEQA Implementation Document. No issues have been eliminated from discussion in this Recirculated Draft EIR.

Impacts of the Proposed Project

Sections 4.1 through 4.16 provide a detailed discussion of the environmental setting, impacts associated with the proposed Project, and mitigation measures designed to reduce significant impacts to less-than-significant levels, when feasible. The impacts, mitigation measures, and residual impacts for the proposed Project are summarized in Table 1-2 at the end of this chapter and are discussed further below.

Less Than Significant Impacts (Including Significant Impacts That Can Be Mitigated, Avoided, or Substantially Lessened).

The analysis of the impacts of the proposed Project documents that the impacts would be less than significant or less than significant after mitigation is implemented on the following resources:

- Aesthetics,
- Biological Resources,
- Cultural Resources,
- Energy
- Geologic and Seismic Hazards,
- Hazards and Hazardous Materials,
- Hydrology and Water Quality,
- Land Use and Planning,
- Mineral Resources,
- Population and Housing,
- Public Services,
- Utilities, and
- Wildfire

Significant and Unavoidable Impacts

Section 15126.2(b) of the CEQA Guidelines requires that the EIR describe any significant impacts, including those that can be mitigated but not reduced to less-than-significant levels. Potential environmental effects of the proposed Project and proposed mitigation measures are discussed in detail in Chapter 4 of this RDEIR. The following environmental impacts were determined to be significant and unavoidable impacts (refer to Table 1-1, *Summary of Significant Impacts of the Proposed Project*).

Table 1-1. Summary of Significant Impacts of the Proposed Project

Resources	Project Impacts	Cumulative Impacts
Agricultural Resources	The conversion of approximately 314.30 acres of agricultural farmland is considered **significant and unavoidable.**	Although the Metropolitan Bakersfield General Plan has various Land Use policies that direct development to encourage site compatibility with surrounding uses, the cumulative loss of agricultural land results in a significant and unavoidable impact. Notwithstanding this conclusion, Project implementation, when combined with the potential loss of other agricultural lands within the Planning area, over time, would remain a **significant and unavoidable** cumulative impact.
Air Quality	Surrounding sensitive receptors could potentially be exposed to substantial ROG pollutant concentrations from the proposed Project. In addition, operational impacts would result in **significant and unavoidable** impacts of ROG, NO_x, CO, and PM_{10} emissions.	While all feasible and reasonable mitigation has been included, however, the proposed mitigation measures do not result in a reduction of ROG, NO_x, CO, and PM_{10}, below the thresholds. Therefore, the remaining unmitigated emissions and related health effects are considered **cumulatively significant and unavoidable.**
Greenhouse Gases	Project-related greenhouse gases impacts would be reduced to **less than significant** levels with incorporation of mitigation measures.	The cumulative impacts of the proposed Project on global climate change are not known with certainty; therefore, cumulative impacts on global climate change and associated health effects are considered **significant and unavoidable.**
Noise	Given a specific Project use is not currently proposed, and the fact that permitted uses within the M-1 PD and M-2 PD Zone Districts allow for operations to be conducted outside of a fully enclosed building, the proposed Project may result in exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. Impacts are considered **significant and unavoidable.**	While all feasible and reasonable mitigation has been included, noise levels at 14 roadway segments a result of the proposed Project and at 15 roadway segments considering the project with past, present and reasonable, would be significant. In addition, noise levels at one residence in proximity to the proposed Project would exceed thresholds. Therefore, even with the implementation of all feasible mitigation, impacts would be both **significant and unavoidable and cumulatively significant and unavoidable**
Transportation and Traffic	Project-related transportation and traffic impacts would be reduced to **less than significant** levels with incorporation of mitigation measures.	Given the uncertainty of the timing and/or ultimate implementation of the recommended improvements which require pro-rata, fair share funding from various sources, along with those improvements necessary within Metropolitan Bakersfield, the proposed Project's contribution would result in **significant and unavoidable impacts.**

Significant Cumulative Impacts

According to Section 15355 of the CEQA Guidelines, the term cumulative impacts "...refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." Individual effects that may contribute to a cumulative impact may be from a single project or a number of separate projects. Individually, the impacts of a project may be relatively minor, but when considered along with impacts of other closely related

or nearby projects, including newly proposed projects, the effects could be cumulatively considerable. This RDEIR has considered the potential cumulative effects of the proposed project along with other current and reasonably foreseeable projects. Impacts for the following have been found to be cumulatively considerable:

- Agriculture,
- Air Quality,
- Greenhouse Gases,
- Noise, and
- Transportation and Traffic

Growth Inducement

The Metropolitan Bakersfield General Plan recognizes that certain forms of growth are beneficial, both economically and socially. CEQA associates development of new utilities and other infrastructure and public services with growth inducement. These facilities will be provided as an accommodation to proposed growth, and growth is expected to occur in the region. A project could induce population growth in an area either directly or indirectly. More specifically, the development of new homes or businesses could induce population growth directly, whereas the extension of roads or other infrastructure could induce population growth indirectly.

This Project would not directly increase population or the housing stock. The Project proposes to amend the Metropolitan Bakersfield General Plan to allow for service industrial and light industrial uses. This allows for additional employment opportunities, which can lead to the relocation of people to jobs and ultimately an increase in population. However, the size of the labor force within Kern County and the current unemployment rates are considered to be sufficient for the current County population to accommodate jobs generated by the proposed Project. Additionally, the proposed Project site is in the vicinity of a Metropolitan Bakersfield General Plan designation for "intensified activity center," and anticipates development of the southern activity center and surrounding areas. Therefore, the introduction of industrial uses on the Project site would not create a growth-inducing impact.

Irreversible Impacts

Section 15126.2(c) of the CEQA Guidelines defines the nature of an irreversible impact as an impact that uses nonrenewable resources during the initial and continued phases of the project. Irreversible impacts can also result from damage caused by environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to ensure that such consumption is justified. Buildout of the proposed Project would commit nonrenewable resources during construction and ongoing utility services. During the operations of the proposed Project, oil, gas, and other nonrenewable resources would be consumed. Therefore, an irreversible commitment of nonrenewable resources would occur as a result of long-term operation under the proposed Project. However, assuming that those commitments occur in accordance with the adopted goals, policies, and implementation measures of the Metropolitan Bakersfield General Plan, as a matter of public policy, those commitments have been determined to be acceptable. The Metropolitan Bakersfield General Plan ensures that any irreversible environmental changes associated with those commitments will be minimized.

1.6 Alternatives to the Proposed Project

CEQA states that an EIR must address "a range of reasonable alternatives to the project, or to the location of the project, which are ostensibly feasible and could attain the basic objectives of the project and evaluate the comparative merits of the alternatives." Please refer to Chapter 6, *Alternatives*, for a more detailed analysis and discussion.

Alternatives Considered in this RDEIR

In accordance with State CEQA Guidelines Section 15126.6, Section 6.0, *Alternatives*, describes a range of reasonable alternatives to the proposed Project that could feasibly attain the basic objectives of the proposed Project and evaluates the comparative merits of each Alternative. The analysis focuses on Alternatives capable of eliminating significant adverse environmental effects or reducing them to less than significant levels, even if these Alternatives would impede, to some degree, the attainment of the Project objectives. Potential environmental impacts are compared to impacts from the proposed Project. The following is a description of each of the Alternatives evaluated in Section 6.0.

Alternative A – "No Project/No Development"

The "No Project/No Development" Alternative assumes that the proposed GPA, ZCC and subsequent development would not be implemented. Under this scenario, the General Plan Land Use Designation on the Project site would remain R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial); the zoning would remain A (Exclusive Agriculture). Additionally, this Alternative assumes that existing land uses on the Project site would remain unchanged, and, as such, would remain under agricultural production. Because the Project site would remain unchanged, few or no environmental impacts would occur. This Alternative serves as the baseline against which to evaluate the effects of the proposed Project and other Project Alternatives presented below.

This Alternative would reduce impacts compared to the proposed Project in all categories. However, this Alternative was rejected because it does not fulfill 9 of the 13 objectives of the proposed Project described in Section 6.2, *Applicant Project Objectives*.

Alternative B – "Buildout Existing General Plan Designation"

Under Alternative B, the "Buildout Existing General Plan Designation" Alternative, the Project site would be developed to the maximum intensity allowed under the existing General Plan land use designation. Implementation of this Alternative would consist of development on the 314.30-acre Project site under the current land use designation of R-IA (Resource – Intensive Agriculture) and HC (Highway Commercial). The R-IA designation allows the development of dwelling units at a density of one unit per 20 acres. The HC designation allows the development of 7.6 acres for commercial uses. Therefore, this Alternative would yield 15 single-family dwelling units and approximately 132,422 square feet of highway commercial facilities. This number is based on the allowable Floor Area Ratio (FAR) of 0.4; therefore, 7.6 acres = 331,056 square feet. The maximum allowable building square footage would be 132,422 square feet (331,056 x 0.4 = 132,422).

This Alternative would reduce impacts compared to the proposed Project in the categories of aesthetics, agriculture, air quality, biological resources, energy, greenhouse gases, land use and relevant planning, noise, public services, utilities and traffic and circulation; and would have equivalent impacts in the categories of cultural resources, geologic and seismic hazards, hazards/hazardous materials, hydrology and water quality mineral resources, and wildfire. However, there would still have significant and unavoidable impacts on cumulative air quality. This Alternative would only partially satisfy the Project objectives, as no industrial land uses would be developed.

Alternative C – "Reduced Density" Alternative

Under Alternative C, the "Reduced Density" Alternative, the Project site would be developed under the LI (Light Industrial) and SI (Service Industrial) land use designation; however, the industrial facilities would be reduced in area. This Alternative would develop the entire 314.30-acre Project site; however, the square footage of industrial facilities would be reduced by approximately 25 percent. This results in the development of approximately 3,459,753 square feet of light and medium industrial facilities. The Project site would continue to require a GPA, ZCC, annexation, and exclusion from Agricultural Preserve Number 13.

This Alternative would reduce impacts compared to the proposed Project in the categories of air quality, energy, and noise ~~and traffic and circulation~~; and would have equivalent impacts in the categories of aesthetics, agriculture, biological resources cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, land use and relevant planning, mineral resources, population and housing, public services and utilities, traffic and circulation, and wildfire. This Alternative would satisfy the Project objectives.

Alternative D – "Reduced Project Size" Alternative

Under Alternative D, the "Reduced Project Size" Alternative, the Project site size would be reduced by 50 percent and the square footage size would be reduced accordingly. Therefore, Alternative D would develop the 159-acre portion of the Project site designated to be SI (Service Industrial) with 2,306,502 square feet of medium industrial facilities, as identified in the proposed Project. The approximately 22-acre parcel on the east, the 9.01-acre Highway Commercial parcel, and the approximately 107.72-acres on the east and north of the Project site to be designated LI (Light Industrial) would not be developed. Additionally, this Alternative would not provide access to any public road. Therefore, this Alternative assumes that existing land uses on the northern and eastern portions of the site would remain unchanged and would remain under their current state as fallow and cultivated land. This Alternative would continue to require the GPA, ZCC, annexation, and Agricultural Preserve Exclusion.

This Alternative would reduce the impacts compared to the proposed Project in the categories of air quality, noise, energy, and traffic and circulation; and would have equivalent impacts in the categories of aesthetics, agriculture, biological resources, cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, land use and relevant planning, mineral resources, noise, population and housing, public services and utilities, traffic and circulation, and wildfire. This Alternative would satisfy the Project objectives.

Environmentally Superior Alternative

An EIR must identify the environmentally superior alternative to the proposed Project. Alternative A, the "No Project/No Development Alternative would be environmentally superior to the proposed Project on the basis of the minimization or avoidance of physical environmental impacts. CEQA Section 15126(d)(2) indicates that, if the "No Project/No Development" Alternative is the "Environmentally Superior" Alternative, then the EIR shall also identify an Environmentally Superior Alternative among the other Alternatives. Among those alternatives that propose development, Alternative D, the "Reduced Project Size" Alternative, is the environmentally superior Alternative because it significantly reduces the amount of agricultural land impacted, while reducing other Project specific impacts.

1.7 Areas of Controversy

Written agency and public comments received during the public review period for the NOP/IS are provided in Appendix A. Also see Appendix A for further details on areas of controversy. In summary, the following key issues were identified during scoping as being controversial due to their potentially significant impacts or the need for mitigation to avoid significant impact.

- The EIR should address the following issues: incompatibility with the Metropolitan Bakersfield General Plan, need for the proposed Project, farmland conversion, air quality, biological resources, global warming, water supplies, energy and solar photovoltaics, traffic, aesthetics and light pollution, alternatives, and cumulative impacts.
- The EIR should address issues involving compatibility with industrial uses and the scope of impact upon the surrounding agricultural properties.
- When the traffic impact study for the proposed Project is submitted to the County, the Roads Department would like a copy for review and comment.
- The proposed Project is located outside the administrative boundaries of any oil or gas field, and there is one plugged and abandoned oil well within the Project boundaries. The abandoned well will need to be addressed if structures, roads, or parking lots are planned in proximity to it.
- The proposed Project is located in an area that Tejon Indian Tribe ancestors used in the past; however, the Tribe has no information or concerns at this time.
- The NAHC, as the state trustee agency, recommended various actions in order to adequately assess the proposed Project-related impacts on historical resources.
- A traffic impact study is needed for the proposed Project. An encroachment permit may be needed for the proposed Project, for any work in the State right-of-way.
- The EIR should include a quantitative emissions analysis, a discussion of greenhouse gas emissions generated by the proposed Project and the effect they will have (if any) on global climate change, a discussion of potential odors/sensitive receptors, potential health impact of Toxic Air Contaminants (if any), existing District regulations, feasible mitigation measures that will reduce air quality impacts.

- The Kern County Superintendent of Schools office represents the Greenfield Union and Kern High School Districts with regard to the imposition of developer fees. The collection of statutory fees shall be collected at the time that building permits are issued. Currently, these fees are set at $0.56 per square foot, an amount subject to adjustment ever two years.

1.8 Issues to Be Resolved

Section 15123(b)(3) of the State CEQA Guidelines requires that an EIR contain issues to be resolved, which includes the choices among alternatives and whether or how to mitigate significant impacts. The major issues to be resolved regarding the proposed Project include decisions by the lead agency as to whether or not:

- the Recirculated Draft EIR adequately describes the environmental impacts of the proposed Project,
- the recommended mitigation measures should be adopted or modified, or
- additional mitigation measures need to be applied.

1.9 Summary of Environmental Impacts and Mitigation

The following is a summary of the environmental impacts of the proposed Project, mitigation measures, and unavoidable significant impacts identified and analyzed in Chapter 4.0 of this RDEIR. Refer to the appropriate RDEIR section for additional information.

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Table 1-2. Summary of Impacts, Mitigation Measures, and Level of Impacts after Mitigation			
Impact	**Level of Significance Before Mitigation**	**Mitigation Measures**	**Level of Significance After Mitigation**
4.1 AESTHETICS			
4.1-1: The Project Would Have a Substantial Adverse Effect on a Scenic Vista.	Less than significant	No mitigation measures are required.	Less than significant
4.1-2: The Project Would Substantially Alter or Damage Scenic Resources, Including but not Limited to, Trees, Rock outcroppings, and Historic Buildings Within a State Scenic Highway.	Less than significant	No mitigation measures are required.	Less than significant
4.1-3: The Project Would Substantially Degrade the Existing Visual Character or Quality of the Proposed Project Site and Its Surroundings.	Potentially ~~Less than~~ significant	**MM 4.1-1:** Prior to the issuance of building permits, the project operator shall demonstrate compliance with ~~one of~~ the following: a. The project proponent shall present a plan to color treat the proposed warehouse and office buildings to blend in with the colors found in the surrounding natural landscape while not producing reflection, as approved by the Kern County Planning and Natural Resources Department; **MM 4.1-2:** The following aesthetic features shall be required in site plans and building permits for commercial buildings located within 1,000 feet of the State Route 99 corridor: a. Rooftop screening features shall be installed to create a visual screen for rooftop mechanical equipment, such as a parapet or screening material. b. Reflective metal exteriors shall not be used as exterior architectural elements in buildings immediately adjacent to State Route 99. **MM 4.1-3:** Prior to the issuance of building permits for any facilities on the project site, the project applicant shall submit to the Kern County Planning and Natural Resources Department for approval, a landscape plan that will effectively buffer foreground views of the proposed project site from State Route 99. This landscape plan shall include, but is not limited to, landscape structural elements (such as fencing), and planting materials consistent with current Kern County landscape requirements and shall be cleared of trash and debris at least monthly during the year. The plan shall also include:	Less than significant

Table 1-2. Summary of Impacts, Mitigation Measures, and Level of Impacts after Mitigation			
Impact	**Level of Significance Before Mitigation**	**Mitigation Measures**	**Level of Significance After Mitigation**
		a. Preparation by a licensed Landscape Architect and approval by the Kern County Planning and Natural Resources Department Director prior to buffer planting; b. The plan shall include California native, drought-tolerant plants. c. The plan shall provide for an irrigation plan as required under the Kern County Zoning Ordinance 19.86.070. d. Should perimeter fencing be proposed, fencing materials shall be constructed of any materials commonly used in the construction of fences and walls such as wood, stone, rock, tubular steel, wrought iron, or brick, or other durable materials. Masonry block walls shall be decorative and not bare masonry blocks. Decorative materials can include a façade, colored masonry blocks, or other materials. Fencing proposed around sumps may be chain-link with view obscuring slats. Barbed wire is not permitted. e. A 20-foot wide perimeter buffer along any visible boundary from the State Route 99 frontage and shall be included as part of the landscape plan. This buffer shall consist of live ground cover, shrubs, or grass, and: 1) One (1) tree having a minimum planting height of six (6) feet for every 50 lineal feet of buffer; 2) Shrubs which reach a minimum height of four (4) to six (6) feet. 3) Live ground cover consisting of low-height plants, or shrubs, or grass shall be planted in the portion of the landscaped area not occupied by trees or evergreen shrubs. 4) Bare gravel, rock, bark or other similar materials may be used, but are not a substitute for ground cover plantings, and shall be limited to no more than 25 percent of the required landscape area. 5) Landscaping shall be installed prior to final occupancy.	
4.1-4: The Project Would Create a New Source of Substantial Light and Glare That Would Adversely Affect Daytime or Nighttime Views of the Area.	Potentially significant	**MM 4.1-4:** The project shall continuously comply with the following: project facility lighting shall comply with the applicable provisions of the Dark Skies Ordinance (Chapter 19.81 of the Kern County Zoning Ordinance), and shall be designed to provide the minimum illumination needed to achieve safety and security objectives. All lighting shall be directed downward and shielded to focus illumination on the desired areas only	Less than significant

Table 1-2. Summary of Impacts, Mitigation Measures, and Level of Impacts after Mitigation			
Impact	**Level of Significance Before Mitigation**	**Mitigation Measures**	**Level of Significance After Mitigation**
		and avoid light trespass into adjacent areas. Lenses and bulbs shall not extend below the shields. **MM 4.1-5:** Prior to the issuance of building permits for any facilities on the project site, the project applicant shall submit, and the Kern County Planning and Natural Resources Department shall have approved, plans verifying all outdoor lighting is designed so that all direct lighting is confined to the project site property lines and that adjacent properties and roadways are protected from spillover light and glare.	
Cumulative Impact	Potentially significant	Implement Mitigation Measures MM 4.1-1 through MM 4.1-5, above.	Less than significant
4.2 AGRICULTURAL RESOURCES			
4.2-1: The Project Would Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as Shown on the Maps Prepared Pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to Nonagricultural Use.	Significant and unavoidable	**MM 4.2-1:** Prior to issuance of a grading or building permit, whichever occurs first, the project proponent shall provide written evidence of completion of one or more of the following measures to mitigate the loss 314.30 acres of agricultural land before conversion, at a one-to-one ratio. Funding and/or purchase of agricultural conservation easements (will be managed and maintained by an appropriate entity); Purchase of credits from an established agricultural farmland mitigation bank; Contribution of agricultural land or equivalent funding to an organization that provides for the preservation of farmland in California; or Participation in any agricultural land mitigation programs adopted by Kern County that provides equal or more effective mitigation than the measures listed above. Mitigation land shall meet the definition of prime farmland or farmland of statewide importance established by the State Department of Conservation. Completion of the selected measure(s), or with the Planning Director's approval, a combination of the selected mitigation measures, can be on qualifying agricultural land within the San Joaquin Valley (San Joaquin, Stanislaus, Merced, Fresno, Madera, Kings, Tulare, Kern Counties) or outside the San Joaquin Valley with written evidence that the same or equivalent crops can be produced on the mitigation land.	Significant and unavoidable

Table 1-2. Summary of Impacts, Mitigation Measures, and Level of Impacts after Mitigation			
Impact	**Level of Significance Before Mitigation**	**Mitigation Measures**	**Level of Significance After Mitigation**
4.2-2: The Project Would Conflict with Existing Zoning for Agricultural Use, or a Williamson Act Contract.	Less than significant	No mitigation measures are required.	Less than significant
4.2-3: The Project Would Conflict with Existing Zoning for, or Cause Rezoning of, Forest Land (as Defined in Public Resources Code Section 12220(g)) or Timberland (as Defined in Public Resources Code Section 4526).	No Impact	No mitigation measures are required.	No impact
4.2-4: The Project Would Result in the Loss of Forest Land or Conversion of Forest Land to Non-Forest Use.	No Impact	No mitigation measures are required.	No impact
4.2-5: The Project Would Involve Other Changes in the Existing Environment Which, Due to Their Location or Nature, Could Result in Conversion of Farmland, to Non-Agricultural Use or Conversion of Forest Land to Non-Forest Use.	Significant and unavoidable	Implement MM 4.2-1.	Significant and unavoidable
4.2-6: The Project Would Result in the Cancellation of an Open Space Contract Made Pursuant to the California Land Conservation Act of 1965 or Farmland Security Zone Contract for Any Parcel of 100 or More Acres (Section 1526(b)(3) Public Resources Code.	Potentially significant	Implement MM 4.2-1.	Less than significant
Cumulative Impacts	Significant and unavoidable	Implement MM 4.2-1.	Significant and unavoidable

4.3 AIR QUALITY			
4.3-1: The Project Would Not Be Consistent with the Air Quality Attainment Plan.	Less than significant	No mitigation measures are required.	Less than significant
4.3-2: The Project Would Violate Any Air Quality Standard as Adopted or Established by EPA or Air District or Contribute Substantially to an Existing or Projected Air Quality Violation.	Less than significant	**MM 4.3-1:** Air Quality. To minimize personnel and public exposure to potential Valley Fever–containing dust both on- and off-site, the following additional control measures shall be included in the DCP to be prepared for this project: Equipment, vehicles, and other items shall be thoroughly cleaned of dust before they are moved off-site to other work locations. Wherever possible, grading and trenching work shall be phased so that earth-moving equipment is working well ahead or down-wind of workers on the ground. The area immediately behind grading or trenching equipment shall be sprayed with water before ground workers move into the area. In the event that a water truck runs out of water before dust is sufficiently dampened, ground workers being exposed to dust are to leave the area until a full truck resumes water spraying. All heavy-duty earth-moving vehicles shall be closed-cab and equipped with a HEPA-filtered air system. **MM 4.3-2:** Valley Fever Training. On-site personnel shall be trained on the proper use of personal protective equipment, including respiratory equipment. National Institute for Occupational Safety and Health (NIOSH)-approved respirators shall be provided to on-site personal, upon request. Evidence of training shall be provided to the Kern County Planning and Natural Resources Department within 24 hours of the training session. Valley Fever informational handout shall be provided to all on-site construction personnel. The handout shall, at a minimum, provide information regarding the symptoms, health effects, preventative measures, and treatment. Additional information and handouts can be obtained by contacting the Kern County Public Health Services Department. **MM 4.3-3:** Valley Fever Education Fees. One-time payment of $3,200.00 shall be made to the Kern County Public Health Services Department for the specific purposes of continued Valley Fever education and outreach.	Less than significant for construction related impacts and operational SOx PM10, and PM2.5. Significant and Unavoidable Impact of ROG, NOx, and CO operational emissions.

		MM 4.3-4: All required landscaping along major and arterial roadways will be designed with native drought-resistant species (plants, trees, and bushes) to reduce demand for gas-powered landscape maintenance equipment. **MM 4.3-5:** Prior to issuance of building permit, the applicant shall submit evidence, verified by the Air District, that the development has total Project construction and operations emissions mitigated baseline below 2 tons per year for NOx (total Project construction and operations) and mitigated baseline below 2 tons per year for PM10 emissions (total Project constructions and operations). Required reductions can be achieved from any combination of Project design, compliance with the Indirect Source Review (ISR) and/or a Development Mitigation Contract. If a Development Mitigation Contract is utilized, a copy of the executed agreement and implementing reports will be provided to the Planning Department to substantiate compliance. As there still would be unmitigated emissions of ROG participation in any air mitigation program adopted by Kern County that provides equal or more effective mitigation than this mitigation measure can be utilized as a replacement for the requirements of this mitigation measure.	
4.3-3: The Project Would Violate Standards for CO Concentrations.	Less than significant	No mitigation measures are required.	Less than significant
4.3-4: The Project Would Result in A Cumulatively Considerable Net Increase of Any Criteria Pollutant For Which The Project Region Is Nonattainment Under an Applicable Federal Or State Ambient Air Quality Standard.	Potentially significant	Implement Mitigation Measures MM 4.3-1 through MM 4.3-5.	Significant and Unavoidable
4.3-5: The Project Would Expose Sensitive Receptors To Substantial Pollutant Concentrations.	Significant and unavoidable	Implement mitigation measures MM 4.3-1 through MM 4.3-5.	Significant and Unavoidable impact of ROG, NOx, and CO operation emissions. Less than significant after mitigation for Project contribution of all other emissions. Less than significant for

			construction emissions.
4.3-6: The Project Would Create Odor Impacts.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts			
Total Cumulative Project Emissions	Significant and unavoidable	**Implement Mitigation Measures MM 4.3-1 through MM 4.3-5.**	Significant and unavoidable
Hazardous Air Pollutants.	Less than significant	No mitigation measures are required.	Less than significant
4.4 BIOLOGICAL RESOURCES			
4.4-1: The Project Will Have a Substantial Adverse Effect, Either Directly or Through Habitat Modifications, on Any Species Identified as a Candidate, Sensitive or Special Status Species in Local or Regional Plans, Policies or Regulations, or by the CDFG or USFWS.	Potentially Significant	**MM 4.4-1: Biological Monitoring.** Prior to initiation of any site preparation and/or construction activities, the project proponent shall retain a Lead Biologist who shall be approved prior to conducting pre-construction surveys by the Kern County Planning and Natural Resources Department with a submitted resume. The Lead Biologist will have oversight over implementation of all necessary avoidance and minimization efforts and will have the authority to stop construction activities, if any of the requirements associated with these measures are not being fulfilled. If the biologist has requested work activities stop due to take of any listed species, the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife will be notified within 1 day via email and telephone. In addition to the Lead Biologist, all other qualified biologists or monitors working on site, conducting evaluations, etc., shall submit resumes for approval to the Kern County Planning and Natural Resources Department. **MM 4.4-2: Environmental Awareness Training and Education Program.** Prior to the issuance of grading or building permits and for the duration of construction activities, all new construction workers at the project site shall attend an Environmental Awareness Training and Education Program, developed and presented by the Lead Biologist. Any employee responsible for the operations and maintenance or decommissioning of the project facilities shall also attend the Environmental Awareness Training and Education Program. The Training Program shall include, but not be limited to, information on the life history of species including the blunt-nosed leopard lizard, San Joaquin whipsnake, coast horned lizard, burrowing owl, Swainson's hawk, prairie falcon, Le Conte's thresher, Nelson's antelope squirrel, giant kangaroo rat, short-nosed kangaroo rat, Tipton kangaroo rat, Tulare grasshopper mouse, San Joaquin pocket mouse, American badger, nesting birds, and San Joaquin kit fox, as well as other wildlife and plant	Less than significant

		species that may be encountered during construction activities, their legal protections, the definition of "take" under the Endangered Species Act, measures to protect the species, reporting requirements, specific measures that each worker shall employ to avoid take of wildlife species, and penalties for violation of the Act. To ensure employees and contractors understand their roles and responsibilities, training may be conducted in languages other than English. An acknowledgement form signed by each worker indicating that Environmental Awareness Training and Education Program has been completed would be kept on record; A sticker shall be placed on hard hats indicating that the worker has completed the Environmental Awareness Training and Education Program. Construction workers shall not be permitted to operate equipment within the construction areas unless they have attended the Environmental Awareness Training and Education Program and are wearing hard hats with the required sticker; A copy of the training transcript and/or training video, as well as a list of the names of all personnel who attended the Environmental Awareness Training and Education Program and copies of the signed acknowledgement forms shall be submitted to the Kern County Planning and Natural Resources Department; and, The construction crews and contractor(s) shall be responsible for unauthorized impacts from construction activities to sensitive biological resources that are outside the areas defined as subject to impacts by project permits. An Operation and Maintenance-phase version of the WEAP will be maintained within the on-site O&M facility for review as may be necessary during the life of the project. All vehicles will be directed to exercise caution when commuting within the project area. A 15-mile per hour speed limit will be enforced on unpaved roads. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards. A litter control program shall be instituted at the project site. All workers shall ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area at the end of each working day. No canine or feline pets or firearms (except for federal, state, or local law enforcement officers and security personnel) shall be permitted on construction sites to avoid harassment, killing, or injuring of listed species.	

		Maintenance and construction excavations greater than 2 feet deep shall be covered, filled in at the end of each working day, or have earthen escape ramps no greater than 200 feet apart provided to prevent entrapment of listed species. All construction activities shall be confined within the project construction area, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. At no time shall equipment or personnel be allowed to adversely affect areas outside the project site. Because dusk and dawn are often the times when listed species are most actively foraging, all construction activities will cease 0.5 hour before sunset and will not begin prior to 0.5 hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of the project site by artificial lighting during nighttime hours is prohibited. Tightly woven fiber netting or similar material shall be used for erosion control or other purposes at the project site to ensure that special-status species do not get trapped. This limitation will be communicated to the contractor through use of Special Provisions included in the bid solicitation package. Use of rodenticides and herbicides at the project site shall be avoided to the maximum extent feasible. If use is unavoidable, rodenticides and/or herbicides shall be utilized in such a manner to prevent primary or secondary poisoning of special-status species and depletion of prey populations on which they depend. All uses of such compounds shall observe labels and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Pesticide Regulation, and other appropriate state and federal regulations as well as additional project-related restrictions deemed necessary by the U.S. Fish and Wildlife Service or California Department of Fish and Wildlife. **MM 4.4-3: Preconstruction Surveys.** A pre-construction survey by a qualified biologist or monitor shall be conducted no more than 30 days and no less than 14 days prior to the commencement of any site preparation, ground disturbance, and/or construction activities in previously undisturbed areas of the project site. If any evidence of occupation of that portion of the project site by listed or other special-status plant or animal species is observed, a buffer shall be established by a qualified biologist that results in sufficient avoidance to comply with applicable regulations. If sufficient avoidance cannot be established, the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife shall be contacted for further guidance and consultation on additional measures. The project proponent or operator shall obtain any required permits from the appropriate wildlife agency. Copies of the pre-construction survey and results, as well as all permits and evidence of compliance with applicable regulations, shall be submitted to the Kern County Planning and Natural Resources Department.	

		The following buffer distances shall be established prior to commencement of any site preparation and/or construction activities, if any listed or other special status plant or animal species is observed: a. San Joaquin kit fox or American badger potential den: 50 feet; b. San Joaquin kit fox or American badger known den: 100 feet; c. San Joaquin kit fox or American badger pupping den: contact the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife; d. Burrowing owl burrow outside of breeding season: as recommended by the California Department of Fish and Wildlife Staff Report 2012; e. Burrowing owl burrow during breeding season: as recommended by the California Department of Fish and Wildlife Staff Report 2012; f. Swainson's hawk nest during breeding season: 0.5 mile; g. Other protected raptor nests during the breeding season: as recommended by a qualified biologist; h. Other protected nesting migratory bird nests during the breeding season: as recommended by a qualified biologist; and i. Coast horned lizard, San Joaquin whipsnake, and other special-status wildlife species: as recommended by a qualified biologist. **MM 4.4-4**: If construction activities are conducted during the typical nesting bird season (February 15 through September 15), pre-construction surveys shall be conducted by a qualified biologist prior to any site preparation and/or construction activity to identify potential nesting bird activity. The survey area shall include a 500-foot buffer surrounding the property. If no active nests are found within the survey area, no further mitigation is required. If nesting activity is identified during the pre-construction survey process, the following measures will be implemented: a. If active nest sites of bird species protected under the Migratory Bird Treaty Act and/or California Fish and Game Code are observed within the project site, then the project will be modified and/or delayed as necessary to avoid direct take of the identified nests, eggs, and/or young; b. If active nest sites of raptors and/or bird species of special concern are observed within the vicinity of the project site, then the appropriate buffer around the nest site (typically 250 feet for passerines and 500 feet for raptors) will be established.	

		Construction activities in the buffer zone will be prohibited until the young have fledged the nest and achieved independence; and, c. Active nests shall be documented by a qualified biologist, and a letter report shall be submitted to the Kern County Planning and Natural Resources Department documenting project compliance with the Migratory Bird Treaty Act and California Fish and Game Code. **MM 4.4-5:** Within 6 months prior to commencement of site preparation and/or construction activities, the project proponent shall ensure that a U.S. Fish and Wildlife Service-approved biologist conducts a protocol survey for blunt-nosed leopard lizard in accordance with the guidelines published by the California Department of Fish and Wildlife, Region 4, Fresno Office (CDFW 2004). If blunt-nosed leopard lizards are located within the action area, the U.S. Fish and Wildlife Service will be contacted to discuss methods for proceeding with the project in a manner which will avoid take. **MM 4.4-6: Burrowing Owl.** The project proponent shall implement the following measures, based on the recently updated California Department of Fish and Game (now California Department of Fish and Wildlife) 2012 Staff Report on Burrowing Owl Mitigation, to ensure potential impacts to burrowing owl resulting from project implementation will be avoided and minimized to less-than-significant levels: A qualified wildlife biologist (i.e., a wildlife biologist with previous burrowing owl survey experience) shall conduct pre-construction surveys of the permanent and temporary impacts areas, plus an ISO-meter (approximately 492-foot) buffer, to locate active breeding or wintering burrowing owl burrows no less than 14 days prior to construction. The survey methodology will be consistent with the methods outlined in the Staff Report and will consist of walking parallel transects 7 to 20 meters apart, adjusting for vegetation height and density as needed, and noting any potential burrows with fresh burrowing owl sign or presence of burrowing. As each burrow is investigated, biologists will also look for signs of American badger and kit fox. Copies of the survey results shall be submitted to the California Department of Fish and Wildlife and Kern County Planning and Natural Resources Department. If burrowing owls are detected, no ground-disturbing activities, such as road construction or ancillary facilities, shall be permitted within the distances listed below in the table titled “Burrowing Owl Burrow Buffers,” unless otherwise authorized by California Department of Fish and Wildlife. Burrowing owls shall not be moved or excluded from burrows during the breeding season. If avoidance of active burrows is infeasible, the owls can be passively displaced from their burrows according to recommendations made in the 2012 Staff Report on	

		Burrowing Owl Mitigation. Burrowing owls should not be excluded from burrows unless or until: Occupied burrows shall not be disturbed during the nesting season unless a qualified biologist meeting the Biologist Qualifications set forth in the May 2012 California Department of Fish and Wildlife Staff Report, verifies through noninvasive methods that either: (1) the owls have not begun egg-laying and incubation; or (2) juveniles from the occupied burrows are foraging independently and are capable of independent survival. Burrowing owls will not be moved or excluded from burrows during the breeding season. A Burrowing Owl Exclusion Plan is developed and approved by the applicable local California Department of Fish and Wildlife office and submitted to the Kern County Planning and Natural Resources Department. The plan shall include, at a minimum: Confirm by site surveillance that the burrow(s) is empty of burrowing owls and other species preceding burrow scoping; Type of scope and appropriate timing of scoping to avoid impacts; Occupancy factors to look for and what will guide determination of vacancy and excavation timing (one-way doors should be left in place 48 hours to ensure burrowing owls have left the burrow before excavation, visited twice daily, and monitored for evidence that owls are inside and can't escape, i.e., look for sign immediately inside the door); How the burrow(s) will be excavated. Excavation using hand tools with refilling to prevent reoccupation is preferable whenever possible (may include using piping to stabilize the burrow to prevent collapsing until the entire burrow has been excavated and it can be determined that owls reside the burrow); Removal of other potential owl burrow surrogates or refugia on-site; Photographing the excavation and closure of the burrow to demonstrate success and sufficiency; Monitoring of the site to evaluate success and, if needed, to implement remedial measures to prevent subsequent owl use to avoid take; How the impacted site will continually be made inhospitable to burrowing owls and fossorial mammals (e.g., by allowing vegetation to grow tall, heavy disking, or immediate and continuous grading) until development is complete. Permanent loss of occupied burrow(s) and habitat is mitigated in accordance with the measures described below.	

		Temporary exclusion is mitigated in accordance with the measures described below. Site monitoring is conducted prior to, during, and after exclusion of burrowing owls from their burrows sufficient to ensure take is avoided. Conduct daily monitoring for 1 week to confirm young of the year have fledged if the exclusion will occur immediately after the end of the breeding season. Excluded burrowing owls are documented using artificial or natural burrows on an adjoining mitigation site (if able to confirm by band re-sight). In accordance with the Burrowing Owl Exclusion Plan, a qualified wildlife biologist shall excavate burrows using hand tools. Sections of flexible plastic pipe or burlap bag shall be inserted into the tunnels during excavation to maintain an escape route for any animals inside the burrow. One-way doors shall be installed at the entrance to the active burrow and other potentially active burrows within 160 feet of the active burrow. The one-way doors can be removed 48 hours after installation, and ground-disturbing activities can proceed. Alternatively, burrows can be filled to prevent reoccupation. During construction activities, monthly and final compliance reports shall be provided to the California Department of Fish and Wildlife, Kern County Planning and Natural Resources Department, and other applicable resources agencies documenting the effectiveness of mitigation measures and the level of burrowing owl take associated with the proposed project. Should burrowing owls be found on-site, compensatory mitigation for lost breeding and/or wintering habitat shall be implemented on-site or off-site in accordance with Burrowing Owl Staff Report guidance and in consultation with the California Department of Fish and Wildlife. At a minimum, the following recommendations shall be implemented: Temporarily disturbed habitat shall be restored, if feasible, to pre-project conditions, including decompacting soil and revegetating. If restoration is not feasible, then the project proponent shall implement (2) below. Permanent impacts to nesting, occupied, and satellite burrows and/or burrowing owl habitat will be mitigated such that the habitat acreage, number of burrows, and burrowing owls impacted are replaced based on a site-specific analysis and shall include: Permanent conservation of similar vegetation communities (grassland, scrublands, desert, urban, and agriculture) to provide for burrowing owl nesting, foraging, wintering, and dispersal (i.e., during breeding and non-breeding seasons) comparable to or better than that of the impact area, and with sufficiently large acreage, and presence of	

		fossorial mammals. Conversation shall occur in areas that support burrowing owl habitat and can be enhanced to support more burrowing owls. Permanently protect mitigation land through a conservation easement deeded to a nonprofit conservation organization or public agency with a conservation mission. If the project is located within the service area of a California Department of Fish and Wildlife-approved burrowing owl conservation bank, the project operator may purchase available burrowing owl conservation bank credits. Develop and implement a mitigation land management plan in accordance with Burrowing Owl Staff Report guidelines to address long-term ecological sustainability and maintenance of the site for burrowing owls. Fund the maintenance and management of mitigation land through the establishment of a long-term funding mechanism such as an endowment. Habitat shall not be altered or destroyed, and burrowing owls shall not be excluded from burrows, until mitigation lands have been legally secured, are managed for the benefit of burrowing owls according to California Department of Fish and Wildlife-approved management, monitoring and reporting plans, and the endowment or other long-term funding mechanism is in place or security is provided until these measures are completed. Mitigation lands should be on, adjacent to, or in proximity to the impact site, where feasible, and where habitat is sufficient to support burrowing owls. Consult with the California Department of Fish and Wildlife when determining off-site mitigation acreages. **MM 4.4-7: Burrowing Owl Buffers.** The project proponent shall continuously comply with the following: If any burrowing owl burrows are observed during the pre-construction survey, avoidance measures shall be consistent with those included in the California Department of Fish and Wildlife staff report on burrowing owl mitigation (CDFG, 2012). If occupied burrowing owl burrows are observed outside of the breeding season, a passive relocation effort may be instituted in accordance with the guidelines established by the California Burrowing Owl Consortium (1993) and the California Department of Fish and Wildlife (CDFG, 2012) (Table 1). During the breeding season, a buffer zone, as noted in Table 1, shall be maintained unless a qualified biologist verifies through noninvasive methods that either the birds have not begun egg laying and incubation or that juveniles from the occupied burrows are foraging independently and are capable of independent survival. Buffer zones may be reduced in size through consultation with	

appropriate agencies and the project biologist to determine if avoidance would still be achieved. The Kern County Planning and Natural Resources Department shall be kept apprised of meetings and correspondence for any consultation.

Table 1: Burrowing Owl Burrow Buffers (CDFG Staff Report, 2012)

Location	Time of Year	Level of Disturbance		
		Low	Medium	High
Nesting Sites	April 1-Aug 15	656 ft	1,640 ft	1,640 ft
Nesting Sites	Aug 16-Oct 15	656 ft	656 ft	1,640 ft
Any Occupied Burrow	Oct 16-Mar 31	164 ft	328 ft	1,640 ft

MM 4.4-8: Trash Abatement. Prior to issuance of grading or building permits, a long-term trash abatement program shall be established for construction, operations and maintenance. Trash and food items shall be contained in closed containers and removed daily.

MM 4.4-9: Trash Abatement and Trench Monitoring Requirements. Prior to and during construction activities, the project proponent shall ensure the project complies with the following:

a. Any pipe, culvert, or similar structure with a diameter of 4 inches or greater, stored on-site for one or more nights shall be inspected to ensure kit foxes or other wildlife have not become entrapped or buried in the pipes. If the pipes, culverts, or similar structures with a diameter of 4 inches or greater are not capped or otherwise covered, they shall be inspected twice daily, in the morning and evening, and prior to burial or closure, to ensure no kit foxes or other wildlife become entrapped or buried in the pipes.

b. All food, garbage, and plastic shall be disposed of in closed containers and regularly removed from the site to minimize attracting ranging kit fox, or other wildlife to the site where they may be harmed. All trash shall be removed and disposed of regularly in accordance with state and local laws and regulations.

		MM 4.4-10: San Joaquin kit fox. Prior to and during construction activities: a. If any San Joaquin kit fox dens are found during pre-construction surveys, the status of the dens shall be evaluated no more than 14 days prior to project ground disturbance. Provided that no evidence of kit fox occupation is observed, potential dens shall be marked and a 50-foot avoidance buffer delineated using stakes and flagging or other similar material to prevent inadvertent damage to the potential den. If a potential den cannot be avoided, it may be hand-excavated following United States Fish and Wildlife Service standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance by the lead biologist. If kit fox activity is observed at a den, the den status shall change to "known" per United States Fish and Wildlife Service guidelines (1999), and the buffer distance shall be increased to 100 feet. Absolutely no excavation of San Joaquin kit fox known or pupping dens shall occur without prior authorization from the United States Fish and Wildlife Service and California Department of Fish and Wildlife. b. To enable kit foxes and other wildlife (e.g., American badger) to pass through the project site during construction, the perimeter security fence shall leave a 5-inch opening between the fence mesh and the ground or the fence shall be raised 5 inches above the ground. The bottom of the fence fabric shall be knuckled (wrapped back to form a smooth edge) to protect wildlife that passes under the fence. c. All pipes, culverts, or similar structures with a diameter of four inches or more that are stored at a construction site for one or more overnight periods shall be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe shall not be moved until the United States Fish and Wildlife Service has been consulted. If necessary, under the direct supervision of the biologist, the pipe may be moved once to remove it from the path of construction activity until the fox has escaped. d. To prevent inadvertent entrapment of San Joaquin kit foxes, badgers, or other animals during construction, all excavated, steep-walled holes or trenches more than two feet deep shall be covered with plywood or similar materials at the close of each working day, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they shall be thoroughly inspected for trapped animals. If trapped animals are observed, escape ramps or structures shall be installed immediately to allow escape. If listed species	

		are trapped, the United States Fish and Wildlife Service and California Department of Fish and Wildlife shall be contacted. e. All vertical tubes used in project construction, such as chain link fencing poles shall be temporarily or permanently capped at the time they are installed to avoid the entrapment and death of special-status birds. **MM 4.4-11: Nesting Birds.** A pre-construction protocol-level surveys by a qualified biologist for nesting birds shall be required if construction activities are scheduled to occur during the breeding season for raptors and other migratory birds (February 1–August 31), to reduce potential impacts to nesting birds and raptors. The survey shall be conducted within 30 days of ground disturbance activities. a. If any nesting birds/raptors are observed, a qualified biologist shall determine buffer distances and/or the timing of project activities so that the proposed project does not cause nest abandonment or destruction of eggs or young. This measure shall be implemented so that the proposed project remains in compliance with the Migratory Bird Treaty Act and applicable State regulations. **MM 4.4-12:** Prior to any vegetation removal during site preparation, the areas required for construction shall be surveyed for actively nesting birds. If any wildlife is encountered during the course of construction, the wildlife shall be allowed to leave the construction area unharmed. Should any active bird nests be identified, the vegetation shall not be removed in areas that contain actively nesting birds. A biological monitor shall survey the areas of vegetation slated for removal, a report shall be submitted to the Kern County Planning and Natural Resources Department for review prior to site preparation. **MM 4.4-13:** The measures below shall be implemented throughout construction and operation of the project: a. Project-related vehicles shall observe a 15 mile-per-hour speed limit in all project areas, except on county roads and State and federal highways. Construction after sundown shall be prohibited. Off-road traffic outside of designated project areas shall be prohibited. b. No pets shall be allowed in project areas, except for trained canine animals related to security and operation of the facility. c. All uses of such herbicidal and rodenticide compounds shall observe label and other restrictions mandated by the United States Environmental Protection Agency, California Department of Food and Agriculture, and federal and State legislation as well as additional project-related restrictions deemed necessary by	

		the California Department of Fish and Wildlife and/or the United States Fish and Wildlife Service. d. No plants or wildlife shall be collected, taken, or removed from the construction areas or areas of off-site improvements, except as necessary for project-related vegetation removal or wildlife relocation. Salvage of native vegetation to be removed from construction areas is encouraged, but shall only be performed by qualified biologists and with written approval from the California Department of Fish and Wildlife. e. If San Joaquin kit fox known or pupping dens are observed in project areas, the project proponent shall contact the United States Fish and Wildlife Service and California Department of Fish and Wildlife to discuss appropriate actions.	
4.4-2: The Project Would Have a Substantial Adverse Effect on any Riparian Habitat or Other Sensitive Natural Community Identified in Local or Regional Plans, Policies, Regulations, or by the CDFG or USFWS.	Less than significant	No mitigation measures are required.	Less than significant
4.4-3: The Project Would Have a Substantial Adverse Effect on Federally Protected Wetlands, as Defined by Section 404 of the CWA (Including, But Not Limited to, Marsh, Vernal Pool, Coastal, etc.) Through Direct Removal, Filling, Hydrological Interruption or Other Means.	Less than significant	No mitigation measures are required.	Less than significant
4.4-4: The Project Would Interfere Substantially with the Movement of Any Native or Migratory Fish or Wildlife Species or With Established Native Resident or Migratory Wildlife Corridors or Impede the Use of Native Wildlife Nursery Sites.	Potentially Significant	Implement Mitigation Measures MM 4.4-1 through MM 4.4-12, above.	Less than significant
4.4-5: The Project Would Conflict With Any Local Policies or Ordinances	Less than significant	No mitigation measures are required.	Less than significant

Protecting Biological Resources, Such as a Tree Preservation Policy or Ordinance.			
4.4-6: The Project Would Conflict With the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan or Other Approved Local, Regional or State Habitat Conservation Plan.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts			
Ecological Communities Previously Occurring within the Metropolitan Bakersfield General Plan Area	Less than significant	Implement Mitigation Measures MM 4.4-1 through MM 4.4-12.	Less than significant
Species of Concern Occurring within the Metropolitan Bakersfield General Plan Area	Potentially significant	Implement Mitigation Measures MM 4.4-1 through MM 4.4-12.	Less than significant
4.5 CULTURAL RESOURCES			
4.5-1: The Project Would Cause a Substantial Adverse Change in the Significance of a Historical or Archaeological Resource.	Potentially Significant	**MM 4.5-1: Archaeological Resources.** Prior to ground disturbance, or the issuance of grading or building permits, the project proponent shall retain a qualified lead archaeologist to carry out all mitigation measures related to archaeological resources. The approved monitor shall monitor all initial ground-disturbing activities (such as site preparation and initial grading) and excavations on the project site. If archaeological resources are encountered during implementation of the project, ground-disturbing activities will cease within the immediate vicinity of the find. The lead archaeologist shall establish a buffer area around the find and make an evaluation of the find to determine appropriate treatment that may include the development and implementation of a data recovery investigation or preservation in place. All cultural resources recovered will be documented on California Department of Parks and Recreation Site Forms to be filed with the California Historic Resources Information System (CHRIS). The archaeologist will prepare a final report about the find to be filed with the Applicant/landowner and the CHRIS. The report will include documentation and interpretation of resources recovered. Interpretation will include full evaluation of the eligibility with respect to the National Register of Historic Places and California Register of Historical Resources and CEQA. The developer, in consultation with the Lead	Less than significant

		Agency and Project Archaeologist, will designate repositories in the event that resources are recovered. **MM 4.5-2: Paleontological Resources.** During project construction, if a paleontological resource is found, the project contractor shall cease ground-disturbing activities within 50 feet of the find. A qualified paleontologist shall be obtained to evaluate the significance of the resource(s) and recommend appropriate treatment measures. Any fossils encountered and recovered shall be catalogued and donated to a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County. Accompanying notes, maps, and photographs shall also be filed at the repository. **MM 4.5-3: Historical Resources.** Prior to the issuance of grading or building permits, the project proponent shall ensure the following measures are implemented for resources, which are discretionarily considered historical resources for the purposes of this project: The construction zone shall be narrowed or otherwise altered to avoid resources. All avoidance areas delineated on the site plan shall be coordinated through the lead archeologist and submitted to the Kern County Planning and Natural Resources Department for approval. In coordination with the qualified archaeologist avoidance shall be ensured by the delineation of environmentally sensitive areas. Protective fencing shall not identify the protected area as a cultural resource area in order to discourage unauthorized disturbance or collection of artifacts. Consistent with Mitigation Measure 4.5-1 (above) a qualified archaeological monitor and Native American Monitor, shall monitor all project-related ground disturbing activities within 150 feet of the environmentally sensitive areas, in order to ensure avoidance. If avoidance is demonstrated to be infeasible, the resource shall be collected and curated at an appropriate curatorial facility. Or if avoidance is demonstrated to be infeasible, a detailed Cultural Resources Treatment Plan shall be prepared and implemented by a qualified archaeologist. The Cultural Resources Treatment Plan shall include a research design and a scope of work for data recovery of the portion(s) to be impacted by the project. Treatment may consist of (but would not be limited to): a sufficient avoidance buffer to protect the resource until data recovery and/or removal is completed; sample excavation;	

		surface artifact collection; site documentation; and, historical research, with the aim to target the recovery of important scientific data contained in the portion of the significant resource to be impacted by the project. The Cultural Resources Treatment Plan shall also include provisions for analysis of data in a regional context, reporting of results within a timely manner, and curation of artifacts and data at an approved facility. The reports documenting the implementation of the Cultural Resources Treatment Plan shall be submitted to and approved by the Kern County Planning and Natural Resources Director and shall also be submitted to the Southern San Joaquin Valley Information Center at California State University, Bakersfield.	
4.5-2: The Project Would Directly or Indirectly Destroy a Unique Paleontological Resource or Site or Unique Geologic Feature.	Potentially significant	**MM 4.5-4: Found Paleontological Resource.** During implementation of the proposed project, if a paleontological resource is found, the project contractor shall cease ground-disturbing activities within 50 feet of the find. A qualified paleontologist shall evaluate the significance of the resource(s) and recommend appropriate treatment measures. At each fossil locality, field data forms shall be used to record pertinent geologic data, stratigraphic sections shall be measured, and appropriate sediment samples shall be collected and submitted for analysis. Any fossils encountered and recovered shall be catalogued and donated to a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County. Accompanying notes, maps, and photographs shall also be filed at the repository.	Less than significant
4.5-3: The Project Would Disturb Any Human Remains, Including Those Interred Outside of Formal Cemeteries.	Potentially significant	**MM 4.5-5: Found Human Remains.** If human remains are uncovered during project construction, the project proponent shall immediately halt work, contact the Kern County Coroner to evaluate the remains, and follow the procedures and protocols set forth in Section 15064.4 (e)(1) of the California Environmental Quality Act Guidelines. If the County Coroner determines the remains are Native American, the coroner shall contact the Native American Heritage Commission, in accordance with Health and Safety Code Section 7050.5, subdivision (c), and Public Resources Code 5097.98 (as amended by Assembly Bill 2641). The Native American Heritage Commission shall designate a Most Likely Descendent (MLD) for the remains per Public Resources Code 5097.98. Per Public Resources Code 5097.98, the landowner shall ensure that the immediate vicinity, according to generally accepted cultural or archaeological standards or practices, where the Native American human remains are located, is not damaged or disturbed by further	Less than significant

		development activity until the landowner has discussed and conferred with the most likely descendent regarding their recommendations, if applicable, taking into account the possibility of multiple human remains. If the remains are determined to be neither of forensic value to the Coroner, nor of Native American origin, provisions of the California Health and Safety Code (7100 et. seq.) directing identification of the next-of-kin will apply. The MLD shall complete the inspection of the site within 48 hours of notification and may recommend scientific removal and nondestructive analysis of human remains and items associated with Native American burials.	
Cumulative Impacts	Potentially significant	Implement Mitigation Measures MM 4.5-1 through MM 4.5-5, above.	Less than significant
4.6 ENERGY			
4.6-1: The Project Would Result in Potentially Significant Environmental Impact Due to Wasteful, Inefficient, or Unnecessary Consumption of Energy Resources, During Project Construction or Operation	Potentially significant	**MM 4.6-1**: The proposed Project, shall to the extent feasible and to the satisfaction of the Kern County Planning Department incorporate the following energy conservation and design features to reduce the level of energy consumption of the proposed Project. The following list is non-inclusive of all potential mitigation that may be included and may be added to at the discretion of Kern County as new technologies become available and feasible to be incorporated: Solar photovoltaics (PV) mounted on proposed structure's roofs to provide a portion of the future electrical demand and offset emissions from fossil fuel fired power plants. Encourage green building measures that contribute to reducing energy use to 25% less than Title 24 requirements; Solar water heating to provide non-industrial water heating; Ground mounted solar PV arrays to provide a portion of the estimated electrical demand for the proposed Wastewater Treatment and Recycle Facility; Commercial buildings shall be designed to meet LEED Silver standards; Roofs on all buildings shall be of a light color to reduce heat generation; Portions of parking lots (drive aisles) may be paved with concrete versus asphalt to reduce initial solar reflectance; Depending on the usage, portions of parking lots may be covered, and the parking lot roofs contain solar PV; Use LED lighting fixtures on all public streets and site lighting;	Less than significant

		Include dedicated EV parking at a rate more than required by current codes; Include EV charging facilities to encourage the usage of electric vehicles; Encourage the utilization of electric forklifts and other material handling vehicles to reduce usage of fossil fuels; Design circulation features into the public street improvements to include bus stops and/or other public transportation; Include bicycle friendly features to reduce Vehicle Miles Traveled (VMT) and to encourage non-vehicular transportation; Encourage the usage of high efficiency electric motors for the industrial uses and the wastewater treatment plant.	
4.6-2: The Project Would Conflict with or Obstruct State or Local Plan for Renewable Energy or Energy Efficiency	Potentially significant	Implement Mitigation Measures MM 4.3-1, and; MM 4.6-1.	Less than significant
4.7 GEOLOGIC AND SEISMIC HAZARDS			
4.7-1: The Project Would Expose People or Structures to Expose People or Structures to Substantial Adverse Effects, Including the Risk of Loss, Injury, or Death Involving the Rupture of a Known Earthquake Fault.	Less than significant	No mitigation measures are required.	Less than significant
4.7-2: The Project Would Expose People or Structures to Adverse Effects, Including the Risk of Loss, Injury, or Death Involving Strong Seismic Ground Shaking Including That Would Result in Potential Substantial Adverse Effects.	Potentially significant	**MM 4.7-1: Phased Grading.** The project proponent shall limit grading to the minimum area necessary for construction. Prior to the initiation of construction, the project proponent shall retain a California registered professional engineer to approve the final grading earthwork and foundation plans prior to construction. **MM 4.7-2: Geotechnical Study.** Prior to the issuance of building or grading permits for the project, the Project proponent shall conduct a full geotechnical study to evaluate soil conditions on the Project site and submit it to the Kern County Public Works Department for review and approval. The geotechnical study must be signed by a California-registered professional engineer and must identify the following: Maximum considered earthquake and associated ground acceleration;	Less than significant

		Potential for seismically induced liquefaction, landslides, differential settlement, and mudflows; Stability of any existing or proposed cut-and-fill slopes; Collapsible or expansive soils; Foundation material type; Recommendations for placement and design of facilities, foundations, and remediation of unstable ground. The project proponent shall determine the final siting of project facilities based on the results of the geotechnical study and implement recommended measures to minimize geologic hazards. The project proponent shall not locate project facilities on or immediately adjacent to a fault trace. All structures shall be offset at least 100-feet from any mapped fault trace. Alternatively, a detailed fault trenching investigation may be performed to accurately locate the fault trace(s) to avoid sighting improvements on or close to these fault structures and to evaluate the risk of fault rupture. After locating the fault, accurate setback distances can be proposed. The Kern County Public Works Department shall evaluate any final facility siting design developed prior to the issuance of any building or grading permits to verify that geological constraints have been avoided. **MM 4.7-3: Seismic Design on Site.** Prior to the issuance of grading permits, the project proponent shall retain a California registered engineer to design the project facilities to withstand probable seismically induced ground shaking at the site. All grading and construction on-site shall adhere to the specifications, procedures, and site conditions contained in the final design plans, which shall be fully compliant with the seismic recommendations of the California-registered professional engineer. The procedures and site conditions shall encompass site preparation, foundation specifications, and protection measures for buried metal. The final structural design shall be subject to approval and follow-up inspection by the Kern County Building Inspection Department. Final design requirements shall be provided to the on-site construction supervisor and the Kern County Building Inspector to ensure compliance. **MM 4.7-4:** Building locations shall be stabilized against the occurrence of liquefaction by dynamic compaction, or other accepted soil stabilization method approved by the County Building official. **MM 4.7-5: Geotechnical Evaluation.** Prior to the issuance of grading permits, a geotechnical evaluation, consisting of field exploration (drilling and soil sampling),	

		laboratory testing of soil samples, and engineering analysis, shall be prepared to determine soil properties related, but not limited, to ground-motion acceleration parameters, the amplification properties of the subsurface units at the specific site, the potential for hydrocompaction to affect the proposed facilities, and the potential for collapsible, subsiding, or expansive soils to affect the proposed facilities. These studies shall be used to determine the appropriate engineering for foundations and support structures as well as building requirements to minimize geotechnical hazard impacts. Copies of all analyses shall be submitted to the Kern County Public Works Department for review and approval. An approved copy of the evaluation shall be submitted to the Kern County Planning and Natural Resources Department. **MM 4.7-6: Minimizing Erosion.** The project proponent shall continuously comply with the following: The project proponent shall use existing roads to the greatest extent feasible to minimize erosion. Prior to approval of the grading permit, final plans shall be reviewed and approved by the Kern County Public Works Department to confirm existing roads were used to the greatest extent feasible. **MM 4.7-7: Minimizing Grading.** The project proponent shall continuously comply with the following: The project proponent shall limit grading to the minimum area necessary for construction and operation of the project. Final grading plans shall include best management practices (BMPs) to limit on-site and off-site erosion, a water plan to treat disturbed areas during construction and reduce dust, and a plan for the disposal of drainage waters originating on-site and from adjacent rights-of-ways (if required). The plans shall be submitted to the Kern County Public Works Department for review and approval.	
4.7-3: The Project Would Result in Substantial Soil Erosion or Loss of Topsoil.	Potentially significant	**MM 4.7-8: Soil Erosion and Sedimentation Control Plan.** The project proponent shall prepare a Soil Erosion and Sedimentation Control Plan to mitigate potential loss of soil and erosion. The plan shall be prepared by a California registered civil engineer or other professional approved to prepare said Plan and submitted for review and approval by the Kern County Public Works Department. The Soil Erosion and Sedimentation Control Plan shall include, but is not limited to, the following: 1. Best Management Practices to minimize soil erosion consistent with Kern County grading requirements and the California Regional Water Quality Control Board	Less than significant

		requirements pertaining to the preparation and approval of a Stormwater Pollution Prevention Plan (Best Management Practices recommended by the Kern County Public Works Department shall be reviewed for applicability); 2. Sediment collection facilities as may be required by the Kern County Public Works Department; 3. A timetable for full implementation, estimated costs, and a surety bond or other security as approved by the County; and 4. Other measures required by the County during permitting, including long-term monitoring (post-construction) of erosion control measures until site stabilization is achieved. Provisions to comply with local and state codes relating to drainage and runoff, including use of pervious pavements, and/or other methods to the extent feasible, to increase stormwater infiltration and reduce runoff onto agricultural lands.	
4.7-4: The Project Would be Located on an Unstable Geologic Unit or Soil That Would Result in On-site or Off-site Landslide, Lateral Spreading, Subsidence, Liquefaction, or Collapse, Liquefaction, or Collapse.	Less than significant	No mitigation measures are required.	Less than significant
4.7-5: The Project Would Result in Adverse Impacts to People or Structures Resulting in a Risk of Loss, Injury or Death Including Flooding, as a Result of the Failure of a Levee or a Dam.	Less than significant	No mitigation measures are required.	Less than significant
4.7-6: The Project Would Result in Impacts from Being Located on Expansive Soil, as Defined in Section 1803.5.3 of the CBC (2016) Creating Substantial Risks to Life or Property.	Less than significant	No mitigation measures are required.	Less than significant
4.7-7: The Project Would Be Constructed on Soils Incapable of Adequately Supporting the Use of Septic Tanks or Alternative Wastewater Disposal Systems Where Sewers Are	Potentially significant	**MM 4.7-9: Septic Design Plans.** Prior to the issuance of permits, the project proponent shall provide evidence to the Kern County Planning and Natural Resources Department that the siting, design and construction of proposed septic system(s) and leach field disposal system(s) comply with the 2016 Kern County On-site Systems Manual as authorized by the California Water Board Local Agency Management Program (LAMP) and administered locally by the Kern County Environmental Health Services Department	Less than significant

Not Available for the Disposal of Wastewater.		(KCEHS). Proving the proposed septic design plans comply with these requirements will ensure that all standards for septic tanks, seepage pits, and soils are capable of adequately supporting the use of septic tanks. **MM 4.7-10: Final Leach Field Disposal System.** The final leach field disposal system shall be designed by a licensed engineer, taking into full consideration the recommendations provided in the June 2016 Kern County On-site Systems Manual.	
Cumulative Impacts	Potentially significant	Implement Mitigation Measures MM 4.7-1 through MM 4.7-10, above.	Less than significant
4.8 GREENHOUSE GASES			
4.8-1: The Project Would Generate Greenhouse Gas Emissions, Either Directly or Indirectly, That May Have a Significant Impact on the Environment.	Less than significant	No mitigation measures are required.	Less than significant
4.8-2: The Project Would Conflict with an Applicable Plan, Policy or Regulation Adopted for the Purpose of Reducing the Emissions of Greenhouse Gases.	Potentially significant	Implement Mitigation Measure MM 4.3-1, above.	Less than significant
Cumulative Impacts	Significant and unavoidable	Implement Mitigation Measure MM 4.3-1, above.	Significant and unavoidable
4.9 HAZARDS/HAZARDOUS MATERIALS			
4.9-1: The Project Create a Significant Hazard to the Public or the Environment Through the Routine Transport, Use or Disposal of Hazardous Materials.	Potentially significant	**MM 4.9-1: Hazardous Materials Business Plan.** During the life of the project, including decommissioning, the project operator shall prepare and maintain a Hazardous Materials Business Plan (HMBP), as applicable, pursuant to Article 1 and Article 2 of California Health and Safety Code 6.95 and in accordance with Kern County Ordinance Code 8.04.030, by submitting all the required information to the California Environmental Reporting System (CERS) at http://cers.calepa.ca.gov/ for review and approval. The HMBP shall: Delineate hazardous material and hazardous waste storage areas Describe proper handling, storage, transport, and disposal techniques Describe methods to be used to avoid spills and minimize impacts in the event of a spill Describe procedures for handling and disposing of unanticipated hazardous materials encountered during construction	Less than significant

		Establish public and agency notification procedures for spills and other emergencies including fires. Include procedures to avoid or minimize dust from existing residual pesticides and herbicides that may be present on the site The project proponent shall ensure that all contractors working on the project are familiar with the facility's HMBP as well as ensure that one copy is available at the project site at all times. In addition, a copy of the approved HMBP from CERS shall be submitted to the Kern County Planning and Natural Resources Department for inclusion in the projects permanent record. **MM 4.9-2: Spill Prevention Control and Countermeasures (SPCC) Response Plan.** Prior to the issuance of a certificate of occupancy for an individual parcel project which exceeds any of the thresholds established by Title 40, Code of Federal Regulations, Part 112, related to facilities requiring a Spill Prevention Control and Countermeasures (SPCC) Response Plan, the individual parcel proponent shall prepare and submit an SPCC Response Plan to the Kern County Public Health Services Department/ Environmental Health Division and the California Department of Water Resources. The individual parcel proponent shall ensure the project is implemented in compliance with the approved Spill Prevention Control and Countermeasures Response Plan.	
4.9-2: The Project Would Create a Significant Hazard to the Public or the Environment Through Reasonably Foreseeable Upset and Accidental Conditions Involving the Release of Hazardous Materials into the Environment.	Potentially significant	**MM 4.9-34: Discovered/Spilled Hazardous Waste Materials.** The Project proponent shall continuously comply with the following: If suspect materials or wastes of unknown origin are discovered during construction on the project site, which is thought to include hazardous waste materials the following shall occur: All work shall immediately stop in the vicinity of the suspected contaminant; Project Construction Manager shall be notified; Area(s) shall be secured as directed by the Project Construction Manager; Notification shall be made to the Kern County Environmental Health Services Division/Hazardous Materials Section for consultation, assessment, and appropriate actions; and, Copies of all notifications and correspondence shall be submitted to the Kern County Planning and Natural Resources Department.	Less than significant

		MM 4.9-~~45~~5: Hazardous Materials Specialist. Prior to issuance of the grading permit, a qualified hazardous materials specialist shall inspect each power pole on-site with a transformer. Those containing polychlorinated biphenyls shall be removed by the hazardous specialist and disposed of at an appropriate hazardous materials disposal site to the satisfaction of Department of Toxic Substances Control. The hazardous materials specialist shall provide a short report to the Kern County Planning and Natural Resources Department and the Kern County Environmental Health Services Division/Hazardous Materials Section for review and approval. Prior to construction, Pacific Gas and Electric Company (PG&E) shall be contacted regarding the disposition of pole-mounted transformers. In the event of a future release or leak of insulating fluids from any of the pole-mounted transformers, PG&E shall be contacted for their removal or replacement. **MM 4.9-~~56~~6: Known/Discovered Well Remediation.** Prior to start of construction, the abandoned petroleum prospect well shall be located, exposed, and re-abandoned, if required, to conform to the current abandonment requirements of the California Department of Conservation, Division of Oil, Gas and Geothermal Resources and the Kern County Department of Environmental Health Services. **MM 4.9-~~67~~7: Final Maps and Grading Plans, Notes.** The following note shall appear on all final maps and grading plans: "If during grading or construction, any plugged and abandoned or unrecorded wells are uncovered or damaged, the Department of Oil, Gas and Geothermal Resources will be contacted to inspect and approve any remediation required." **MM 4.9-~~78~~8: Underground Service Alert One-call.** Prior to grading or excavating the Underground Service Alert One-call center shall be contacted at (800) 227-2600. The proposed excavation area shall be delineated with white marking paint or with other suitable markers such as flags or stakes at least two days prior to commencing any excavation work. A "Dig Alert" ticket number would be issued at the time Underground Service Alert is contacted. Excavating is not permitted without this ticket number and is valid for twenty-eight days. Underground Service Alert would notify its member utilities having underground facilities in the area. Underground Service Alert does not notify nonmember utilities or energy companies, or Caltrans. **MM 4.9-~~89~~9: Ruptured Pipeline Safety**. If a rupturing of a pipeline should occur during excavation and construction activities the Kern County Fire Department and Pacific Gas and Electric Company should be contacted immediately. Natural gas transmission pipeline rupture most often indicated an emergency situation and 9-1-1 should be dialed. If an emergency is not indicated, the Kern County Fire Department Greenfield	

		Station 52, located at 312 Taft Highway, should be contacted at (661) 834-5144. Non-Emergency telephone numbers for the Kern County Fire Department number (661) 324-6551 and the project proponent shall follow all safety and cleanup regulations. **MM 4.9-9~~10~~: On-site Water Wells**. If the on-site water wells are not to be used for irrigation or industrial purposes, they shall be destroyed in accordance with California Well Standards as governed by the California Department of Water Resources, and permit requirements of the Kern County Environmental Health Services Division. **MM 4.9-1011~~:~~ Herbicides**. Prior to the issuance of grading or building permits for the project, if herbicides are to be utilized, the contractor or personnel applying herbicides must have the appropriate State and local herbicide applicator licenses and comply with all State and local regulations regarding herbicide use. Herbicides shall be mixed and applied in conformance with the product manufacturer's directions. The herbicide applicator shall be equipped with splash protection clothing and gear, chemical resistant gloves, chemical spill/splash wash supplies, and material safety data sheets for all hazardous materials to be used. To minimize harm to wildlife, vegetation, and waterbodies, herbicides shall not be applied directly to wildlife, products identified as non-toxic to birds and small mammals shall be used if nests or dens are observed. Herbicides shall not be applied if it is raining at the site, rain is imminent, or the target area has puddles or standing water, and shall not be applied when wind velocity exceeds 10 miles per hour. If spray is observed to be drifting to a non-target location, spraying shall be discontinued until conditions causing the drift have abated. **MM 4.9-1112~~:~~ Asbestos Containing Materials.** If asbestos containing materials are identified during construction (particularly in the concrete irrigation (transite) pipe located on-site, then the San Joaquin Valley Air Pollution Control District shall be contacted for removal and disposal procedures. These procedures shall be followed in order to eliminate asbestos exposure to construction workers and surrounding workers and residents.	
4.9-3: The Project Would Emit Hazardous Emissions or Handle Hazardous or Acutely Hazardous, Substances, or Waste Within One-	Less than significant.	No mitigation measures are required.	Less than significant.

Quarter Mile of an Existing or Proposed School.			
4.9-4: The Project Would Be Located on a Site That is Included on a List of Hazardous Materials Sites Compiled Pursuant to Government Code Section 65962.5 and, as a Result, Would Create a Significant Hazard to the Public or the Environment.	Less than significant.	No mitigation measures are required.	Less than significant.
4.9-5: The Project Would Be Located Within an Adopted Kern County Airport Land Use Compatibility Plan Resulting in a Safety Hazard for People Residing or Working in the Project Area	Less than significant	No mitigation measures are required.	Less than significant
4.9-6: The Project Would Result in a Safety Hazard for People Residing or Working in the Project Area from a Private Airstrip.	Less than significant	No mitigation measures are required.	Less than significant
4.9-7: The Project Would Impair Implementation of, or Physically Interfere with, an Adopted Emergency Response Plan or Emergency Evacuation Plan.	Less than significant	No mitigation measures are required.	Less than significant
4.9-8: The Project Would Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Wildland Fires, Including Where Wildlands are Adjacent to Urbanized Areas or Where Residences Are Intermixed with Wildlands.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Potentially significant	Implement Mitigation Measure MM 4.9-1 through MM 4.9-11~~12~~.	Less than significant
4.10 HYDROLOGY AND WATER QUALITY			

4.10-1: The Project Would Violate Any Water Quality Standards or Waste Discharge Requirements.	Potentially significant	Implement Mitigation Measure MM 4.7-8.	Less than significant
4.10-2: The Project Would Substantially Deplete Groundwater Supplies or Interfere Substantially with Groundwater Recharge Such That There Would be a Net Deficit in Aquifer Volume or a Lowering of the Local Groundwater Table Level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted).	Potentially significant	Implement Mitigation Measure MM 4.17-1 through MM 4.17-5.	Less than significant
4.10-3: The Project Would Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, in a Manner Which Would Result in Substantial Erosion or Siltation On- or Off-Site.	Potentially significant	Implement Mitigation Measure MM 4.7-8.	Less than significant
4.10-4: The Project Would Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.	Potentially significant	Implement Mitigation Measure MM 4.7-8.	Less than significant
4.10-5: The Project Would Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff.	Less than significant	Implement Mitigation Measure MM 4.7-8.	Less than significant

4.10-6: The Project Would Otherwise Substantially Degrade Water Quality.	Less than significant	Implement Mitigation Measure MM 4.7-8.	Less than significant
4.10-7: The Project Would Place Housing Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map.	Less than significant	No mitigation measures are required.	Less than significant
4.10-8: The Project Would Place Within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows.	Less than significant	No mitigation measures are required.	Less than significant
4.10-9: The Project Would Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam.	Less than significant	No mitigation measures are required.	Less than significant
4.10-10: The Project Would Be Subject to Inundation By Seiche, Tsunami, or Mudflow.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Potentially significant	Implement Mitigation Measure MM 4.7-8 and Mitigation Measure MM 4.17-5 and MM 4.17-6.	Less than significant
4.11 LAND USE AND PLANNING			
4.11-1: The Project Would Physically Divide an Existing Community or Contribute to the Decline of an Existing Community.	Less than significant	No mitigation measures are required.	Less than significant
4.11-2: The Project Would Conflict with Applicable Land Use Plan, Policy or Regulation of an Agency with Jurisdiction Over the Project.	Potentially significant	**MM 4.11-1: Master Precise Development Plan**. Prior to the issuance of any grading or building permit issued on the proposed project site, the project proponent shall process through the Kern County Planning and Natural Resources Department a Master Precise Development Plan in accordance with the requirements identified in Chapter 19.56 of the Kern County Zoning Ordinance. All future changes to the physical environment of the site and or the specific characteristics of the existing uses of the site, either by a Master Developer or	Less than significant

		subsequent future land owners shall require revision and/or modification of the Master Precise Development Plan in accordance with Chapter 19.56 of the Kern County Zoning Ordinance. The following thresholds have been established for the project site. The proposed uses on the site shall not exceed a maximum of 4,613,004square feet of industrial and/or commercial use as determined by the Kern County Planning Director.	
4.11-3: The Project Would Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plans.	Less than significant	No mitigation measures beyond compliance with the Metropolitan Bakersfield Habitat Conservation Plan is required. No additional mitigation measures are proposed.	Less than significant
Cumulative Impacts	Less than significant	No mitigation beyond compliance with the goals, policies, and implementation measures of the Metropolitan Bakersfield General Plan and the Metropolitan Bakersfield Habitat Conservation Plan is required. No additional mitigation measures are proposed.	Less than significant
4.12 MINERAL RESOURCES			
4.12-1: The Project Would Not Result in the Loss of Availability of a Known Mineral Resource That Would be of Value to the Region and the Residents of the State.	Potentially significant	Implement Mitigation Measures MM 4.9-5~~6~~, 4.9-6~~7~~, 4.9-8~~9~~, and 4.9-9~~10~~. **MM 4.12-1: Natural Gas Pipeline Easements**. The Pacific Gas and Electric (PG&E) natural gas pipeline easement shall be included on all maps and grading plans to allow for continuous PG&E access for all maintenance activities	Less than significant
4.12-2: The Project Would Result in the Loss of Availability of a Locally Important Mineral Resource Recovery Site Delineated on a Local General Plan, Specific Plan or Other Land Use Plan.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Less than significant	No mitigation measures are required.	Less than significant
4.13 NOISE			

4.13-1: The Project Would Result in Exposure of Persons to, or Generation of, Noise Levels in Excess of Standards Established in the Local General Plan or Noise Ordinance or Applicable Standards of Other Agencies.	Significant and unavoidable	**MM 4.13-1: Acoustical Analysis.** Prior to the submittal of any Precise Development Plan or modification to an approved Master Precise Development Plan: The project proponent shall be required to prepare an acoustical analysis to ensure that all appropriate noise control measures are incorporated in to the proposed project design so as to mitigate any noise impacts to off-site sensitive uses. Such noise control measures may include, but are not limited to: noise barrier use, site redesign, silencers, partial or complete enclosures of critical equipment, etc. Noise impacts shall be evaluated by the Planning and Natural Resources Department during the Precise Development Plan review process. **MM 4.13-2: Noise Levels.** The following measures are recommended to reduce short-term noise levels associated with project construction: 1. Construction activities at the project site shall comply with the hourly restrictions for noise-generating construction activities, as specified in the Kern County Noise Ordinance (Municipal Ordinance Code 8.36.020). Accordingly, construction activities shall be prohibited between the hours of 9:00 PM to 6:00 AM on weekdays, and between 9:00 PM to 8:00 AM on weekends. These hourly limitations shall not apply to activities where hourly limitations would result in increased safety risk to workers or the public. 2. Equipment staging and laydown areas shall be located at the furthest practical distance from nearby residential land uses. To the extent possible, staging and laydown areas should be located at least 500 feet of existing residential dwellings. 3. Where feasible construction equipment shall be fitted with approved noise-reduction features such as mufflers, baffles and engine shrouds that are no less effective than those originally installed by the manufacturer. 4. Haul trucks shall not be allowed to idle for periods greater than five minutes, except as needed to perform a specified function (e.g., concrete mixing). 5. On-site vehicle speeds shall be limited to 15 miles per hour, or less (except in cases of emergency). 6. Back-up beepers for all construction equipment and vehicles shall be broadband sound alarms or adjusted to the lowest noise levels possible, provided that the Occupational Safety and Health Administration and California Division of Occupational Safety and Health's safety requirements are not violated. On vehicles where back-up beepers are not available, alternative safety measures such as escorts and spotters shall be employed.	Significant and unavoidable

		MM 4.13-3: Noise Disturbance Coordinator. Prior to the issuance of grading permits, a "Noise Disturbance Coordinator" shall be established. The project operator shall submit evidence of methods of implementation and shall continuously comply with the following during construction: 1. The disturbance coordinator shall be responsible for responding to any local complaints about construction noise. 2. The disturbance coordinator shall determine the cause of the noise complaint (e.g., starting to early, bad muffler, etc.) and shall be required to implement reasonable measures such that the complaint is resolved.	
4.13-2: The Project Would Expose Persons to or Generation of Excessive Ground Borne Vibration or Ground Borne Noise Levels.	Potentially significant	Implement Mitigation Measure MM 4.13-2, above.	Significant and unavoidable
4.13-3: The Project Would Create a Substantial Permanent Increase in Ambient Noise Levels in the Project Vicinity Above Levels Existing Without the Project.	Potentially significant	Implement Mitigation Measures MM 4.13-2, above. **MM 4.13-4: Noise Reduction Methods**. The following notes shall be placed on all grading and building permits issued for the project site: Construction noise reduction methods such as shutting off idling equipment, installing temporary acoustic barriers around stationary construction noise sources, maximizing the distance between construction equipment staging areas and occupied residential areas, and use of electric air compressors and similar power tools, rather than diesel equipment, shall be used where feasible. During construction, stationary construction equipment shall be placed such that emitted noise is directed away from sensitive noise receivers. All equipment shall be fitted with factory equipped mufflers, and be in good working condition. Construction contracts shall specify that all construction equipment, fixed or mobile, shall be equipped with properly operating and maintained mufflers and other state required noise attenuation devices.	Less than significant
4.13-4: The Project Would Create a Substantial Temporary or Periodic Increase in Ambient Noise Levels in the Project Vicinity Above Levels Existing Without the Project.	Significant and unavoidable	Implementation of Mitigation Measure MM 4.13-2, above. **MM 4.13-5: Written Notice to the Public.** Prior to commencement of any on-site construction activities (i.e., fence construction, mobilization of construction equipment, initial grading, etc.) the project proponent shall provide written notice to the public through mailing a notice.	Significant and unavoidable

		1. The mailing notice shall be to all residences within 1,000 feet of the project site, 15 days or less prior to construction activities. The notices shall include: The construction schedule, telephone number and email address where complaints and questions can be registered with the noise disturbance coordinator. 2. A minimum of one sign, legible at a distance of 50 feet, shall be posted at the construction site or adjacent to the nearest public access to the main construction entrance throughout construction activities that shall provide the construction schedule (updated as needed) and a telephone number where noise complaints can be registered with the noise disturbance coordinator. 3. Documentation the public notice has been sent and the sign has been posted shall be provided to the Kern County Planning and Natural Resources Department.	
4.13-5: The Project is Not Located Within an Airport Land Use Plan or, Where Such a Plan Has Not Been Adopted, Within Two Miles of a Public Airport or Public Use Airport, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.	Less than significant	No mitigation measures are required.	Less than significant
4.13-6: The Project is Within the Vicinity of a Private Airstrip, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Significant and unavoidable	Implement Mitigation Measures MM 4.13-1 through MM 4.13-5 above.	Significant and unavoidable
4.14 POPULATION AND HOUSING			
4.14-1: The Project Would Directly Induce Substantial Population Growth.	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Less than significant	No mitigation measures are required.	Less than significant
4.15 PUBLIC SERVICES			

4.15-1: The Project Would Result in Adverse Physical Impacts Associated with New or Physically Altered Governmental Facilities or Result in the Need for New or Physically Altered Governmental Facilities and Have Significant Fiscal Impacts on Public Services.	Potentially significant	**MM 4.15-1: Fire Safety Plan.** Prior to the issuance of grading or building permits, the project proponent shall develop and implement a Fire Safety Plan for use during construction and operation. The project proponent will submit the Fire Safety Plan, along with maps of the project site and access roads, to the Kern County Fire Department for review and approval. The Fire Safety Plan will contain notification procedures and emergency fire precautions for construction and operations phases of the proposed project. **MM 4.15-2: Land Development Services Fee Schedule.** Prior to the issuance of grading or building permits, the project proponent shall coordinate with Kern County to determine the need for payment of land development services fees, in accordance with the Kern County Land Development Services Fee Schedule, for impacts to countywide public protection, sheriff's patrol and investigative services, and fire services.	Less than significant
Cumulative Impacts	Potentially significant	Implement Mitigation Measures MM 4.15-1 and 4.15-2, above.	Less than significant.
4.16 Transportation and Traffic			
4.16-1: The Project Would Not Conflict with an Applicable Plan, Ordinance, or Policy Establishing Measures of Effectiveness for the Performance of the Circulation System, Including but not Limited to Intersections, Streets, Highways and Freeways, Pedestrian and Bicycle Paths, and Mass Transit.	Less than significant	No mitigation measures are required.	Less than significant
4.16-2: The Project Would Not Conflict with an Applicable Congestion Management Program, Including, but not Limited to Level of Service Standards and Travel Demand Measures, or Other Standards developed by the County Congestion Management Agency for designated roads or highways.	Potentially significant	**MM 4.16-1: Supplemental Road Improvements.** Prior to final approval of any Master Precise Development Plan or recordation of any parcel map, the project proponent will provide to the County a written statement of intent, which will detail the approach used to satisfy obligations for supplemental road improvements. This written statement of intent and method proposed will be approved by the Kern County Public Works Department- Development Review. The applicant will have three approaches to fulfill the road improvement responsibilities: Lump Sum Payment: Any lump sum payment will be made prior to final approval of any Master Precise Development Plan, parcel map recordation or issuance of grading or building permits. All monies will be paid to the Kern County Roads Department. At the time of payment, the Kern County Roads Department will conduct a review of the distributed share amount and make adjustments, if required, based on increases to the construction cost index, other changes in standards or technology for required	Less than significant

		signalization or improvements, or updated development projects or proposals. The Kern County Roads Department may request, at a cost to be borne by the applicant, a supplemental traffic analysis to determine the correct lump sum payment. Construction of Road Improvements: If, in an approved summary of intent, the Project Applicant seeks to construct road improvements in lieu of a lump sum payment, the improvements will be constructed and accepted by the County prior to issuance of the Certificate of Occupancy for the related building permits. Deviations from this sequence of events may be approved by the Kern County Roads Department. Combination of Approach A and Approach B: The Project Applicant may choose to provide construction for certain roadway improvements and payment for others. This approach must be used in communication with the Kern County Roads Department. All monies designated for roadway improvements shall initially be identified and calculated during processing of the Master Precise Development Plan or parcel map, whichever comes first. All final payments and or construction of roadway improvements shall be completed at the issuance of any grading or building permit. **MM 4.16-2: Construction Traffic Control Plan.** Prior to the issuance of construction or building permits, the project proponent shall: Prepare and submit a Construction Traffic Control Plan to Kern County Public Works Department- Development Review and the California Department of Transportation offices for District 9, as appropriate, for approval. The Construction Traffic Control Plan must be prepared in accordance with both the California Department of Transportation Manual on Uniform Traffic Control Devices and Work Area Traffic Control Handbook and must include, but not be limited to, the following issues: Timing of deliveries of heavy equipment and building materials; Directing construction traffic with a flag person; Placing temporary signing, lighting, and traffic control devices if required including pedestrians and bicyclist; including, but not limited to, appropriate signage along access routes to indicate the presence of heavy vehicles and construction traffic; Ensuring access for emergency vehicles to the project sites; Temporarily closing travel lanes or delaying traffic during materials delivery, transmission line stringing activities, or any other utility connections; Maintaining access to adjacent property; and,	

		Specifying both construction-related vehicle travel and oversize load haul routes, minimizing construction traffic during the AM and PM peak hour, distributing construction traffic flow across alternative routes to access the project sites, and avoiding residential neighborhoods to the maximum extent feasible. Obtain all necessary encroachment permits for the work within the road right-of-way or use of oversized/overweight vehicles that will utilize county-maintained roads, which may require California Highway Patrol or a pilot car escort. Copies of the approved traffic plan and issued permits shall be submitted to the Kern County Planning and Natural Resources Department and the Kern County Public Works Department-Development Review. Enter into a secured agreement with Kern County to ensure that any County roads that are demonstrably damaged by project-related activities are promptly repaired and, if necessary, paved, slurry-sealed, or reconstructed as per requirements of the state and/or Kern County. Submit documentation that identifies the roads to be used during construction. The project proponent shall be responsible for repairing any damage to non-county-maintained roads that may result from construction activities. The project proponent shall submit a preconstruction video log and inspection report regarding roadway conditions for roads used during construction to the Kern County Public Work Department-Development Review and the Kern County Planning and Natural Resources Department. 5. Within 30 days of completion of construction, the project proponent shall submit a post-construction video log and inspection report to the County. This information shall be submitted in DVD format. The County, in consultation with the project proponent's engineer, shall determine the extent of remediation required, if any.	
4.16-3: The Project Would Cause an Increase in Operation-Related Safety Hazards or Result in a Change in Air Traffic Patterns, Including Either an Increase in Traffic Levels or a Change in Location that Would Result in Substantial Safety Risks.	Less than significant	No mitigation measures are required.	Less than significant
4.16-4: The Project Would Cause an Increase in Construction-Related Safety Hazards or Would Substantially Increase Hazards Due to a Design Feature (e.g.,	Potentially significant	Implement Mitigation Measure MM 4.16-2.	Less than significant

Sharp Curves or Dangerous Intersections) or Incompatible Uses (e.g., Farm Equipment).			
4.16-5: The Project Would Result in Inadequate Emergency Access.	Less than significant	Implement Mitigation Measure MM 4.16-2.	Less than significant
4.16-6: The Proposed Project Would Conflict with Adopted Policies, Plans or Programs Supporting Alternative Transportation (e.g., bus turnouts and bicycle racks).	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Significant and unavoidable	Implement Mitigation Measure MM 4.16-2.	Significant and unavoidable
4.17 UTILITIES			
4.17-1: The Project Would Exceed Wastewater Treatment Requirements of the Applicable Regional Water Quality Control Board.	Less than significant	No mitigation measures are required.	Less than significant
4.17-2: The Project Would Require or Result in the Construction of New Water or Wastewater Treatment Facilities or Expansion of Existing Facilities, the Construction of Which Would Cause Significant Environmental Effect.	Potentially significant	**MM 4.17-1:** All special equipment for the proposed Project, such as package treatment plants, their appurtenances, and their effluent disposal areas and methods shall be designed, located, and constructed in coordination with the Kern County Public Works Department, so as to preclude contamination, pollution, nuisance, and structural and mechanical instability. **MM 4.17-2: Package Treatment and Disposal Facilities.** Proposals and plans for package treatment and disposal facilities shall be subject to the review and approval of: 1. The State and County Environmental Health Services Departments for design and contamination aspects; 2. The Regional Water Quality Control Board for elements of pollution and nuisance; and 3. The Kern County Public Works Department for structural and mechanical integrity. Special structures, such as pump stations, pressure lines and sags, etc.	Less than significant

		shall be subject to the approval of the Kern County Public Works Department and the maintaining District. **MM 4.17-3: Wastewater Package Plant Facility.** The new wastewater package plant facility shall be constructed according to State specifications, with coordination of Kern County Public Works and Kern County Environmental Health Services Departments and shall be operated in such a way as to not contaminate the underlying unconfined aquifer. **MM 4.17-4: Water System.** All facilities of the water system shall be designed and constructed to comply with Kern County Development Standards and approved by the Kern County Public Works Department.	
4.17-3: The Project Would Require or Result in the Construction of New Stormwater Drainage Facilities or Expansion of Existing Facilities.	Potentially significant	Implement Mitigation Measures MM 4.7-8.	Less than significant
4.17-4: The Project Would Have Insufficient Water Supplies Available to Serve the Project from Existing Entitlement and Resources and New or Expanded Entitlement is Needed.	Potentially significant	**MM 4.17-5: Water Meters.** Water meters shall be installed on all facilities. Once operations of the first facility constructed on-site have commenced, the Master Developer or subsequent future land owners shall be required to submit annual reports to the Kern County Planning Department and the Kern County Environmental Health Services Department detailing the annual water usage on site.	Less than significant
4.17-5: The Project Would Result in a Determination by the Wastewater Treatment Provider Which Serves or May Serve the Project That it Does Not Have Adequate Capacity to Serve the Project's Projected Demand in Addition to the Provider's Existing Commitments.	Potentially significant	Implement Mitigation Measures MM 4.17-1 through MM 4.17-5.	Less than significant
4.17-6: The Project Would be Served by a Landfill That Has Sufficient Permitted Capacity to Accommodate the Project's Solid Waste Disposal Needs.	Potentially significant	**MM 4.17-6: Recycling on Site.** During construction, demolition debris and construction wastes shall be recycled to the extent feasible. 1. An on-site recycling coordinator will be designated by the Project Applicant/ Developer to facilitate recycling of all construction waste through coordination with the on-site contractors, local waste haulers, and/or other facilities that recycle construction/demolition wastes. 2. The name and phone number of the coordinator will be provided to the Kern County Waste Management Department prior to issuance of building permits	Less than significant

		3. The on-site recycling coordinator will also be responsible for ensuring that wastes requiring special disposal are handled according to state and County regulations that are in effect at the time of disposal.	
4.17-7: The Project Would Comply with Federal, State, and Local Statues and Regulations Related to Solid Waste.	Potentially significant	Implement Mitigation Measure MM 4.17-6.	Less than significant
4.17-8: The Project Would Exceed the Capacity of the Electrical and Natural Gas Facilities Within the Project Area.	Potentially significant	**MM 4.17-7: Electrical Services.** Prior to approval of a Master Precise Development Plan or modification to an existing precise development plan on-site, the Master Developer or future land owner shall coordinate with Pacific Gas and Electric Company (PG&E) staff early in the planning stages to ensure that adequate facilities are incorporated into the Project design. Prior to issuance of grading and building permits the Project proponent shall coordinate with PG&E staff to determine the specific requirements regarding any potential electric service or facility issues needed to adequately accommodate the proposed Project. The Project proponent shall comply with and adhere to all requirements identified by PG&E to full mitigate impacts to electric services and facilities, as needed as Project construction progresses. **MM 4.17-8: Natural Gas.** Prior to approval of a Master Precise Development Plan or modification to an existing precise development plan on-site, the Master Developer or future land owner shall coordinate with Pacific Gas and Electric Company (PG&E) staff early in the planning stages to ensure that adequate facilities are incorporated into the Project design. Prior to issuance of grading and building permits the Project proponent shall coordinate with PG&E staff to determine the specific requirements regarding any potential natural gas service or facility issues needed to adequately accommodate the proposed Project. The Project proponent shall comply with and adhere to all requirements identified by PG&E to fully mitigate impacts to natural gas services and facilities, as needed as Project construction progresses. **MM 4.17-9: PG&E Notification**. The Project proponent shall notify PG&E six months prior to any construction activities in the immediate vicinity of PG&E Transmission Line 300B.	Less than significant
Cumulative Impacts	Potentially significant	Implement Mitigation Measures MM 4.17-1 through MM 4.17-9.	Less than significant
4.18 Wildfire			

4.18-1: The Project Would Substantially Impair an Adopted Emergency Response Plan or Emergency Evacuation Plan.	Less than significant	No mitigation measures are required.	Less than significant
4.18-2: The Project Would Due to Slope, Prevailing Winds, and Other Factors, Exacerbate Wildfire Risks, and Thereby Expose Project Occupants to, Pollutant Concentrations from a Wildfire or the Uncontrolled Spread of a Wildfire.	Less than significant	No mitigation measures are required.	Less than significant
4.18-3: The Project Would Require the Installation or Maintenance of Associated Infrastructure (Such As Roads, Fuel Breaks, Emergency Water Sources, Power Lines or Other Utilities) That May Exacerbate Fire Risk or That May Result In Temporary or Ongoing Impacts to The Environment.	Less than significant	No mitigation measures are required.	Less than significant
4.18-4: The Project Would Expose People or Structures to Significant Risks, Including Downslope or Downstream Flooding or Landslides, as a Result of Runoff, Post-Fire Slope Instability, or Drainage Changes	Less than significant	No mitigation measures are required.	Less than significant
Cumulative Impacts	Less than significant	No mitigation measures are required.	Less than significant

Chapter 2

Introduction

Chapter 2
Introduction

2.1 Intent of the California Environmental Quality Act

The Kern County Planning and Natural Resources Department, as lead agency, has determined that a Project Level Recirculated Environmental Impact Report (REIR) must be prepared for the proposed 99 Houghton Industrial Park Project. The proposed Project would permit the development of a light to medium industrial park containing approximately 4,613,004 square feet (ft^2) (net building area) of warehousing, distribution, and retail showroom uses.

This Recirculated Draft EIR has been prepared pursuant to the following:

- California Environmental Quality Act (Public Resources Code [PRC], Section 21000 et seq.);
- CEQA Guidelines (California Code of Regulations [CCR], Title 14, Chapter 3, Section 15000 et seq.); and
- Kern County CEQA Implementation Document.

The overall purposes of the CEQA process are to:

- ensure that the environment and public health and safety are protected in the face of discretionary projects initiated by public agencies or private concerns;
- provide for full disclosure of the project's environmental effects to the public, the agency decision-makers who will approve or deny the project, and responsible and trustee agencies charged with managing resources (e.g., wildlife, air quality) that may be affected by the project; and
- provide a forum for public participation in the decision-making process with respect to environmental effects.

2.2 Purpose of this Recirculated Draft Environmental Impact Report

This document is the Recirculated DEIR for the 99 Houghton Industrial Park. This introduction provides the manner in which changes were made to the previous DEIR, background information concerning this document, and the procedure for commenting on this Recirculated DEIR.

The 99 Houghton Industrial Park Project Environmental Impact Report was originally circulated for public comment from February 13, 2018, with a comment closing date of April 2, 2018, by the Kern County Planning Department acting as the lead agency. On March 13, 2018, prior to the end of the original comment period, the project was formally withdrawn from circulation. The County has received and considered written comments that were received after the close of the public comment period.

County staff has determined that changes should be made in the Draft EIR that was originally circulated for public comment. In some cases changes have been made to the project and in some cases new or revised information or analysis has been included in the Recirculated Draft EIR.

The Guidelines adopted by the Governor's Office of Planning and Research for the California Environmental Quality Act (Guidelines) provide that a lead agency is required to recirculate an environmental impact report when *significant new information* is added to an EIR after public review of the Draft EIR has begun. New information can include changes in the project description, changes in the environmental setting, as well as other additional data or information. This information may relate to new environmental impacts, severity of such impacts, alternatives or mitigation. Recirculation of an EIR is covered by CEQA Guidelines Section 15088.5.

As mandated by State law, the minimum public review period for this document is 45 days. CEQA Guidelines Section 15088.5 (f) (1) provides that when an Environmental Impact Report (EIR) is substantially revised and the entire EIR is circulated, Kern County, as lead agency, may require that reviewers submit new comments, and the lead agency need not respond to those comments received during the earlier circulation period. Kern County will therefore respond in the Final Recirculated EIR only to new comments received regarding this Recirculated Draft EIR received during this comment period

Additions to the text of the 2018 DEIR are indicated with underline formatting, and text deletions are indicated with strikethrough formatting.

An EIR is a public informational document used in the planning and decision-making process. This Project Level REIR will analyze the environmental impacts of the proposed Project. The Kern County Planning Commission and Board of Supervisors will consider the information in the REIR, including the public comments and staff responses to those comments, during the public hearing process. As a legislative action, the final decision is made at the Board of Supervisors where the proposed Project may be approved, conditionally approved, or denied. The purpose of a Recirculated EIR is to identify:

- the significant potential impacts of the proposed Project on the environment and indicate the manner in which those significant impacts can be avoided or mitigated
- any unavoidable adverse impacts that cannot be mitigated
- reasonable and feasible alternatives to the proposed Project that would eliminate any significant adverse environmental impacts or reduce the impacts to a less-than-significant level

A Recirculated EIR also discloses growth-inducing impacts; impacts found not to be significant; and significant cumulative impacts of past, present, and reasonably anticipated future projects.

CEQA requires that a Recirculated EIR reflect the independent judgment of the lead agency regarding the impacts, the level of significance of the impacts (both before and after mitigation), and mitigation measures proposed to reduce the impacts. A Recirculated Draft EIR is circulated to responsible agencies, trustee agencies with resources affected by the project, and interested agencies and individuals. The purposes of public and agency review of a Recirculated Draft EIR include sharing expertise, disclosing agency analyses, checking for accuracy, detecting omissions, discovering public concerns, and soliciting counterproposals.

Reviewers of a Recirculated draft EIR should focus on the sufficiency of the document in identifying and analyzing the possible impacts on the environment and ways in which the significant effects of the proposed Project might be avoided or mitigated. Comments are most helpful when they suggest additional specific alternatives or mitigation measures that would provide better ways to avoid or mitigate significant environmental effects.

Issues to Be Resolved

Section 15123(b)(3) of the CEQA Guidelines requires that a Recirculated EIR contain issues to be resolved, which includes the choices among alternatives and whether or how to mitigate significant impacts. The major issues to be resolved regarding the proposed Project include decisions by the lead agency as to whether or not:

- the Recirculated Draft EIR adequately describes the environmental impacts of the proposed Project;
- the recommended mitigation measures should be adopted or modified; or
- additional mitigation measures need to be applied.

2.3 Terminology

To assist readers in understanding this Recirculated EIR, terms used are defined in the following manner.

- *Project* means the whole of an action that has the potential for resulting in a physical change in the environment, directly or indirectly.
- *Environment* means the physical conditions that exist in the area that would be affected by a proposed Project, including land, air, water, minerals, flora, fauna, ambient noise and objects of historical or aesthetic significance. The area included in this definition is the area in which significant direct or indirect impacts would occur as a result of the proposed Project. The environment includes both natural and artificial conditions.
- *Impacts* analyzed under CEQA must be related to a physical change. Impacts are:
  - direct or primary impacts that are caused by the proposed Project and occur at the same time and place or
  - indirect or secondary impacts that are caused by the proposed Project and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect or secondary impacts may include growth-inducing impacts and other effects related to induced changes in the pattern of land use; population density or growth rate and related effects on air, water and other natural systems, including ecosystems.
  - the California Supreme Court recently ruled that the environment's impact on a project fall outside the scope of CEQA except to the extent that impacts from a project exacerbate such impacts. This Recirculated DEIR includes the environment's impacts on a project for informational purposes, and to address the exacerbation component of the Court's decision.

- *Significant impact on the environment* means a substantial or potentially substantial, adverse change in any of the physical conditions in the area affected by the proposed Project, including land, air, water, minerals, flora, fauna, ambient noise and objects of historical or aesthetic significance. An economic or social change by itself is not considered a significant impact on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant.

- *Mitigation* consists of measures to avoid or substantially reduce the proposed Project's significant environmental impacts by:
  - avoiding the impact altogether by not taking a certain action or parts of an action;
  - minimizing impacts by limiting the degree or magnitude of the action and its implementation;
  - rectifying the impact by repairing, rehabilitating or restoring the affected environment;
  - reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action: or
  - compensating for the impact by replacing or providing substitute resources or environments.

- *Cumulative impacts* are two or more individual impacts that, when considered together, are considerable, compound, or increase other environmental impacts. The following statements also apply when considering cumulative impacts:
  - The individual impacts may be changes resulting from a single project or separate projects.
  - The cumulative impact from several projects is the change in the environment that results from the incremental impact of the proposed Project when added to other closely related past, present and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over time.

This Recirculated EIR uses a variety of terms to describe the level of significance of adverse impacts. These terms are defined as follows:

- *Less than significant:* An impact that is adverse but that does not exceed the defined thresholds of significance. Less than significant impacts do not require mitigation.

- *Significant:* An impact that exceeds the defined thresholds of significance and would or could cause a substantial adverse change in the environment. Mitigation measures are recommended to eliminate the impact or reduce it to a less than significant level.

- *Significant and unavoidable:* An impact that exceeds the defined thresholds of significance and cannot be eliminated or reduced to a less than significant level through the implementation of mitigation measures.

2.4 Decision-Making Process

CEQA requires lead agencies to solicit and consider input from other interested agencies, citizen groups, and individual members of the public. CEQA also requires the proposed Project to be monitored after it has been permitted to ensure that mitigation measures are carried out.

CEQA requires the lead agency to provide the public with a full disclosure of the expected environmental consequences of the proposed Project, and with an opportunity to provide comments. In accordance with CEQA, the following is the process for public participation in the decision-making process:

- **Notice of Preparation/Initial Study (NOP/IS).** Kern County prepared and circulated an NOP/IS to responsible, trustee, and local agencies for review and comment on May 1, 2009. The NOP/IS and responses to the NOP are included in Appendix A, *Initial Study/Notice of Preparation and Notice of Preparation Responses*. In conjunction with this public notice, a scoping meeting was held by Kern County on May 22, 2009, to provide a forum for public comments on the scope of the EIR.

- **Recirculated Draft EIR Preparation/Notice of Completion (NOC).** A Recirculated Draft EIR will be circulated for review and comment to appropriate agencies and additional individuals and interest groups who have requested to be notified of EIR projects. Per Section 15105 of the CEQA Guidelines, Kern County will provide for a 45-day public review period on the Recirculated Draft EIR. Kern County will provide responses to comments to each agency or person who provided written comments on the Recirculated EIR two weeks before the scheduled Planning Commission hearing.

- **Preparation and Certification of Final Recirculated EIR.** The Kern County Planning Commission will consider the Final Recirculated EIR and the proposed Project, acting in an advisory capacity to the Kern County Board of Supervisors. Upon receipt of the Planning Commission's recommendation, the Board of Supervisors will also consider the Final Recirculated EIR, along with all public comments, and take final action on the proposed Project. At least one public hearing will be held by both the Planning Commission and Board of Supervisors to consider the Final Recirculated EIR, take public testimony, and either approve, conditionally approve, or deny the proposed Project.

Notice of Preparation

In accordance with Section 15082 of the CEQA Guidelines, as amended, the Kern County Planning and Natural Resources Department circulated an NOP/IS to the State Clearinghouse, public agencies, special districts, and members of the public for a 30-day public review. The public review period for the NOP/IS began on May 1, 2009, and ended on June 1, 2009. The NOP/IS was also posted in the Kern County Clerk's office for 30 days and sent to the State Clearinghouse at the Governor's Office of Planning and Research to solicit statewide agency participation in determining the scope of the Recirculated EIR. The purpose of the NOP/IS was to formally convey that the County, as the lead agency, solicited input regarding the scope and proposed content of the Recirculated EIR. The NOP/IS and all comment letters are provided in Appendix A of this Recirculated EIR.

Scoping Meeting

Pursuant to Section 15206 of the CEQA Guidelines, the lead agency is required to conduct at least one scoping meeting for all projects of statewide, regional, or area-wide significance. The scoping meeting is for jurisdictional agencies and interested persons or groups to provide comments regarding, but not limited to, the range of actions, alternatives, mitigation measures, and

environmental effects to be analyzed. A public scoping meeting was held at 1:30 p.m. on May 22, 2009, at the Kern County Public Services Building, 2700 M Street, Conference Room 1A, Bakersfield, California.

Notice of Preparation/Initial Study and Scoping Meeting Results

Nine (9) comment letters were received during the scoping process. Specific environmental concerns raised in written comments provided to staff during circulation of the NOP/IS for the proposed Project are discussed below. The NOP/IS and all comments are included in Appendix A, along with the Summary of Proceedings from the Scoping Meeting.

Notice of Preparation Written Comments

Table 2-1, *Summary of Written Comments on Notice of Preparation/Initial Study*, summarizes the comments received in response to the NOP/IS. Copies of the original comments are included in Appendix A.

Table 2-1. Summary of Written Comments on Notice of Preparation/Initial Study

Commenter	Summary of Comment
Sierra Club - Kern-Kaweah Chapter (letter dated May 27, 2009)	The EIR should address the following issues: incompatibility with the Metropolitan Bakersfield General Plan, need for the project, farmland conversion, air quality, biological resources, global warming, water supplies, energy and solar photovoltaics, traffic, aesthetics and light pollution, alternatives, and cumulative impacts.
Department of Agriculture and Measurement Standards (letter dated May 21, 2006)	The Department is concerned about the project depleting prime agricultural land to industrial uses. The EIR should address issues involving compatibility with industrial uses and the scope of impact upon the surrounding agricultural properties.
Kern County Resource Management Agency, Roads Department (letter dated May 18, 2009)	When the traffic impact study for the proposed Project is submitted to the County, the Roads Department would like a copy for review and comment.
Division of Oil, Gas and Geothermal Resources (DOGGR) (letter dated May 5, 2009)	The proposed Project is located outside the administrative boundaries of any oil or gas field, and there is one plugged and abandoned oil well within the Project boundaries. The abandoned well will need to be addressed if structures, roads, or parking lots are planned in proximity to it.
Tejon Indian Tribe (letter dated May 24, 2009)	The proposed Project is located in an area that Tejon Indian Tribe ancestors used in the past; however, the Tribe has no information or concerns at this time.
Native American Heritage Commission (NAHC) (letter dated May 22, 2009)	The NAHC, as the state trustee agency, recommended various actions in order to adequately assess the project-related impacts on historical resources.
California Department of Transportation (letter dated May 20, 2009)	A traffic impact study is needed for the proposed Project. An encroachment permit may be needed for the proposed Project, for any work in the State right-of-way.

Table 2-1. Summary of Written Comments on Notice of Preparation/Initial Study	
Commenter	Summary of Comment
San Joaquin Valley Air Pollution Control District (letter dated June 1, 2009)	The EIR should include a quantitative emissions analysis, a discussion of greenhouse gas emissions generated by the project and the effect they will have (if any) on global climate change, a discussion of potential odors / sensitive receptors, potential health impact of Toxic Air Contaminants (if any), existing District regulations, feasible mitigation measures that will reduce air quality impacts.
Kern County Superintendent of Schools (letter dated May 13, 2009)	The Kern County Superintendent of Schools office represents the Greenfield Union and Kern High School Districts with regard to the imposition of developer fees. The collection of statutory fees shall be collected at the time that building permits are issued. Currently, these fees are set at $0.47 per square foot, an amount subject to adjustment every two years.

Availability of Recirculated Draft EIR

This Recirculated Draft EIR is being distributed directly to agencies, organizations, and interested groups and persons for comment during a 45-day formal review period, in accordance with Section 15087 of the State CEQA Guidelines. This Recirculated Draft EIR and the full administrative record for the proposed Project, including all studies, is available for review during normal business hours, Monday through Friday, at the Kern County Planning and Natural Resources Department, located at:

Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, CA 93301-2370
Phone: (661) 862-8600, Fax: (661) 862-8601

Additionally, this Recirculated Draft EIR is available at the following library:

Kern County Library/Beale
Local History Room
701 Truxtun Avenue
Bakersfield, CA 93301

2.5 Format and Content

This Recirculated Draft EIR addresses the potential environmental effects of the proposed Project and was prepared following input from the public and the responsible and affected agencies, through the EIR scoping process, as discussed previously. The content of this Recirculated Draft EIR was established based on the findings in the NOP/IS, and public and agency input. Based on the findings of the NOP/IS and amendments to CEQA Guidelines in 2018, a determination was

made that a Recirculated DEIR is required to address potentially significant environmental effects on the following resources:

- Aesthetics/Urban Decay
- Agricultural Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Geologic and Seismic Hazards ~~Geology and Soils~~
- Energy
- Greenhouse Gases
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Mineral Resources
- Noise
- Population and Housing
- Public Services
- Recreation (discussed in Section 4.14, Public Services)
- Transportation/Traffic
- Utilities
- Wildfires

Required Recirculated DEIR Content and Organization

This Recirculated Draft EIR includes all sections required by CEQA. Table 2-2, *Required EIR Contents,* contains a list of sections required under CEQA, along with a reference to the chapter in which they can be found in this document.

Table 2-2. Required EIR Contents

Requirement/CEQA Section	Location in EIR
Table of contents (Section 15122)	Table of Contents
Summary (Section 15123)	Chapter 1
Project description (Section 15124)	Chapter 3
Significant environmental impacts (Sections 15126 and 15126.2)	Chapter 1; Sections 4.1–4.16; Chapter 5
Environmental setting (Section 15125)	Sections 4.1–4.16
Mitigation measures (Section 15126.4)	Chapter 1; Sections 4.1–4.16
Cumulative impacts (Section 15130)	Chapter 1; Sections 4.1–4.16; Chapter 5
Alternatives to the proposed project (Section 15126.6)	Chapter 6
Growth-inducing impacts (Section 15126.2)	Chapter 1; Section 4.13; Chapter 5
Effects found not to be significant (Section 15128)	Chapter 1; Sections 4.1–4.16; Chapter 5
Unavoidable significant environmental impacts (Section 15126.2)	Chapter 1; Sections 4.2, 4.3, 4.7, 4.12, and 4.15; Chapter 5
Organizations and persons consulted (Section 15129)	Chapter 8
List of preparers (Section 15129)	Chapter 9
References (Section 15129)	Chapter 10

Recirculated DEIR Organization

The content and organization of this Recirculated Draft EIR are designed to meet the requirements of CEQA, the CEQA Guidelines, and the Kern County CEQA Implementation Document, as well as to present issues, analysis, mitigation, and other information in a logical and understandable way. This Recirculated Draft EIR is organized into the following sections:

- Chapter 1, *"Executive Summary,"* provides a project description and a summary of the environmental impacts and mitigation measures.
- Chapter 2, *"Introduction,"* provides CEQA compliance information, overview of the decision-making process, organization of the Recirculated EIR and a responsible and trustee agency list.
- Chapter 3, *"Project Description,"* provides a description of the location, characteristics, objectives and the relationship of the project to other plans and policies.
- Chapter 4, *"Environmental Setting, Impacts and Mitigation Measures,"* contains a detailed environmental analysis of the existing conditions, project impacts, mitigation measures and unavoidable adverse impacts.
- Chapter 5, *"Consequences of Project Implementation (Mandatory CEQA Sections),"* presents an analysis of the project's cumulative and growth-inducing impacts and other CEQA requirements, including significant and unavoidable impacts and irreversible commitment of resources.
- Chapter 6, *"Alternatives,"* describes a reasonable range of alternatives to the project that could reduce the significant environmental effects that cannot be avoided.

- Chapter 7, *"Responses to Comments,"* is reserved for responses to comments on this Recirculated Draft EIR.
- Chapter 8, *"Organizations and Persons Consulted,"* lists the organizations and persons contacted during preparation of this Recirculated Draft EIR.
- Chapter 9, *"Preparers,"* identifies persons involved in the preparation of the Recirculated Draft EIR.
- Chapter 10, *"Bibliography,"* identifies reference sources for the Recirculated Draft EIR.
- Chapter 11, *"Acronyms and Abbreviations,"* lists all acronyms and abbreviations mentioned throughout the Recirculated Draft EIR with corresponding definitions.
- *"Appendices"* provide information and technical studies that support the environmental analysis contained within the Recirculated Draft EIR.

The analysis of each environmental category in Chapter 4 is organized as follows:

- *"Introduction"* provides a brief overview on the purpose of the section being analyzed with regard to the project.
- *"Environmental Setting"* describes the physical conditions that exist at this time and that may influence or affect the topic being analyzed.
- *"Regulatory Setting"* provides state and federal laws and the Metropolitan Bakersfield General Plan (MBGP) goals, policies, and implementation measures that apply to the topic being analyzed.
- *"Impacts and Mitigation Measures"* discusses the impacts of the project in each section, presents the determination of the level of significance and provides a discussion of feasible mitigation measures to reduce any impacts.

2.6 Responsible and Trustee Agencies

Projects or actions undertaken by the lead agency, in this case the Kern County Planning and Natural Resources Department, may require subsequent oversight, approvals or permits from other public agencies in order to be implemented. Other such agencies are referred to as "responsible agencies" and "trustee agencies." Pursuant to Sections 15381 and 15386 of the State CEQA Guidelines, as amended, responsible agencies and trustee agencies are defined as follows:

- A "*responsible agency"* is a public agency that proposes to carry out or approve a project, for which a lead agency is preparing or has prepared an EIR or Negative Declaration. For the purposes of CEQA, the term "responsible agency" includes all public agencies other than the lead agency that have discretionary approval power over the projects. (Section 15381).
- A "*trustee agency"* is a state agency having jurisdiction by law over natural resources affected by a project that are held in trust for the people of the State of California. (Section 15386).

  The various public, private, and political agencies and jurisdictions with a particular interest in the proposed Project include but are not limited to the following:

Federal Agencies

- U.S. Fish and Wildlife Service
- Department of Agriculture (USDA)
- Department of Interior
- Environmental Protection Agency
- Farm Service Agency
- Federal Highway Administration (FHWA)
- U.S. Army Corps of Engineers
- USDA, Forest Service

State Agencies

- Department of Conservation
- Reclamation Board
- Department of Conservation, Division of Oil, Gas & Geothermal Resources (DOGGR)
- Department of Mines and Geology
- Department of Fish and Wildlife
- Department of Water Resources
- Office of Historic Preservation
- Governor's Office of Planning and Research
- California Air Resources Board
- California Integrated Waste Management Board
- Regional Water Quality Control Board (RWQCB) – Central Valley Region
- California Department of Transportation (Caltrans) District 6
- California Native American Heritage Commission
- California Public Utilities Commission
- California Department of Forestry and Fire Protection (CalFire)

Local Agencies

- Kern Council of Governments (Kern COG)
- Kern County Administrative Office

- Kern County Board of Supervisors
- Kern County Economic Development Department
- Kern County Department of Agriculture
- Kern County Public Works Department
- Kern County Fire Department
- Kern County Library Facilities
- Kern County Parks and Recreation Department
- Kern County Planning Commission
- Kern County Sherriff's Department
- Kern County Water Agency (KCWA)
- Greenfield County Water District
- Kern County Superintendent of Schools
- Kern High School District
- Greenfield Union School District
- San Joaquin Valley Air Pollution Control District (SJVAPCD)
- City of Bakersfield Public Works Department
- City of Bakersfield Development Services Department

2.7 Incorporation by Reference

In accordance with Section 15150 of the *CEQA Guidelines* to reduce the size of the report, the following documents are hereby incorporated by reference into this Recirculated Draft EIR and are available for public review at the Kern County Planning and Natural Resources Department. A brief synopsis of the scope and content of these documents is provided below.

- **Metropolitan Bakersfield General Plan (MBGP) (2007)** - The MBGP is a policy document designed to give long-range guidance for decision-making affecting the future character of the Metropolitan Bakersfield planning area. It represents the official statement of the community's physical development as well as its economic, social and environmental goals. The MBGP has the following elements: Land Use, Circulation, Housing, Conservation, Open Space, Noise, Safety, Public Services and Facilities, and Parks. An additional element includes the Kern River Plan, which helps to define goals and policies for issues unique to the Metropolitan Bakersfield area. The MBGP was utilized throughout this Recirculated EIR as the fundamental planning document governing development on the proposed Project site. Background information and policy information from the Plan are cited in several sections of the Recirculated EIR.

- **Metropolitan Bakersfield Habitat Conservation Plan (MBHCP) (April 1994)** - The MBHCP, as amended, and implementing agreements and ordinances provide a method of collecting funds for the acquisition and perpetual management of habitat land for the purpose of creating preserves. The MBHCP and associated implementing ordinances and agreements are available through the Kern County Planning and Natural Resources Department. The plan provides descriptions of species of concern and habitat areas within the Metropolitan Bakersfield General Plan Area. Development projects within Metropolitan Bakersfield pay mitigation fees, which are used to buy habitat lands. These lands are managed by wildlife agencies or by entities approved by wildlife agencies. Measures to avoid taking a protected species are also listed in the MBHCP. The amount of habitat preserved must always be greater than what is being developed. The boundaries of the MBHCP study area match the boundaries of the MBGP, which consists of 408 square miles.

- **Kern County Zoning Ordinance (July 2016)** - According to Chapter 19.02.020, Purposes, Title 19 was adopted to promote and protect the public health, safety, and welfare through the orderly regulation of land uses throughout the unincorporated area of Kern County. Further, the purposes of this title are to:
    - Provide the economic and social advantages resulting from an orderly planned use of land resources;
    - Encourage and guide development consistent with the Kern County General Plan (KCGP);
    - Divide Kern County into zoning districts of a number, size and location deemed necessary to carry out the purposes of the KCGP and this title;
    - Regulate the size and use of lots, yards and other open spaces;
    - Regulate the use, location, height, bulk and size of buildings and structures;
    - Regulate the intensity of land use;
    - Regulate the density of population in residential areas;
    - Establish requirements for off-street parking;
    - Regulate signs and billboards; and
    - Provide for the enforcement of regulations of Chapter 19.02.020.

- **County of Kern Housing Element 2015-2023 (2016)** - The development and preservation of adequate and affordable housing is important to the well-being of the residents and the economic prosperity of the County. To plan for the development of adequate housing for all income segments, a Housing Element was prepared as a part of the KCGP. This document specifically addresses housing needs and resources in the County's unincorporated areas. The Housing Element must maintain consistency with the other elements of the KCGP.

- **Destination 2030: Regional Transportation Plan (RTP)** - The latest Regional Transportation Plan (RTP) was adopted in 2018. The 2018 RTP/Sustainable Communities Strategy (SCS) establishes a set of regional transportation goals, objectives, policies, and actions intended to guide development of the planned multimodal transportation systems in Kern County. It was developed through a continuing, comprehensive, and cooperative planning process, and

provides for effective coordination between local, regional, State, and federal agencies. This RTP/SCS provides transportation and air quality goals, policies and actions for now and into the future, and includes programs and projects for congestion management, transit, airports, bicycles and pedestrians, roadways, and freight. The 2018 RTP/SCS continues the implementation of California's Sustainable Communities and Climate Protection Act (Senate Bill [SB] 375) which requires the inclusion of a Sustainable Communities Strategy that reduces greenhouse gas emissions from passenger vehicles and light duty trucks by 5 percent per capita by 2020 and 10 percent per capita by 2035. In addition, it provides a discussion of all mechanisms used to finance transportation and air quality (including greenhouse gas) program implementation (Kern Council of Governments [COG], 2018).

- **Kern County Airport Land Use Compatibility Plan -** The Kern County Airport Land Use Compatibility Plan (ALUCP) was originally adopted in 1996 and has since been amended to comply with Aeronautics Law, Public Utilities Code (Chapter 4, Article 3.5) regarding public airports and surrounding land use planning. As required by that law, proposals for public or private land use developments that occur within defined airport influence areas are subject to compatibility review. The principle airport land use compatibility concerns addressed by the plan are: (1) exposure to aircraft noise; (2) land use safety with respect to both people and property on the ground and the occupants of aircraft; (3) protection of airport air space; and (4) general concerns related to aircraft overflights.

  The ALUCP identifies policies and compatibility criteria for influence zones or planning area boundaries. The ALUCP maps and labels these zones as A, B1, B2, C, and D, ranging from the most restrictive (A - airport property-runway protection zone) to the least restrictive (D - disclosure to property owners only). As required by law, the following affected cities have adopted the ALUCP for their respective airports: City of Bakersfield, City of California City, City of Delano, City of Shafter, City of Taft, City of Tehachapi, and City of Wasco.

2.8 Sources

This Recirculated Draft EIR is dependent upon information from many sources. Some sources are, for example, studies or reports that have been prepared specifically for this document. Others are studies or reports that may provide background information related to one or more issue areas that have been discussed in this document. The sources and references used in the preparation of this Recirculated Draft EIR are listed in Chapter 10, *"Bibliography,"* and are available for review during normal business hours at the:

Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, California 93301-2370

This Draft Recirculated DEIR is also available on the Kern County Planning and Natural Resources Department website:
https://kernplanning.com/planning/environmental-documents/.

Chapter 3

Project Description

Chapter 3
Project Description

3.1 Project Overview

This Environmental Impact Report (EIR) has been prepared to identify and evaluate potential environmental impacts associated with implementation of 99 Houghton Industrial Park Project (proposed Project). When the Notice of Preparation (NOP) was initially circulated in May 2009, the proposal consisted of the same parcels with different proposed land use designation and zoning classifications, and a larger net building space. However, after the circulation of the NOP and further analysis of the proposed Project, the project proponent elected to reduce the net building space and allow for highway commercial and general commercial land uses. Table 3-1, *Project Statistics*, provides a comparison the changes to the proposed Project between the time of the NOP and this EIR. The size of the project site has not changed. The characteristics of the Project site are summarized in Table 3-2, *Description of Site*. All associated technical studies prepared for the proposed Project have been reviewed and updated as needed to reflect these changes to the proposed Project.

Table 3-1. Project Statistics

Total Project Site Boundary		Net Building Space	Proposed MBGP Land Use Designations				Proposed Zoning Classifications			
			GC	HC	LI	SI	M-1 PD	M-2 PD	CH PD	C-2 PD
Previous (NOP)	314.31 acres	5,134,253 square feet (ft^2)	N/A	N/A	129.73 acres	184.58 acres	129.73 acres	184.58 acres	N/A	N/A
Current (DEIR)	314.30 acres	4,613,004 ft^2	22 acres	9.01* acres	107.72 acres	159 acres	107.72 acres	159 acres	25 acres	22 acres
Change	-0.01 acre	-521,249 ft^2	+22 acres	+9.01* acres	-22.01 acres	-25.58 acres	-22.01 acres	-25.58 acres	+25 acres	+22 acres

Metropolitan Bakersfield General Plan (MBGP) Land Use Designations:
GC = General Commercial; HC = Highway Commercial; LI = Light Industrial; SI = Service Industrial

Kern County Zoning Classifications:
M-1 (Light Industrial); M-2 (Medium Industrial); CH = Highway Commercial; C-2 = General Commercial; PD = Precise Development Combining

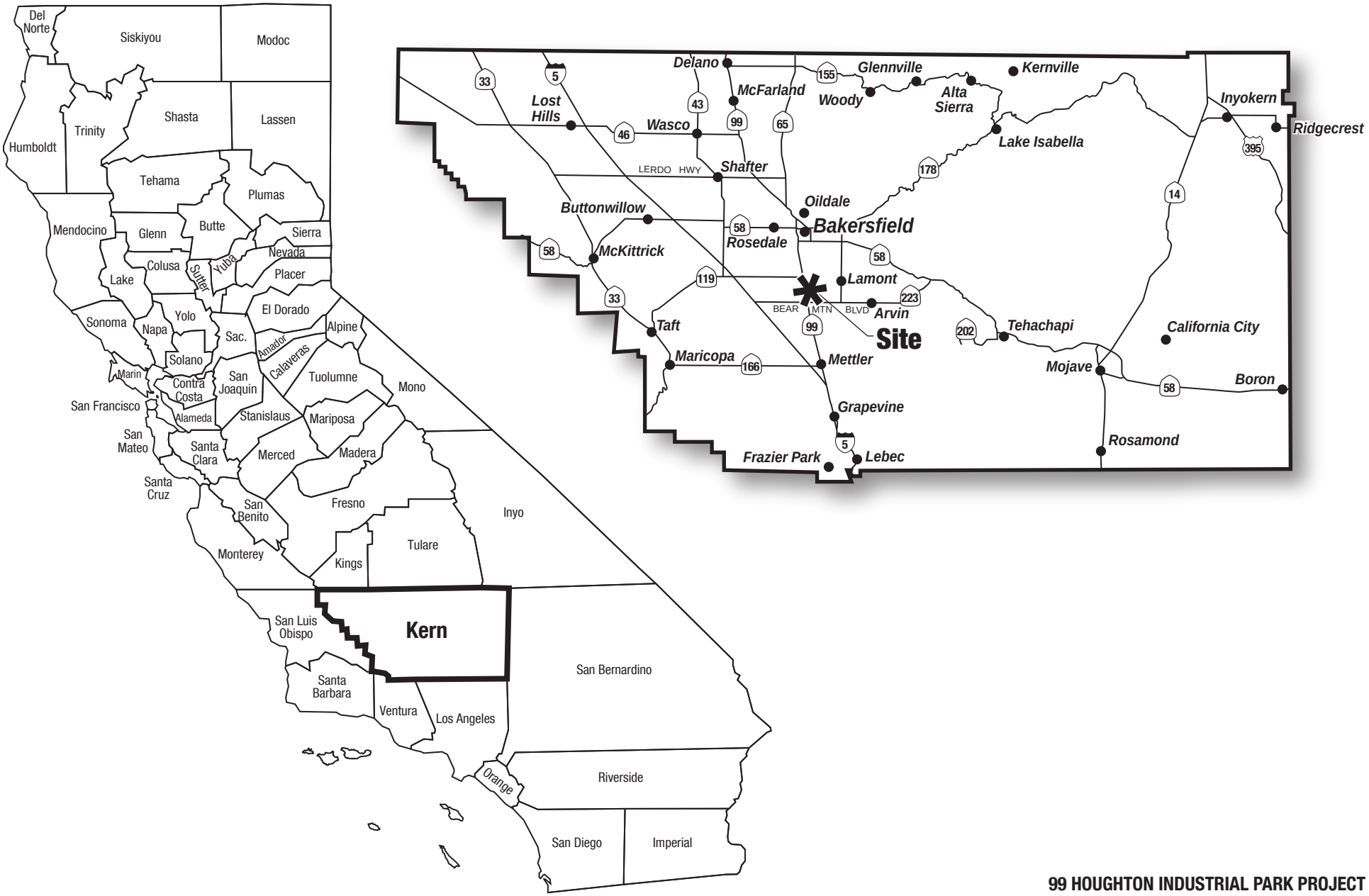
* The project site currently contains 15.99 acres of exiting HC land use designation under the MBGP; therefore, the proposed project would have a total of 25 acres of HC land use designation.

Table 3-2. Description of Site

Developer/Total Acreage	Entitlements	Location
99 Houghton Industrial Park 314 acres	General Plan Amendment No. 1, Map 143-07; Zone Change No. 2, Map 143-07; Conditional Use Permit No. 5, Map 143-07; Conditional Use Permit No. 6, Map 143-07; Exclusion from Agricultural Preserve No. 13	APN 185-140-08; bounded by South Union Avenue to the east, State Route 99 to the west, DiGiorgio Road to the north, and Houghton Road to the south

As shown in Table 3-1, *Project Statistics*, and Table 3-2, *Description of Site*, above, the proposed Project encompasses approximately 314 acres, and is located north of Houghton Road, east of State Route 99 (SR-99), west of South Union Avenue, and south of DiGiorgio Road, in Kern County (Figure 3-1, *Regional Vicinity*, and Figure 3-2, *Project Vicinity*). The proposed Project would allow for development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. A private package sewer treatment plant is proposed to provide sewer services for the Project site. Development of the proposed Project would require the following decisions by the Kern County Planning Commission and Board of Supervisors:

- approval of a General Plan Amendment (GPA) to amend the existing land use designation from R-IA (Resource – Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), GC (General Commercial), and HC (Highway Commercial);
- approval of a Zone Change (ZCC) to remove the existing A (Exclusive Agriculture) zoning classification and rezone the Project site to M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining);
- approval of a Conditional Use Permit for a Sewer Treatment Plant; and
- ~~approval of a Conditional Use Permit for a Water Treatment Plant; and~~
- approval of an agricultural preserve exclusion from Agricultural Preserve No. 13.



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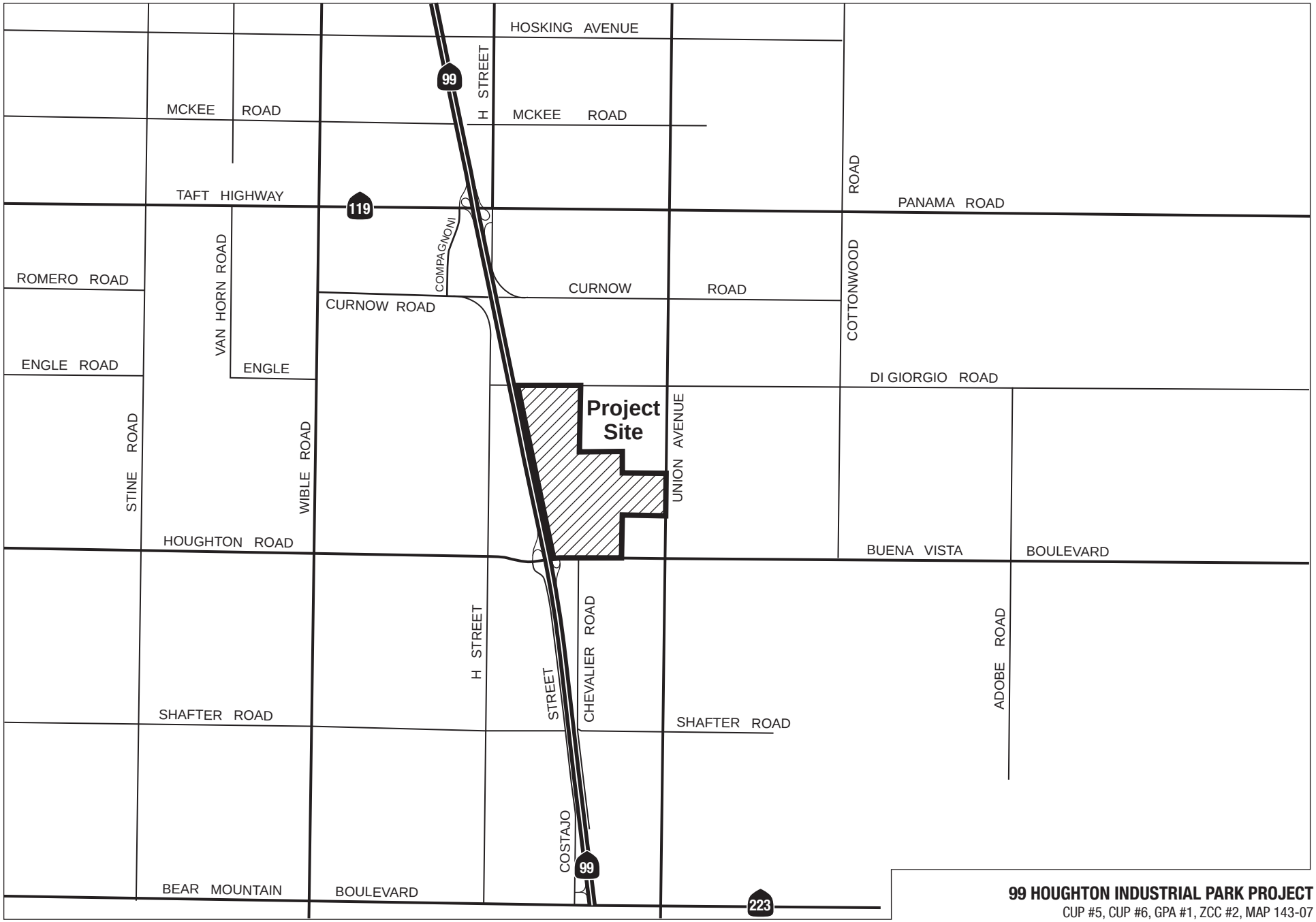
99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Regional Vicinity

Figure 3-1



99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Project Vicinity

Figure 3-2

3.2 Project Location and Setting

Project Location

The proposed Project is situated in the southern San Joaquin Valley in Kern County, California; refer to Figure 3-1, *Regional Vicinity*. It is located approximately 1.10 miles south of the Bakersfield City limits (approximately 8.6 miles south of downtown), within the administrative boundaries of the Metropolitan Bakersfield General Plan (MBGP) in Kern County. The proposed Project consists of approximately 314 acres, generally located north of Houghton Road, east of SR-99, west of South Union Avenue, and south of DiGiorgio Road. South Union Avenue (SR-204), Houghton Road, and the DiGiorgio Road alignment provide the primary access to and from the Project area. Refer to Figure 3-2, *Project Vicinity*.

The proposed Project is located within a portion of Section 7, Township 31 South (S), Range 28 East (E), Mount Diablo Base and Meridian (MDBM). The latitude and longitude of the approximate center of the site is 35°14'34.10" North (N) and 119°0'40.69" West (W). The Universal Transverse Mercator (UTM) coordinates for the approximate center are East 3901819.39 meters and South 316999.72 meters, in Zone 11.

Regional Setting

Kern County is California's third largest county in land area, encompassing approximately 8,202 square miles and has a total population of 916,464 as of January 1, 2019 (California Department of Finance, 2019). The County is bound by Kings, Tulare, and Inyo counties to the north; San Bernardino County to the east; Los Angeles and Ventura counties to the south; and Santa Barbara and San Luis Obispo counties to the west. The County's geography is diverse, containing mountainous areas, agricultural lands, and desert areas. These areas are generally divided into three regions: the Valley Region, the Mountain Region, and the Desert Region. The Project site is located within the Valley Region, which is characterized by relatively low rainfall, relatively high average summer temperatures, and generally mild winters.

The dominant land use within the County is agriculture, although over the last few decades, urban development has occurred in and around the County's 11 incorporated cities. Bakersfield is the County's largest City, with a population of approximately 386,839 persons as of January 1, 2018 (California Department of Finance 2018). The Project site is located approximately 1.10 miles south of the Bakersfield city limits (8.6 miles south of downtown Bakersfield), 5.2 miles west of Lamont, 10 miles northwest of Arvin, 12.3 miles north of Mettler, and 25.7 miles east of Taft.

Local Setting and Surrounding Land Uses

Current Land Use

The Project site consists of disced land and has been utilized for row-crop agriculture consisting of cotton, alfalfa, carrot corn, wheat, and grain; a steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue. The topography of the Project site is relatively flat, sloping slightly from the northwest to the southeast with elevations ranging from approximately 331 feet above mean sea level (msl) to 340 feet above msl.

The majority of the Project site is currently designated by the Metropolitan Bakersfield General Plan (MBGP) as R-IA (Resource-Intensive Agriculture), while the southwest corner of the Project site is designated HC (Highway Commercial). The proposed Project has a Kern County Zoning Ordinance classification of A (Exclusive Agriculture). The Project site is located within an area that is designated by the California Department of Conservation (DOC) as Prime Farmland, Farmland of Statewide Importance, Semi-Agricultural and Rural Commercial Land, and Vacant or Disturbed Land (DOC, 2014a). The Project site does not contain Farmland of Local Importance (DOC, 2014a). The approximately 257.57 acres of the Project site is located within the boundary of Agricultural Preserve No. 13, as is the standard practice in Kern County for any land that is zoned A (Exclusive Agriculture). The Project site is not subject to a Williamson Act land use contract.

Kern County is one of the richest oil-producing counties in the United States with approximately 66 active oil fields[1]. The State Division of Oil, Gas, and Geothermal Resources (DOGGR) most recent information on Kern County's oil production is the 2018 Oil, Gas, and Water Production and Well Count by County (DOGGR, 2018). In 2018, Kern County produced 113,141,827 billion barrels of oil. According to DOGGR, the proposed Project is not located within an oil or gas field. There is one plugged and abandoned oil well located within the proposed Project boundaries (Big McKittrick Oil Company "Sea Cliff-Houghton" 1). In addition, one active, diesel-powered irrigation well and one domestic well are located on-site.

Surrounding Land Uses

Adjacent land uses include vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard located south/southeast of Project site. Table 3-3, *Proposed Project Site and Surrounding Land Uses*, provides existing land uses and zoning classifications of the Project site and surrounding area.

Table 3-3. Proposed Project Site and Surrounding Land Uses

Direction from Project Site	Existing Land Use	*Existing Land Use Designation (Metropolitan Bakersfield General Plan)*	Existing Zone Classification (Kern County)
Project Site	Agriculture	R-IA (Resource-Intensive Agriculture) HC (Highway Commercial)	A (Exclusive Agriculture)
North	Agriculture; DiGiorgio Road	R-IA (Resource-Intensive Agriculture) LMR (Low Medium Density Residential, 4 to 10 units per acre) HMR (High Medium Density Residential, 7.26 to 17.42 units per acre) SR (Suburban, 4 units per acre) GC (General Commercial)	A-1 (Limited Agriculture) A (Exclusive Agriculture) E(1) RS MH (Estate 1 Acre, Residential Suburban Combining, Mobile Home Combining) E(2 ½) RS (Estate 2.5 Acres, Residential Suburban Combining) E(1/2) RS (Estate 0.5 Acres, Residential Suburban Combining)

[1] DOGGR GIS data. California Department of Conservation. (2019).

Table 3-3. Proposed Project Site and Surrounding Land Uses

Direction from Project Site	Existing Land Use	*Existing Land Use Designation (Metropolitan Bakersfield General Plan)*	Existing Zone Classification (Kern County)
			R-2 (Medium Density Residential, 16 units per acre)
East	Agriculture, Single-Family Residential, Commercial, SR-204	R-IA (Resource-Intensive Agriculture) RR (Rural Residential) SI (Service Industrial)	A (Exclusive Agriculture) A-1 (Limited Agriculture) E(10) RS (Estate 10 Acres, Residential Suburban Combining) M-2 PD (Medium Industrial, Precise Development Combining) CH (Highway Commercial)
West	SR-99; Agriculture, Fallow Land	PT (Public Transportation) R-IA (Resource-Intensive Agriculture)	A (Exclusive Agriculture) A-1 (Limited Agriculture) C-2 PD (General Commercial, Precise Development Combining)
South	Agriculture, Rural Residential, Automobile Wrecking Yard; Houghton Road	R-IA (Resource-Intensive Agriculture) RR (Rural Residential, 2½ acres per unit) HC (Highway Commercial)	A (Exclusive Agriculture) A-1 (Limited Agriculture) C-2 PD (General Commercial, Precise Development Combining)

3.3 Existing Planning and Zoning Regulations

The proposed Project is under the jurisdiction of the County and within the City of Bakersfield's Sphere of Influence. Land use and planning decisions are regulated by a variety of jurisdictional planning agencies and programs. Land use is governed by the jointly prepared, but separately adopted County/City Metropolitan Bakersfield General Plan and the Kern County Zoning Ordinance. Proposed Project development would also be regulated by the Metropolitan Bakersfield Habitat Conservation Plan. Applicable land use planning documents that regulate the proposed Project area are discussed below.

Metropolitan Bakersfield General Plan (MBGP)

The City and County have prepared and adopted the MBGP to provide cohesive land use planning for areas that lie both within the County's jurisdiction and the City's future service area. The MBGP is a separate but interrelated land use planning program within Kern County. It was updated by the County in 2007 and was updated by the City on January 20, 2016. The area covered by the MBGP coincides with the City of Bakersfield sphere of influence.

Kern County Zoning Ordinance

The Kern County Zoning Ordinance establishes the basic regulations under which land is developed. This includes allowable uses, building setback requirements, and development standards. Pursuant to state law, the Kern County Zoning Ordinance must be consistent with the Kern County General Plan and all Specific Plans. The basic intent of the Kern County Zoning

Ordinance is to promote and protect the public health, safety, and welfare via the orderly regulation of land uses throughout the unincorporated area of the county. This zoning code applies to all property in unincorporated Kern County, except land owned by the United States or any of its agencies.

The proposed Project is currently zoned A (Exclusive Agriculture). The purpose of the A zone is to designate areas suitable for agricultural uses and to prevent the encroachment of incompatible uses onto agricultural lands and the premature conversion of such lands to nonagricultural uses.

Metropolitan Bakersfield Habitat Conservation Plan

The goal of the MBHCP is to acquire, preserve, and enhance native habitats that support endangered and sensitive species, while allowing urban development to proceed as set forth in the MBGP. The study area covered by the MBHCP contains both City and County jurisdictions. The MBHCP is intended to meet the requirements of both state and federal endangered species acts. In addition, the MBHCP complies with state and federal environmental regulations set forth in the National Environmental Policy Act (NEPA) and CEQA. Upon payment of required mitigation fees and receipt of project approval, a developer/applicant would become a subpermittee and would be allowed the "incidental take" of covered species in accordance with state and federal endangered species laws. The proposed Project site is within the boundaries of the MBHCP.

3.4 Project Objectives

The Project proponent has defined the following objectives for the proposed Project:

- Facilitate quality development that is consistent with and implements the goals of the Kern County General Plan and Metropolitan Bakersfield General Plan.
- To develop the site consistent with the provisions of the Kern County Zoning Ordinance, Land Division Ordinance, and Development Standards.
- Assure adequate planning for all community facilities including circulation improvements, drainage facilities, water, and wastewater facilities.
- Ensure that the project, in and of itself, does not contribute to the conversion of adjacent agricultural areas.
- Cluster commercial retail uses that provide goods and services near an interchange with SR-99 to accommodate interstate freight and reduce traffic congestion and air emissions.
- Accommodate new development that channels land uses in a phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.
- Address community circulation, both vehicular and pedestrian, utilizing available capacity with the existing circulation system, and provide fair-share system improvements to deficient intersections or road segments.
- Facilitate a planned development and related in-line tenants consistent with the market objectives of the applicant and its tenants.

- Accommodate growth within the proposed project while balancing environmental considerations.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.
- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.
- Provide new industrial development that captures the economic demands generated by the marketplace.
- Provide new development that will assist the County of Kern in obtaining fiscal balance in the years and decades ahead.

3.5 Proposed Project

The proposed Project includes a General Plan Amendment (GPA) and concurrent Change of Zoning District (ZCC) to modify the existing MBGP land use designations, and the Kern County Zoning Ordinance classifications on the 314-acre Project site. In addition, the Project includes a petition to exclude the Project site from Agricultural Preserve No. 13. The GPA and ZCC would allow for development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. Table 3-4, *Existing and Proposed Land Use and Zoning,* below, provides the proposed GPA and ZCC summary for the proposed Project.

Table 3-4. Existing and Proposed Land Use and Zoning

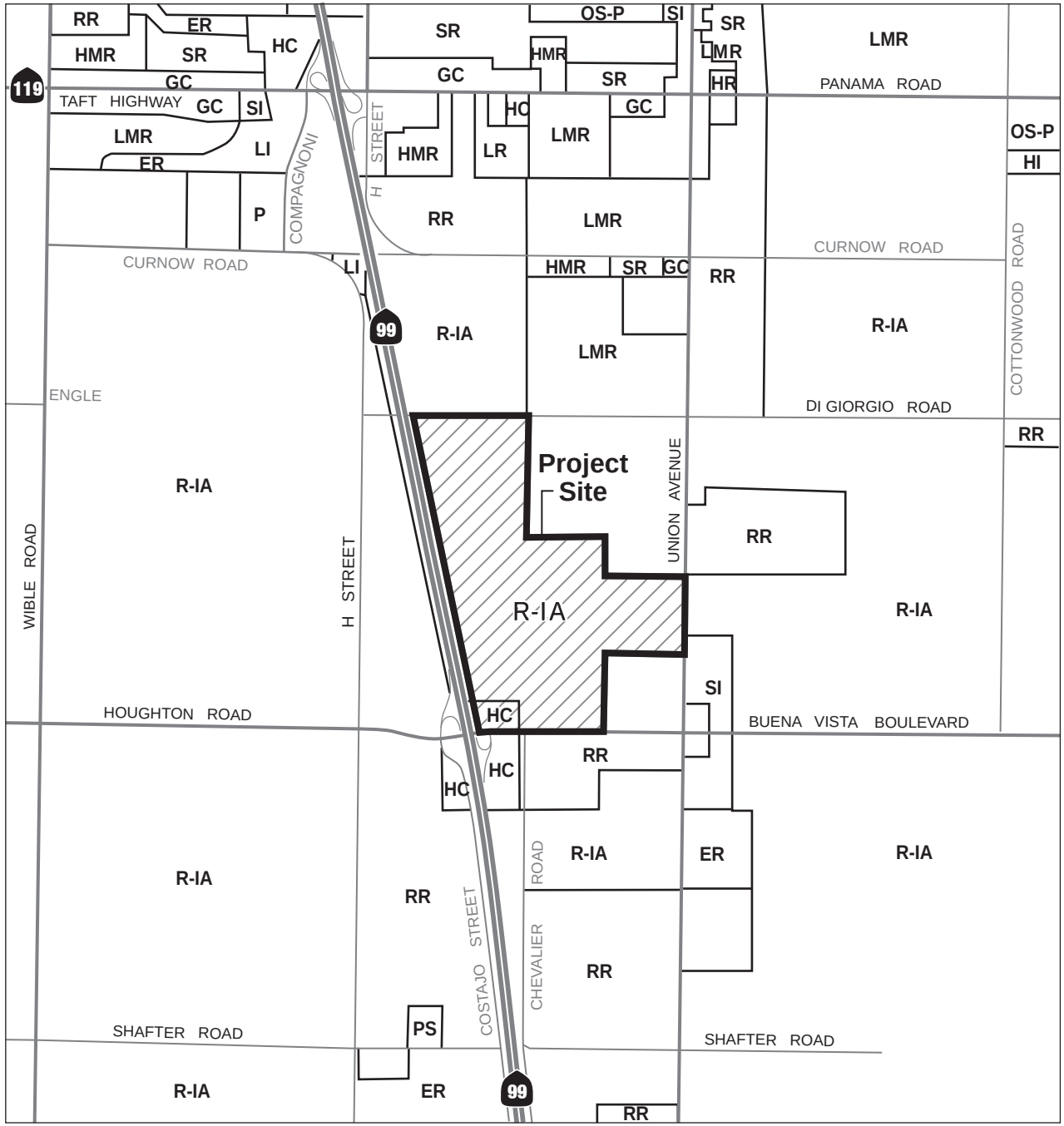
Existing MBGP Land Use Designations	Proposed MBGP Amendment (Land Use Designations)	Existing Zone Classification	Proposed Zone Change (Zone Classification)	Gross Acres
R-IA (Resource-Intensive Agriculture) HC (Highway Commercial)	GC (General Commercial)	A (Exclusive Agriculture)	C-2 PD (General Commercial, Precise Development Combining)	22
	LI (Light Industrial)		M-1 PD (Light Industrial, Precise Development Combining)	108
	SI (Service Industrial)		M-2 PD (Medium Industrial, Precise Development Combining)	159
	HC (Highway Commercial)		CH PD (Highway Commercial, Precise Development Combining)	25
			Total	**314***

Numbers have been rounded to the nearest whole number.
* Petition for Exclusion from Agricultural Preserve No. 13

Proposed General Plan Amendment

The Project proposes to amend the MBGP land use designations from R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial), to LI (Light Industrial), SI (Service Industrial), HC

(Highway Commercial), and GC (General Commercial) (refer to Figure 3-3, *Existing General Plan Land Use Designations* and Figure 3-4, *Proposed General Plan Land Use Designations*). Approximately 108 acres would be amended to LI, approximately 159 acres would be amended to SI, approximately 9.01 acres would be amended to HC (Highway Commercial), and approximately 22 acres would be amended to GC (General Commercial). The Project site contains 15.99 acres of HC (Highway Commercial) that would remain unchanged. The LI designation is characterized by unobtrusive industrial activities that can be located in close proximity to residential and commercial uses with a minimum of environmental conflicts. The SI designation is characterized by industrial activities which involve outdoor storage or use of heavy equipment (MBGP, 2007).



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Land Use Designations

R-IA	Resource - Intensive Agriculture
LMR	Low Medium Residential
HMR	High Medium Residential
RR	Rural Residential
ER	Estate Residential
SR	Suburban Residential
GC	General Commercial
HC	Highway Commercial
LI	Light Industrial
SI	Service Industrial
HI	Heavy Industrial
OS-P	Parks and Recreation Facilities
PS	Public and Private Schools
P	Publicly Owned Facilities

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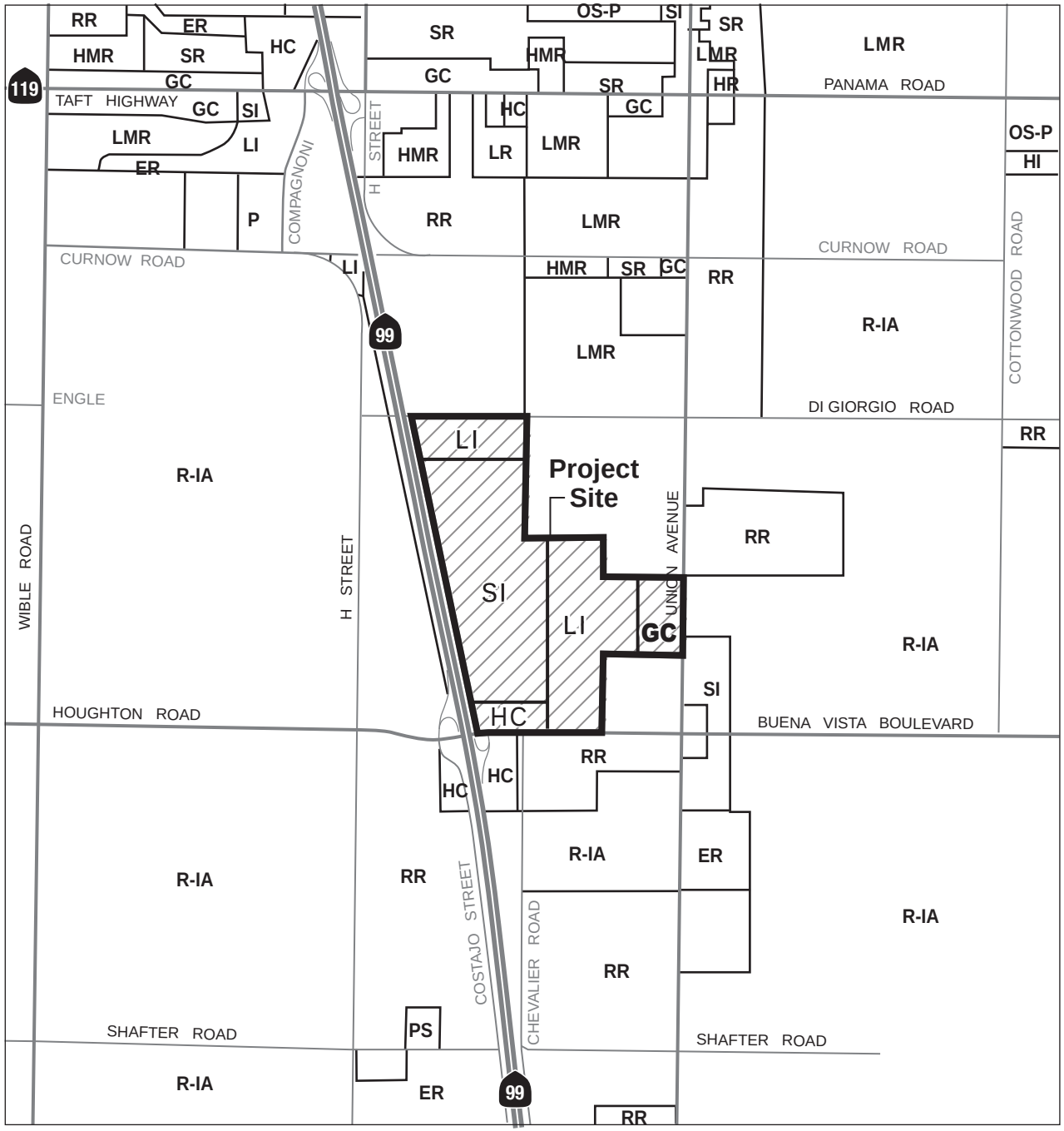
AGRICULTURAL PRESERVE #13 EXCLUSION

Existing General Plan Land Use Designations

Figure 3-3



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Land Use Designations

R-IA	Resource - Intensive Agriculture
LMR	Low Medium Residential
HMR	High Medium Residential
RR	Rural Residential
ER	Estate Residential
SR	Suburban Residential
GC	General Commercial
HC	Highway Commercial
LI	Light Industrial
SI	Service Industrial
HI	Heavy Industrial
OS-P	Parks and Recreation Facilities
PS	Public and Private Schools
P	Publicly Owned Facilities

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Proposed General Plan Land Use Designations

Figure 3-4

Proposed Zone Change

The Project proposes a Zone Change from A (Exclusive Agriculture) to M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining). Approximately 108 acres would be amended to M-1 PD, approximately 159 acres would be amended to M-2 PD, approximately 22 acres would be amended to C-2 PD, and approximately 25 acres would be amended to CH PD; refer to Figure 3-5, *Existing Zoning*, and Figure 3-6, *Proposed Zoning*, for a graphical representation of the proposed Project zone changes. As discussed in further detail below, all zones would be amended to contain the PD (Precise Development) Combining District overlay. The C-2 zoning classification is typically characterized by regional shopping centers and heavy commercial uses while CH zoning classification is typically characterized by gas stations, restaurants, and motels. The purpose of the M-1 zoning classification is to designate areas for wholesale commercial, storage, trucking, assembly-type manufacturing, and other similar industrial uses. The M-2 zoning designation is typically characterized by general manufacturing, processing, and assembly activities. The purpose of the PD Combining District is to designate areas with unique site characteristics or environmental conditions or areas surrounded by sensitive land uses to ensure that development in such areas is compatible with such constraints.

Precise Development Plans

Included with the proposed zone change to C-2, CH, M-1, and M-2 is the Precise Development (PD) Combining District. The purpose of the Precise Development (PD) Combining District is to designate areas with unique site characteristics or environmental conditions or areas surrounded by sensitive land uses to ensure that development in such areas is compatible with such constraints. All development in the PD Combining District shall be subject as a minimum to Special Development Standards as specified in Chapter 19.80 of the Kern County Zoning Ordinance; however, a Special Development Standard Plan Review shall not be required. The regulations established by the PD District shall be in addition to the regulations of the base district with which the PD District is combined.

Given the uncertainty regarding the specific use to be developed on site at this time, the PD Combining District is being included in the proposed zone change request. Implementation of the PD Combining District will ensure that as development of the site moves forward, the Kern County Planning and Natural Resources Department and the community at large will have the opportunity to publicly review site specific proposals to ensure compliance with the environmental impact report, the specific development standards and overall compatibility with the surrounding uses. Implementation of the site is expected to be processed under a Master Precise Development Plan.

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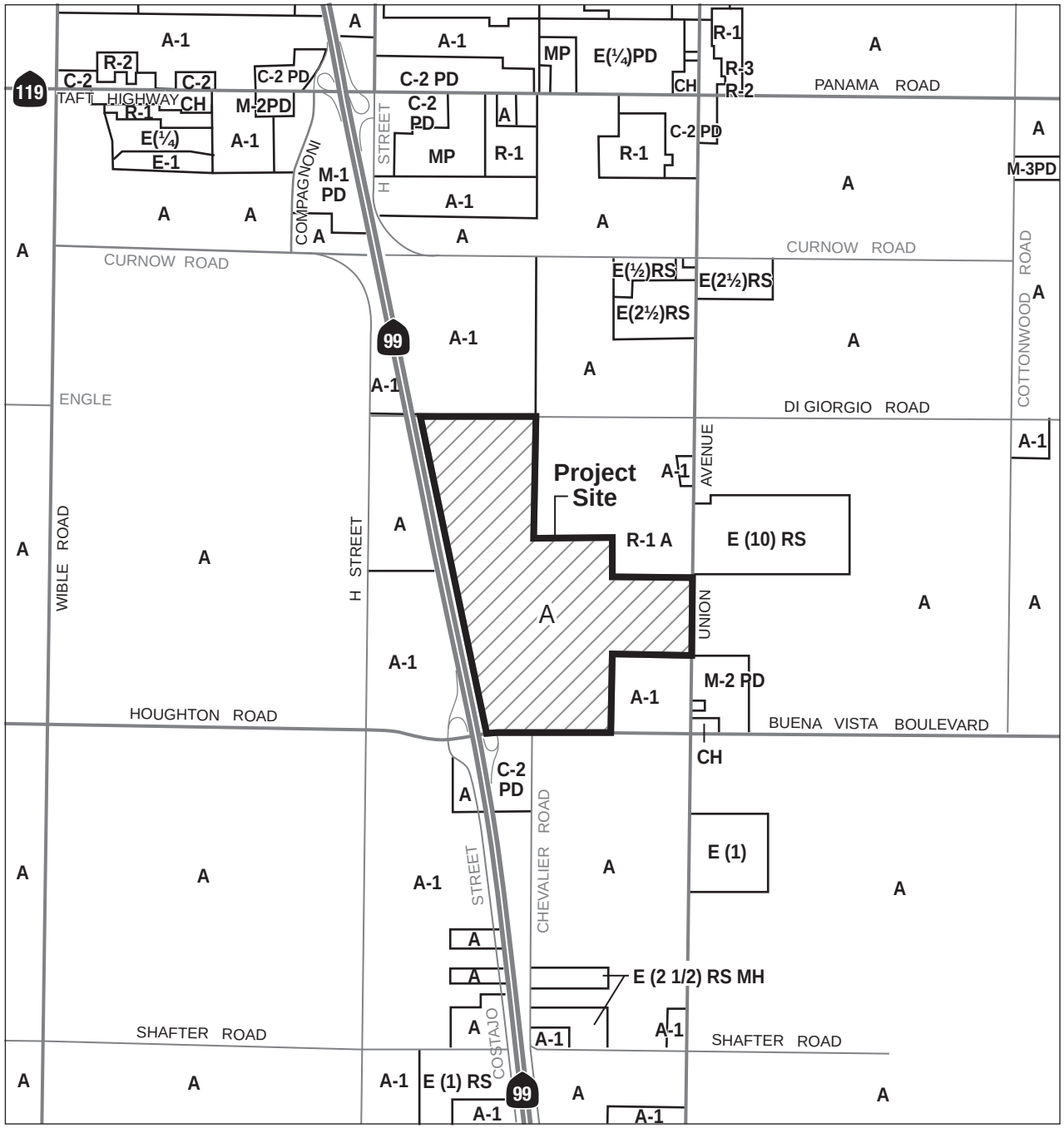

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Zoning Districts

A	Exclusive Agriculture
A-1	Limited Agriculture
C-2 PD	General Commercial, Precise Development Combining
C-2	General Commercial
CH	Highway Commercial
E (1/4)	Estate .25 Acres
E (1/2) RS	Estate .5 Acres, Residential Suburban Combining
E (1)	Estate 1 Acre
E (10) RS	Estate 10 Acres, Residential Suburban Combining
E (2 1/2) RS	Estate 2.5 Acre, Residential Suburban Combining
M-2 PD	Medium Industrial, Precise Development Combining
M-3 PD	Heavy Industrial, Precise Development Combining
MP	Mobile Home Park
R-1	Low Density Residential

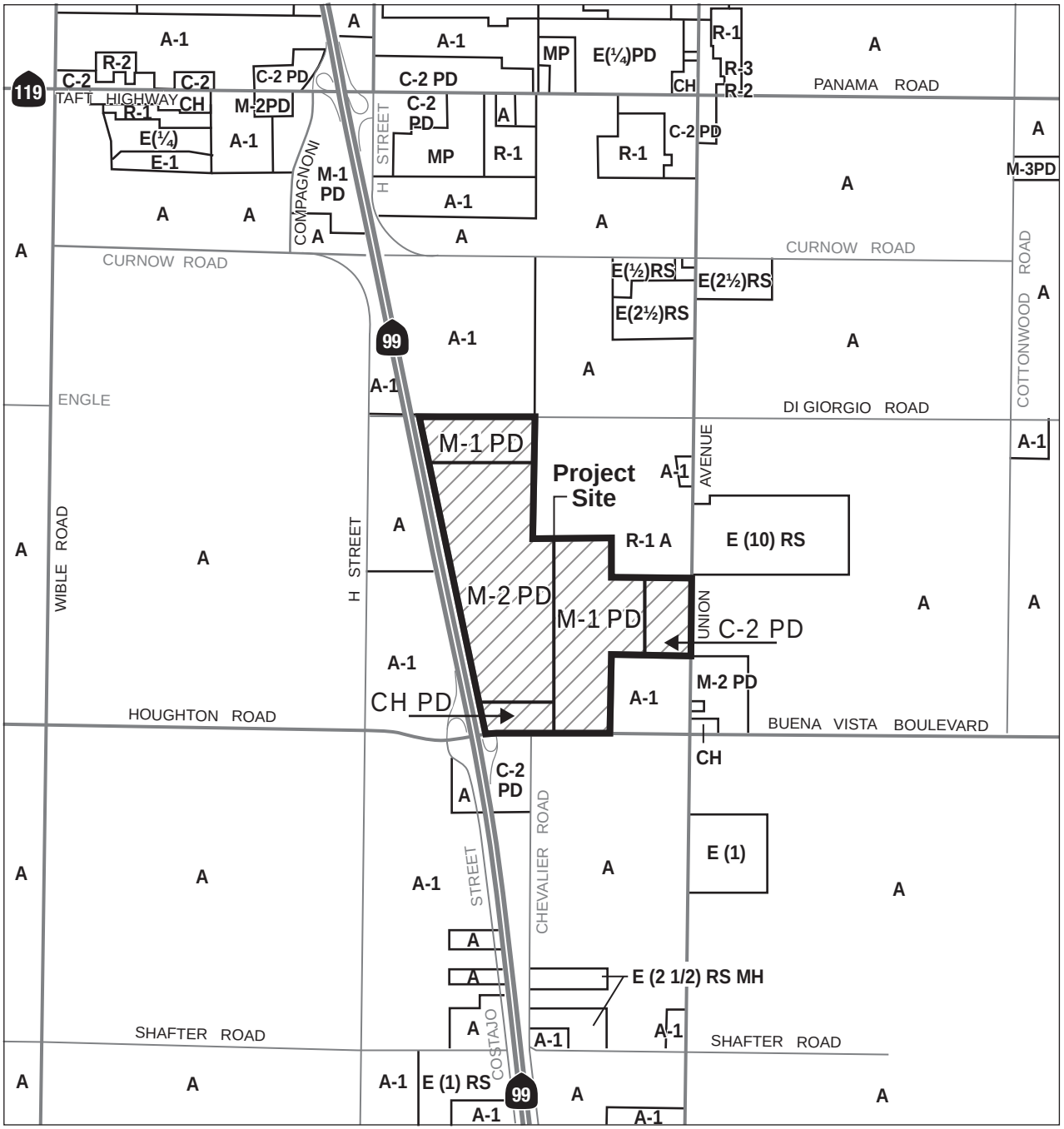
99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Existing Zoning

Figure 3-5



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Zoning Districts

A	Exclusive Agriculture
A-1	Limited Agriculture
C-2 PD	General Commercial, Precise Development Combining
C-2	General Commercial
C-2 PD	General Commercial Precise Development Combining
CH	Highway Commercial
CH PD	Highway Commercial Precise Development Combining
E (1/4)	Estate .25 Acres
E (1/2) RS	Estate .5 Acres, Residential Suburban Combining
E (1)	Estate 1 Acre
E (10) RS	Estate 10 Acres, Residential Suburban Combining
E (2 1/2) RS	Estate 2.5 Acre, Residential Suburban Combining
M-1	Light Industrial
M-1 PD	Light Industrial, Precise Development Combining
M-2	Medium Industrial
M-2 PD	Medium Industrial, Precise Development Combining
M-3 PD	Heavy Industrial, Precise Development Combining
MP	Mobile Home Park
R-1	Low Density Residential

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Proposed Zoning

Figure 3-6

Agricultural Preserve – Exclusion

An agricultural preserve defines the boundary of an area within the County that meets the criteria for property owners to enter into Williamson Act Land Use Contracts and Farmland Security Zone Contracts. Only land within an agricultural preserve is eligible for such contracts. The Kern County Board of Supervisor policy has established the criteria for inclusion into a preserve as land having a General Plan resource designation (RI–A), and having a zoning designation of A (Exclusive Agriculture). If approved, the requested MBGP designations of LI and SI would require the exclusion of approximately 257.57 acres from Agricultural Preserve No. 13 (refer to Figure 3-7, *Agricultural Preserve No. 13 Map*).

Parcel Map Processing

A Parcel Map shows the subdivision of land into parcels for sale and is recorded in the County Recorder's Office. Parcel Maps typically contain fewer "Lots" than Tract Maps and requirements for improvements (to the property) are less extensive than for Tract Maps. Industrial projects are done by Parcel Map if they plan to sell off the parcels. If one large complex is being developed, and parcels will not be sold, then a Parcel Map is not required. It is expected that the proposed Project will require Parcel Map processing; however, the certainty is unknown at this time.

Project Phasing

Implementation of the proposed Project is planned to be developed in phases over a twenty-five-year period. The layout for the individual phases is unknown at this time. The construction details regarding a construction start date is unknown at this time.

Water Supply

Water would be provided to the project site by the California Water Services Company (Cal Water), which provides service through of 24 Districts within California. The proposed project is not located within an existing service area but is approximately 0.5 mile south of the Bakersfield District (District). To serve the proposed project, Cal Water would require approval from the California Public Utility Commission (CPUC) to expand its service area to include the proposed project. Cal Water will submit an application to the CPUC and anticipates receiving approval to expand its serving to the proposed site in mid to late 2019. A water service line would be extended from an existing 12" Cal Water main located on the east side of Wible Road at the intersection with Engle Road (CR 918), then east along an alignment along the section line, currently a disturbed unimproved dirt dairy access road within the County's road reservation, to the intersection of S. H St. and DiGiorgio Road (CR 704), then continue east and across S.R. 99 to the northwest corner of the proposed project site along DiGiorgio Road. If needed by Cal Water, a second water main extension would begin at the current end of the 12" water main located on the south side of Shafter Road at the east side of the General Shafter Elementary School, continue east along Shafter Road in an existing right-of-way to the intersection with Costajo Road, then continue east and across SR-99 to the intersection with Chevalier Road in existing right-of-way, then continue north in existing right-of-way to the south side of the proposed project north of Houghton Road. A treated water service line would be constructed from the southwest corner of the proposed WWTP westerly under SR-99, continuing to the Kern Island Canal and the Kern Island Recharge Basins located near the northwest corner of S. H St & Houghton Road as an outfall location for excess treated recycled water. An agreement with Kern Delta District will be required.

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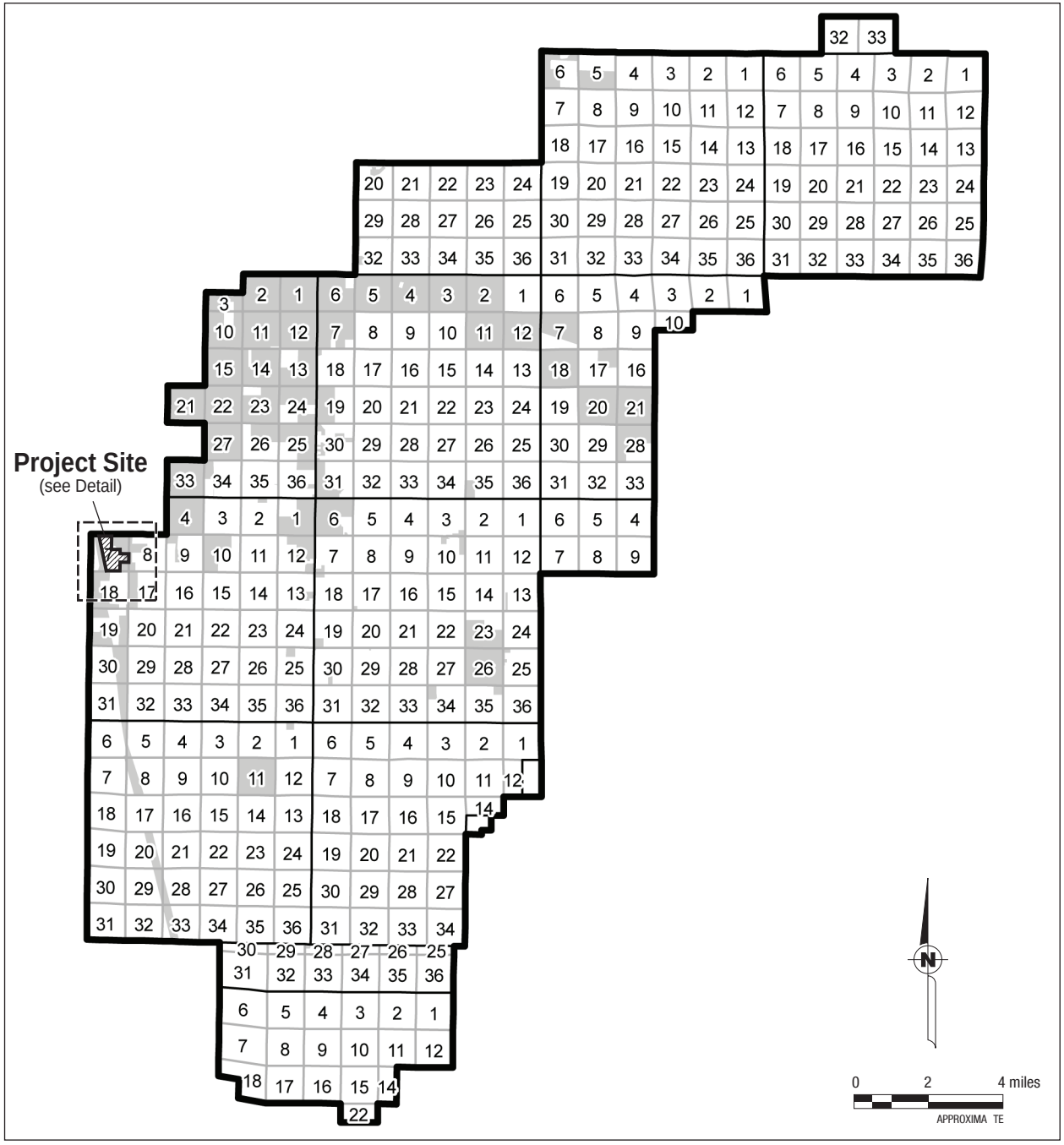

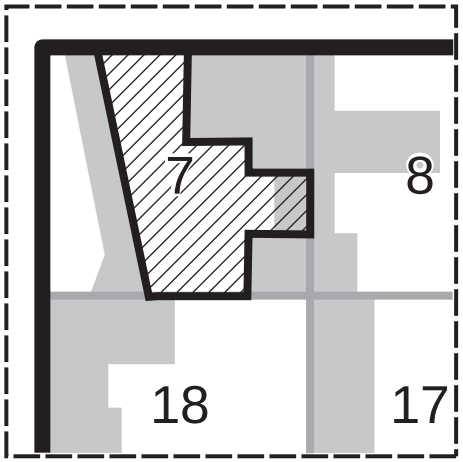

Project Site Detail

LEGEND

- 99 Houghton Project Site
- Agricultural Preserve 13
- Townships
- PLSS Sections
- Portion Excluded From Agricultural Preserve

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Agricultural Preserve No. 13 Map

Figure 3-7

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3.6 Entitlements Required

The Kern County Planning and Natural Resources Department, as lead agency for the proposed Project, has discretionary authority over the primary project proposal. Construction and operation of the proposed Project may require certain discretionary actions and approvals including, but not limited to, the following:

Kern County

- Consideration and certification of a final Environmental Impact Report (FEIR) with appropriate State CEQA Guidelines Sections 15091 Findings, 15093 Statement of Overriding Considerations, the mitigation measures monitoring reporting program by the Kern County Planning Commission and Kern County Board of Supervisors
- Approval by the Kern County Board of Supervisors for a general plan amendment for the proposed Project site, to amend the existing land use designation from R-IA (Resource – Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), HC (Highway Commercial), and GC (General Commercial)
- Approval by the Kern County Board of Supervisors for a zone change (ZCC) for the Project site, to remove the existing A (Exclusive Agriculture) zoning classification and rezone the Project site M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining)
- Approval by the Kern County Board of Supervisors for a conditional use permit (CUP) for a Sewer Treatment Plant;
- Exclusion of the Project site from Agricultural Preserve No. 13
- ~~Approval by the Kern County Board of Supervisors and processing of a parcel map(s)~~
- ~~Kern County Public Works Department – construction, grading, and building permits~~
- ~~Kern County Environmental Health Services Division – Water well permits, if applicable~~
- ~~Kern County Fire Department – Fire Safety Plan~~
- ~~Kern County Permit for Occupancy~~

Other Responsible Agencies

- California Department of Fish and Wildlife
- Agreements/Permits/Authorizations pursuant to the California and federal Endangered Species Acts, if necessary

- Approval by California Department of Transportation (Caltrans) for encroachment permit(s) for road access to the project site under Caltrans jurisdiction
- Regional Water Quality Control Board (RWQCB) permits
- State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) Permit
- General Construction Stormwater Permit (Preparation of a SWPPP)
- Approvals from the California Public Utilities Commission for any project elements to be constructed by regulated public utilities
- San Joaquin Valley Air Pollution Control District (SJVAPCD) – Fugitive Dust Control Plan, Authority to Construct, Permit to Operate, any other permits as necessary
- Other additional permits or approvals from responsible agencies may be required for the proposed Project

Upon completion of the environmental review process and prior to construction, the proposed Project would be reviewed through standard County plan check procedures, to verify that the Project conforms to all applicable County design criteria.

3.7 Cumulative Projects

CEQA requires that an EIR evaluate a project's cumulative impacts. Cumulative impacts are the project's impacts combined with the impacts of other related past, present and reasonably foreseeable future projects. As set forth in the CEQA Guidelines, the discussion of cumulative impacts must reflect the severity of the impacts, as well as the likelihood of their occurrence; however, the discussion need not be as detailed as the discussion of environmental impacts attributable to the project alone. As stated in CEQA, Public Resources Code, Section 21083(b) (2), "a project may have a significant effect on the environment if the possible effects of a project are individually limited but cumulatively considerable."

According to the CEQA Guidelines:

Cumulative impacts refer to two or more individual effects, which, when considered together, are considerable and which compound or increase other environmental impacts.

(a) The individual effects may be changes resulting from a single project or a number of separate projects.

(b) The cumulative impact from several projects is the change in the environment, which results from the incremental impact of the project when added to other closely related past, present, and reasonable foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time (California Code of Regulations [CCR], Title 14, Division 6, Chapter 3, §15355).

In addition, as stated in the CEQA Guidelines, it should be noted that:

The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable (CCR, Title 14, Division 6, Chapter 3, Section 15064[I][5]).

Each environmental topic has a different way of evaluating cumulative effects. Cumulative impact discussions for each environmental topic area are provided at the end of each technical analysis contained within Chapter 4, under "*Impacts and Mitigation Measures*." The San Joaquin Valley Air Pollution Control District (SJVAPCD) requires use of a 1-mile radius to identify hazardous air pollutant emissions as well as most odor sources. The SJVAPCD also recommends a one-mile limit for hazardous air pollutants because such emissions primarily affect individuals that reside or work within the immediate vicinity (1 mile) of the emissions source. The Kern County Planning and Natural Resources Department's Guidelines for Preparing an Air Quality Assessment for Use in Environmental Impact Reports requires a six-mile radius to assess cumulative impacts because housing growth, especially in rural areas, tends to affect a larger geographical area than developments located in urban areas.

As set forth in the CEQA Guidelines, related projects consist of "closely related past, present, and reasonable foreseeable probable future projects that would likely result in similar impacts and are located in the same geographic area" (CCR, Title 14, Division 6, Chapter 3, Section 15355). City and County files were reviewed to determine the number of permitted or planned projects within the 1 to 6-mile radius. The cumulative analysis in Chapter 4 of this Recirculated Draft EIR is based on a quantitative cumulative analysis of the projects located within this 6-mile radius of the proposed Project, as well as growth projections to the year 2030. Different resource-specific analyses use this 6-mile radius unless specific methodology deems other supplemental approaches are appropriate. Projects that are planned but have not been submitted for review or approved by the City or County are not included in this analysis because there is no way to know or ascertain what they might consist of, be approved, or be completed.

EIRs that have been prepared for various areas surrounding Bakersfield by the City and County have been incorporated into the Bakersfield General Plan EIR and the MBGP Update EIR (June 2002). The Bakersfield General Plan EIR states that between 1987 and 2010, an expected 112,620 dwelling units will be built. The MBGP Update EIR expects an additional 39,500 residential units from 2010 to 2020. Both of these EIRs considered the impacts from the development of additional residential construction within the proposed Project area.

The MBGP is the primary guide for land development in the proposed Project vicinity. The Land Use Element provides for a growth in commercial and industrial development similar to the existing rate and anticipates the growth rate will parallel the growth rate in residences to the unincorporated areas of the County. The proposed Project can and should be considered part of this projected growth.

Table 3-5, *Cumulative Projects List for Kern County,* lists pending projects within a six-mile radius of the Project site pertaining to Kern County projects. Table 3-6, *Cumulative Projects List for the City of Bakersfield,* lists pending projects within a six-mile radius of the Project site pertaining to City of Bakersfield Projects. These projects were considered when analyzing cumulative conditions and impacts

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Table 3-5. Cumulative Projects List for Kern County

Zone Map	Project	Location or APN	Acres	Description
142	Cruz, Gabriel/B Anderson	Western Section of South "H" Street, North of Bear Mountain Boulevard	N/A	AR Trucking, Products and Services; CUP
143	Recology Blossom Valley Organics/ Nicole Proiette	1261 North Wheeler Ridge Road	N/A	Modification of CUP 27, Map 143 (Community Recycling)
143	Douglas Kaiser	13627 Chevalier Road (APN 185-381-31)	15.25	Ag Truck Facility, CUP
142	Beard Family Trust	184-310-23	38.16	CUP for concrete batch plant per Section 19.12-030G of County Zoning Ordinance
143	Fresno MSA Limited Partnership dba Verizon Wireless	14911 Adobe Road (APN 185-310-03)	N/A	CUP to allow a 150-foot tall monopole wireless communication facility with associated equipment shelter
143	Dominguez/Cuevas by Afinar Civil Engineers	Northeast corner of Di Giorgio Road and South Union Avenue (APN 185-050-03)	17.89	GPA from RR to GC; ZCC from A to C-2
143	Delgado By Jaime Sandoval	Western Section of Union Avenue, 5/8 mile south of Bear Mountain Boulevard	N/A	GPA from 8.1 to 5.7/2.3; ZCC to E(5)
143	Jose Ramos By Jaime Sandoval	West of South Union Avenue, ½ mile south of Bear Mountain Blvd.	21.18	GPA from 8.1 to 5.7/2.3, ZCC to E (5)
142	Jon Moule	Northeast Corner of Progress Road and Shafter Road	20	GPA from R-IA to RR, ZCC from A to E (2½)
143	Bakersfield Land Company LLC by Delmarter	Costajo Road and Bear Mountain Blvd.	20	GPA RR to HC; ZCC from A-1 to CH
143	Nolan Campbell	13308 South Union Avenue	N/A	Metropolitan Bakersfield GPA from ER to Mineral and Petroleum; ZCC from E(1) to NR
142	DFI Commercial & Residential Project by CE	Weedpatch Highway between Mountain View Road and McKee	73	GPA to Commercial and Residential; ZCC to Commercial and Residential
143	Loma Vista Real Estate / D&D	3130 Di Giorgio Road	9.92	ZCC to E (2½) RS
142	Gill, Punit K by GW Wilson	Northeast Corner of Gosford and Chaidez	9.218	ZCC change to E (2½) RS
143	NSR Investors	South Side of Suckow, West of Flint	61.32	ZCC to 4-1 MP, M-1

Table 3-5. Cumulative Projects List for Kern County

Zone Map	Project	Location or APN	Acres	Description
143	Guadalupe Jimenez	17221 South Union Avenue	3.30	ZCC to M-1 or M-2
142	Juarez, Ethel	10604 South "H" Street	4.00	ZCC to C-2
143	Miguel de Leon	14103 South Union Avenue	9.64	ZCC from A to M-1 PD
143	K&P Stenderup Family Trust	Southwest corner of Bear Mountain Boulevard and Weedpatch Highway	20	ZCC from Agriculture to Commercial
143	Arnold S. Kirschenmann	Northwest corner of Bear Mountain Boulevard and Weedpatch Highway	20	ZCC for future development of Travel Plaza
123	Lopez, Pablo / Frank Slinkard	3018 Wood Lane	N/A	ZCC to R-1; CUP
160	Rudnick Feedlot / Philip and Daniel Rudnick	Old River Road 2 miles south of I-5 (APN 295-110-31)	320.00	CUP, Feedlot
161	Silver Oak / David & Douglas Kaiser	Northeast Corner of Teale Road and Adobe Road	632	CUP, Dairy
161	Rosa Dairy / Agricultural Man Systems	South of Herring, West of Wheeler Ridge Road	640	CUP, Dairy
161	Bloomfield / Tillema, Rich / John Schaap	Bear Mountain Road and Cottonwood Road	1,274	CUP, Dairy
124	Mayberry, Danny	3125 South Fairfaxs	N/A	CUP
124	Del Toro, Joe	5516 Weedpatch Highway (APN 174-011-05)	5.00	CUP, Ag Trucking Facility
124	Ana Maria Garay	6214 Kimber Avenue	2.50	CUP, firewood sales
124	Douglas Escalante	7401 Reynolds Street	1	CUP
124	Michael E. Ford	7837 East White Lane	4.51	CUP, outdoor event venue Section 19.08.085
160	California Bioenergy LLC	20400 Old River Road	300.57	CUP, co-digestion facility
124	Raul Perez	Southeast corner of Pacheco Road and Cottonwood	39.49	CUP, park (soccer fields)
124	Verizon Wireless	5941 Panama Lane	2.44	CUP to allow a wireless communication facility

Table 3-5. Cumulative Projects List for Kern County

Zone Map	Project	Location or APN	Acres	Description
123	THV Enterprises, Inc. Attn: Chris Ghasabyan	1015 Castro Lane	N/A	CUP to convert church to community care facility
124	Broadband Integrators Attn: Robert Gonzales	6217 Brundage Lane	N/A	CUP
124	Alfonso G. Moreno	1213 Feliz Drive	N/A	CUP
123	Salvador Cruz	Northwest corner of Taft Highway and Cerro Drive	0.12	GPA from GC to SI; ZCC from C-2 to M-2 PD
123	Munn and Fong Chau	Northwest corner of Michele Street and Taft Highway	6.78	GPA from SR to GC; ZCC from E(1) to C-2 PD
124	Firas Mufli	1300 Union Avenue	1.25	GPA, ZCC to C-2
124	Cornerstone Engineering / Louis Rodriguez	Southwest corner of Mountain View Road and Weedpatch Highway	73.17	GPA from E(R) to GC and HMR; ZCC from A to C-2 and R-3
124	Joshua Huff	113 Pepper Drive	2.11	GPA from 5.4 to 7.1; SPA
124	Valdez, Maria/San Joaquin Eng'g	170 and 180 Berkshire Lane	N/A	ZCC to C-2
124	Solis, Luis Manuel	6221 East Brundange Lane	2.70	ZCC to M-1 PD
123	Keith Spurlock	21 Stine Road	0.15	ZCC to small office
124	Ghaleb Haddad	1227 Ming Avenue	0.24	ZCC from R-1 to C-2
124	Ruben Escalera	328 Trinity Avenue	0.14	ZCC from R-1 to R-2
124	Carlos Amezcua	8005 Blackburn Street	2.52	ZCC from A-1 MH to E(1) RS MH and M-1 PD
124	Felipe Laines by LAV Consulting	1955 East Panama Lane	10.65	ZCC, parking/storage for trucks
124	Shakib Dashtipour	South Fairfax Road and East Panama Lane	N/A	ZCC E(2 ½) RS MH PE FPS to C-2 PD

Table 3-6. Cumulative Projects List for the City of Bakersfield

Project Number	Project	Location or APN	Acres	Description
Environmental Impact Reports				
07-2211	Crossroads EIR	South of Harris Road, north of Panama Lane, and west of Gosford Road	69.85	Tentative Tract Map / Site Plan Review
Zone Changes				
ZC 16-0365	N/A	N/A		ZCC from A to M-1
Annexations				
654	Michelle No. 1	N/A	6.83	Annexation
658	Taft Highway No. 2	N/A	15.24	Annexation
669	Panama No. 22	N/A	0.90	Annexation
667	Old River Road Detachment	Detachment "B"	1.48	Annexation
675	White No. 11	N/A	0.45	Annexation

File Number	Developer/Subdivider	Engineer	Acres	Tract Number
Tentative Tract Map				
T6503R	BAK BULLFROG LLC	R THOMPSON CONSULTING	N/A	6503
T6505	GLOBAL INVESTMENT & DEVELOPMENT, LL	HENDRICKS ENGINEERING		6505
T6514	GLOBAL INVESTMENT & DEVELOPMENT, LL	HENDRICKS ENGINEERING		6514
T6519	JAMES T MURPHY	PINNACLE ENGINEERING		6519
T6521	BVGG LLC.	PINNACLE ENGINEERING		6521
T6522R	RYER ISLAND LAND CO.	PINNACLE ENGINEERING		6522
T6531	LENNAR HOMES	SMITHTECH USA INC		6531
T6551	MARGUERITE GARRONE BENTZ	JOHN R WILSON		6551
T6585	GLOBAL INVESTMENT & DEV, LLC	HENDRICKS ENGINEERING		6585

File Number	Developer/Subdivider	Engineer	Acres	Tract Number
T6615	ENNIS LAND DEVELOPEMENT, LLC	QUAD KNOPF		6615
T6739	PB1-VENTURES, LLC	SMITHTECH USA INC		6739
T6741	SANTA BARBARA CAPITAL	McINTOSH & ASSOC		6741
T6744	SANTA BARBARA CAPITAL	McINTOSH & ASSOC		6744
T6745	SANTA BARBARA CAPITAL	McINTOSH & ASSOC		6745
T6747	SANTA BARBARA CAPITAL	McINTOSH & ASSOCIATES		6747
T6748	SANTA BARBARA CAPITAL	McINTOSH & ASSOC		6748
T6749	SANTA BARBARA CAPITAL	McINTOSH & ASSOCIATES		6749
T6750	SANTA BARBARA CAPITAL	McINTOSH & ASSOCIATES		6750
T6788	NIRMAL S GILL	SAN JOAQUIN ENGINEERING, INC		6788
T6792	PB3, PB6, PB7- VENTURES LLC	SMITHTECH USA		6792
T6802	FLOYD HINESLEY	PORTER-ROBERTSON		6802
T6807	DELRAY DEVELOPMENT	STANTEC CONSULTING INCV		6807
T6811	LYNX REALTY & MANAGEMENT	DEWALT CORPORATION		6811
T6849	TREND CAPITAL	MC INTOSH & ASSOCIATES		6849
T6859	ADAVCO, INC.	SMITHTECH USA INC		6859
T6860	ADAVCO, INC.	SMITHTECH USA INC		6860
T6865	EAST PANAMA LLC	DELMARTER & DEIFEL		6865
T6868	JM DEVELOPMENT INC.	MC INTOSH & ASSOCIATES		6868
T6871	COTTONWOOD VILLAS, LLC	HENDRICKS ENGINEERING		6871
T6873	PB 5 VENTURES LLC	SMITHTECH-USA		6873
T6874	PB 5 VENTURES LLC	SMITHTECH USA INC.		6874
T6875	PB5 VENTURES LLC	SMITHTECH USA		6875
T6880	LENNOX HOMES	SMITHTECH USA		6880
T6917	SITARAM HAPPY HOMES, LLC	PINNACLE ENGINEERING		6917

File Number	Developer/Subdivider	Engineer	Acres	Tract Number
T6919	KERN DELTA LAND DEVELOPMENT	CORNERSTONE ENGINEERING, INC.		6919
T6945	GGB PROPERTIES LLC	TERRA SURVEYING CONSULTANTS		6945
T7043	PB1-VENTURES, LLC	SMITHTECH USA, INC		7043
T7044	PB1-VENTURES, LLC	SMITHTECH USA, INC		7044
T7045	PB1-VENTURES, LLC	SMITHTECH USA, INC		7045
T7113	WINCHESTER WOOLLARD	PINNACLE ENGINEERING		7113
T7140	OLD RIVER LAND CO LLC	SUMMIT ENGINEERING		7140
T7190	PB3 VENTURES LLC	SMITHTECH USA		7190
T7191	PB3 VENTURES LLC	SMITHTECH USA		7191
T7192	PB3 VENTURES LLC	SMITHTECH USA		7192
T7193	PB7 VENTURES LLC	SMITHTECH USA		7193
T7194	PB7 VENTURES LLC	SMITHTECH USA		7194
T7195	PB6 VENTURES LLC	SMITHTECH USA		7195
T7196	PB6 VENTURES LLC	SMITHTECH USA		7196
T7213	OLD RIVER LAND CO	SUMMIT ENGINEERING		7213
T6181	GLOBAL INVESTMENT & DEVELOPMENT CO.	HENDRICKS ENGINEERING		6181
T6283R	S.W.M. DEVELOP. TRACT 6283	DELMARTER AND DEIFEL		6283
T6369	FLOYD HINSLEY	PORTER-ROBERTSON ENGINEERING		6369
T6410	HERSHEL & CLARISSA MOORE	DELMARTER AND DEIFEL		6410
T6442	ADAVCO, INC.	SMITHTECH USA, INC.		6442
T6616-2R	110 McCUTCHEN LLC	THE LUSICH COMPANY INC		6616
T7136	TRIMARK PACIFIC HOMES	THE LUSICH CO		7136
T7165	OLD RIVER LAND CO	SUMMIT ENGINEERING		7165
T7226	BERKSHIRE BAKERSFIELD LLC	DELMARTER & DEIFFEL		7226
T6520	LENOX HOMES	DELMARTER & DEIFFEL		6520

File Number	Developer/Subdivider	Engineer	Acres	Tract Number
T6712	ADAVACO, INC.	SMITHTECH USA INC.		6712
T7253	CLEAR CREEK HOMES	PORTER & ASSOC		7253
T7261	PANAMA LANE PROPERTIES, LLC	MC INTOSH & ASSOCIATES		7261
T6746	SANTA BARBARA CAPITAL	McINTOSH & ASSOCITATE		6746
T6969	CENTEX HOMES	McINTOSH & ASSOCIATES		6969
T6759	CENTEX HOMES	MC INTOSH & ASSOCIATES		6759
T6743	SANTA BARBARA CAPITAL	McINTOSH & ASSOCIATES		6743
T6825	CENTEX HOMES	MC INTOSH & ASSOCIATES		6825
T6536	LENNAR HOMES OF CALIFORNIA	SMITHTECH USA INC		6536
T6760	CENTEX HOMES	McINTOSH & ASSOC		6760
T6742	SANTA BARBARA CAPITAL	McINTOSH & ASSOCIATES		6742
T6397	ADAVCO INC	SMITHTECH USA		6397
T6607	MICHEL GARONE	PORTER-ROBERTSON ENGINEERING		6607
T6755	GLOBAL INVESTMENT & DEVP LLC	HENDRICKS ENGINEERING		6755
T7263	PANAMA LANE PROPERTIES, LLC	McINTOSH & ASSOC		7263
T6663	THE JOHN M ANTONGIOVANNI TRUST	PACIFIC ENGINEERING ASSOCIATES, INC		6663
T7301	AKERS LLC	PASQUINI ENGINEERING INC		7301
T7262	PANAMA LANE PARTNERS, LLC	McINTOSH & ASSOCIATES		7262
T6899	M. S. WALKER & ASSOCIATES, INC.	CRC ENTERPRISES		6899
T7029	EAST PANAMA LLC	DELMARTER & DEIFEL		7029
T7267	RIVER RANCH COMMUNITY, LLC	DPSI		7267

File Number	Developer/Subdivider	Engineer	Acres	Tract Number
T7304	OLD RIVER ROAD, LLC	DPSI		7304

Tentative Parcel Map

Project Number	Subdivider	Engineer	File Number	Map Type
12023	BEECH A/C PROPERTIES, LLC	JASON VAN CUREN, PLS	P12023	STANDARD
12086	WIBLE INVESTORS II, LLC	SMITHTECH USA	P12086	STANDARD
12123	GTIS GID HOLDINGS, LLC	SMITHTECH USA INC.	P12123	STANDARD
12122	GTIS GID HOLDINGS, LLC	SMITHTECH USA INC.	P12122	STANDARD
12167	STEVE ANTONGIOVANNI ET. AL.	McINTOSH & ASSOCIATES	P12167	STANDARD
12169	ROLL REAL ESTATE DEVELOPMENT LLC	DPSI	P12169	CONDOMINIUM
12173	M&R INVESTMENT GROUP, LLC	McINTOSH & ASSOC	P12173	STANDARD
11864	SUKHVINDER SINGH GHUMAN	HIGHER GROUND	P11864R	STANDARD
11118	CASTLE & COOKE CALIFORNIA, INC	MC INTOSH & ASSOCIATES	P11118R	STANDARD
11554	WILLIAM LEE	DEE JASPAR & ASSOCIATES	P11554	STANDARD
11592	LEONARDO LOPEZ	HENDRICKS ENGINEERING	P11592	STANDARD
11614	JESUS & ADRIANA CONTRERAS	WILEY D HUGHES SURVEYING	P11614	STANDARD
11718	BAKERSFIELD GROVE LTD, LLC	M.S. WALKER & ASSOC INC	P11718	STANDARD
11773	GREGORY D BYNUM ASSOC	McINTOSH & ASSOC	P11773	STANDARD
11783	METRO NOVA DEVELOPMENT	DEWALT CORP	P11783	STANDARD
11809	OLD RIVER LAND CO LLC	SUMMIT ENGINEERING	P11809	STANDARD

11874	PANAMA & GOSFORD RETAIL LLC	HIGHER GROUND	P11874	STANDARD
11331	THREE GILLS INC, A CALIFORNIA CORP	DELMARTER AND DEIFEL	P11331	STANDARD
11472	ARNULFO ZEPEDA	NELMS SURVEYING INC	P11472	STANDARD
11879	CASTLE & COOKE COMMERCIAL-CA	McINTOSH & ASSOC	P11879	STANDARD
11865	CASTLE & COOKE COMMERCIAL\	McINTOSH AND ASSOC	P11865	STANDARD
10606	RUBEN MIRONOWSKI	DAWSON ENGINEERING & ASSOC.	P10606	STANDARD
11992	BENTON PARK LLC	H3 ASSOCIATES	P11992	STANDARD

Specific Plan Review

Project Number	Type	Address	Dwelling Units	Description
13-0266	COMMERCIAL	9855 COMPAGNONI STREET	N/A	HIGHWAY PATROL STATION
SPR16-0252	COMMERCIAL	9800 & 9804 COMPAGNONI STREET	N/A	HOTEL AND RESTAURANT – 78 ROOMS / 54,679 SQUARE FEET
12-0254	COMMERCIAL	4607 WIBLE RD	0	AUTO DEALERSHIP - 6,000 S.F.
12-0247	COMMERCIAL	1800 WHITE LN	0	OFFICE - 864 S.F.
12-0280	INDUSTRIAL	5551 DISTRICT BLVD	0	WAREHOUSE BG - 6,600 S.F.
12-0289	COMMERCIAL	4621 WHITE LN	0	MEDICAL OFFICE - 845 S.F.
12-0311	COMMERCIAL	7800 SILVER DOLLAR WAY	0	TRAILER SALES / SHOP - 7000 S.F.
12-0358	COMMERCIAL	700 PLANZ RD	0	RETAIL BG - 3,300 S.F.
12-0319	MISCELLANEOUS	9100 ELLASHOSH ST	0	CHURCH - 1,500 S.F.
12-0073	COMMERCIAL	571 Panama Ln	0	1541 sf Addition to existing convenience store
12-0432	COMMERCIAL	6900 McCutchen Rd	0	18,701 square foot office/warehouse buildings
13-0061	COMMERCIAL	3515 PANAMA LN	0	Fitness Club - 18,370 sf
13-0149	INDUSTRIAL	67 East White Lane	0	Auto dismantling facility in an M-3
13-0060	INDUSTRIAL	7225 Schirra Ct	0	9,750 sf warehouse
13-0164	INDUSTRIAL	4200 Resnick Ct	0	Warehouse/office 14,560sf
13-0171	INDUSTRIAL	7700 District Blvd	0	Warehouse/Office 30,860sf
13-0169	COMMERCIAL	3221 Taft Hwy	0	Convenience Store addition 591sf
13-0206	MISCELLANEOUS	1451 MADISON AVE	0	75-foot tall stealth wireless communications facility
12-0002	INDUSTRIAL	5010 YOUNG ST	0	75,600 square foot industrial office/warehouse building
13-0347	COMMERCIAL	5100 YOUNG ST	0	22,316 SF general office building & 1,836 SF addition to existing building
13-0319	INDUSTRIAL	3451 Panama Lane	0	70' stealth wireless comm. facility in a C-2
13-0354	INDUSTRIAL	3232 STINE RD	0	84-foot tall stealth wireless facility in a C-1 zone
13-0364	INDUSTRIAL	4801 S H ST	0	72' stealth wireless facility in a C-1
13-0377	INDUSTRIAL	5102 PARK DIANE AVE	0	6,506 sf general office & 1,216 storage buildings

13-0371	COMMERCIAL	2540 WIBLE RD	0	1850 sf Restaurant
13-0389	COMMERCIAL	5300 GASOLINE ALLEY DRIVE	0	5400sf ADD to service garage
13-0397	MISCELLANEOUS	5614 WOODMERE DRIVE	0	12000 sf church
14-0078	INDUSTRIAL	5913 WOODMERE DR	0	industrial office/warehouse 4235 sf
14-0124	COMMERCIAL	8601 South H St	0	13,401sf assembly building & 8,480 sq ft social hall
14-0125	INDUSTRIAL	5907 WOODMERE	0	3920sf Industrial office / Warehouse
14-0169	COMMERCIAL	4250 Ashe Road	0	two modular office buildings totaling 11,610 sq ft
14-0215	RESIDENTIAL	4103 Rock Lake Dr	2	492 sf 2d DU
14-0323	INDUSTRIAL	6013 Nathaniel Way	0	7,157 sf office/warehouse
14-0283	INDUSTRIAL	4516 District Blvd	0	6,000 sf warehouse (additional to existing)
14-0408	INDUSTRIAL	5500 Gasoline Alley Drive	0	12,100-square foot auto dealership repair shop
14-0456	INDUSTRIAL	5813 NATHANIEL WAY	0	Office/Warehouse - 4130sf
15-0019	COMMERCIAL	2500 White Ln	0	Restaurant - 1,776 s.f. w/Drive through
14-0466	INDUSTRIAL	5700 Woodmere Drive	0	Retail/Warehouse - 6,006 s.f.
15-0047	COMMERCIAL	3117 WILSON RD	0	Banquet Hall 16,451 s.f.
15-0132	COMMERCIAL	3105 AUTO MALL DR	0	672 SF automobile sales office
15-0151	INDUSTRIAL	5901 WOODMERE DR	0	4248 sf Ofc/Warehouse
15-0159	INDUSTRIAL	5815 WOODMERE DR	0	3920 sf ofc/warehouse
15-0105	COMMERCIAL	5701-6411 Gosford Road	0	786,370-sq ft retail center in M-2
15-0231	INDUSTRIAL	4325 Stine Road	0	6,000-sf industrial office/warehouse building
15-0203	COMMERCIAL	2303-2305 S Union Ave	0	51,815 sf RETAIL CENTER
15-0274	COMMERCIAL	7700 District Boulevard	0	15,210 SF RESTARUANT/BREWERY BLDG
14-0177	MISCELLANEOUS	5703 Nathaniel Way	0	11,088 sf church building in an M-1
15-0393	RESIDENTIAL	6503 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6507 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6511 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6601 JERNO DR	2	1 DUPLEXE of 57 TOTAL

15-0393	RESIDENTIAL	6605 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6609 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6613 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6617 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6703 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6707 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6711 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6715 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6719 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6801 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6807 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6811 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6815 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6819 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6600 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6606 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6612 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6616 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6702 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6706 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6712 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6716 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6722 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6800 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	6806 JERNO DR	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5200 GASOL CT	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5204 GASOL CT	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5208 GASOL CT	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5212 GASOL CT	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5216 GASOL CT	2	1 DUPLEXE of 57 TOTAL

15-0393	RESIDENTIAL	5000 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5004 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5010 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5016 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5102 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5108 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5114 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5200 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5208 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5216 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5001 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5005 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5009 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5013 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5017 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5103 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5107 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5111 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5115 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5205 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5209 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5217 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0393	RESIDENTIAL	5221 CALLADO LN	2	1 DUPLEXE of 57 TOTAL
15-0430	COMMERCIAL	4550 PANAMA LN	0	TIRE SHOP - 8099 SF
15-0446	COMMERCIAL	5203 YOUNG ST	0	ATHLETIC TRAINING FACILITY
15-0425	COMMERCIAL		0	10.023 sf outpatient medical clinic
15-0365	COMMERCIAL	4151 Mexicali Dr	0	720 s.f. Modular Medical office building
15-0486	COMMERCIAL	6600 COLONY ST	0	1850 S.F. RESTRAUNT w/ Drive thru
15-0509	MISCELLANEOUS	4300 STINE ROAD	0	63 FT STEALTH WIRELESS TOWER
16-0026	COMMERCIAL	3699 Wilson Rd	0	351 SF ADD. TO CONVENIENCE STORE

16-0037	RESIDENTIAL	5201 GASOL CT	216	APT COMPLEX - 216 units
16-0070	COMMERCIAL	2201 S UNION AVE	0	WRHSE conversion to Truck repair shop
16-0171	INDUSTRIAL	7224 SCHIRRA CT	0	Warehouse - 20,000 sf
16-0113	RESIDENTIAL	1418 ROSALIA DR	2	2ND DU
16-0198	RESIDENTIAL	2301 WILSON RD	2	2ND DU
16-0174	COMMERCIAL	6300 White Lane	0	CRV Recycling facility
16-0192	INDUSTRIAL	6514 & 6515 Woodmere Dr	0	Ofc Bldg 26,925 sf
16-0245	COMMERCIAL	7315 WHITE LN	0	Car Wash & detail shop
16-0256	MISCELLANEOUS	4500 Hughes Lane	0	Water Well
16-0257	MISCELLANEOUS	3411 Hosking Ave (	0	water well (#225-01)
16-0191	COMMERCIAL	3301 Wible Rd`	0	Mini Mart addition
16-0288	MISCELLANEOUS	3608 Brisbane Ave	0	Unmanned water treatment facility
16-0357	INDUSTRIAL	2612 Pacheco Rd	0	TEMP. Auto Storage
16-0356	INDUSTRIAL	2620 Pacheco Rd	0	TEMP. Auto Storage
16-0358	INDUSTRIAL	2604 Pacheco Rd	0	TEMP. Auto Storage
16-0368	COMMERCIAL	5700 Gasoline Alley Dr	0	64,675 sq ft auto service repair shop
16-0376)	COMMERCIAL	2128 SOUTH UNION AVE	0	commercial truck repair facility 16,090 sf
16-0417	COMMERCIAL	7701 WHITE LN	0	CRV Recycling
16-0482	RESIDENTIAL	4602 CROSSHAVEN AVE (#B)	2	2nd du
16-0460	COMMERCIAL	6710 COLONY ST	0	RETAIL BLDG - 22000 sf
16-0474	COMMERCIAL	2309 South Union Ave	0	14,428 sf Banquet Hall
16-0481	INDUSTRIAL	8701 SWIGERT CT	0	9694 SF Ofc/Warehouse
16-0474	COMMERCIAL	8101 STINE RD	0	11715 SF ENTRY & DINING HALL ADD.

Source: City of Bakersfield, July and August 2017.

Section 4.1

Aesthetics

Section 4.1
Aesthetics

4.1.1 Introduction

This section discusses impacts associated with the potential for the proposed Project to degrade the existing visual character or quality of the site and its surroundings through changes in the existing landscape. Potential effects are evaluated relative to important visual features (e.g., scenic highways, scenic features), and the existing visual landscape and its users.

Degradation of the visual character of a site is usually addressed through a qualitative evaluation of the changes to the aesthetic characteristics of the existing environment, and the proposed Project-related modification that would alter the visual setting. Aesthetics, as addressed under the California Environmental Quality Act (CEQA), refers to visual considerations in the physical environment. Because a person's reaction and attachment to a given viewshed are subjective, visual changes inherently affect viewers differently. Accordingly, aesthetics analysis, or visual resource analysis, is a systematic process to logically assess visible change in the physical environment and the anticipated viewer response to that change. This Aesthetics section of this Recirculated Draft Environmental Impact Report (RDEIR) describes the existing landscape character of the project site, existing views of the surrounding area from various on-the-ground vantage points, the visual characteristics of the project site, and the landscape changes that would be associated with the implementation of the proposed project, as seen from various vantage points.

Issues of visual blight are addressed by considering the potential for urban decay that may be precipitated or exacerbated in metropolitan Bakersfield and its environs and by considering the indirect changes in visual quality that could occur as a result of the proposed Project. Visual blight related to urban decay is defined as a general deterioration of the urban landscape that is characterized by long-term building vacancies, poor building maintenance, and increased vandalism. This definition of urban decay is based on the *Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) (124 Cal. App. 4th 1184) decision.

The term *visual blight*, as referred to in this Recirculated Draft Environmental Impact Report (RDEIR), is a condition where real property, by reason of its appearance, is detrimental to the property of others or to the aesthetic value of adjacent properties or reduces the aesthetic appearance of the neighborhood. The analysis regarding potential impacts from urban decay is based on the Urban Decay Study prepared in August 2017 by The Natelson Dale Group, Inc. See Appendix K, *Urban Decay Study*, and Appendix N, *Original Technical Studies*.

4.1.2 Environmental Setting

Local Character

The proposed Project is located is located approximately 1.10 miles southeast of the Bakersfield City limits, within the Metropolitan Bakersfield General Plan, in Kern County. The proposed

Project consists of approximately 314.3 acres, generally located north of Houghton Road, east of State Route (SR) 99, west of South Union Avenue, and south of DiGiorgio Road. The proposed Project location is illustrated on Figure 3-2, *Project Vicinity*, of the Recirculated Draft EIR.

On-site topography is relatively flat, with elevations ranging between 331 and 340 feet above mean sea level (msl). The proposed Project is mostly vacant; however, a steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue. The proposed Project site consists of disked land and has been previously utilized for row-crop agriculture consisting of cotton, alfalfa, carrot, corn, wheat, and grain. Views across the proposed Project site are currently unobstructed due to the existing agricultural use of the site and level terrain. Public viewers of the site include motorists traveling along the surrounding roadways. Refer to Figure 4.1-1, *Photograph Vantage Point Locations*, and Figures 4.1-2, *Key Observation Point A*, 4.1-3, *Key Observation Point B,* 4.1-4, *Key Observation Point C*, and 4.1-5, *Key Observation Point D*, that show representative pictures of the proposed Project site and surrounding area.

Key Observation Points (KOPs) Existing Conditions

Existing land uses in the area include vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard located south/southeast of proposed Project site.

KOP A - Northward Views from Houghton Road.

Views northward toward the project site consist of existing agricultural land that depending on the season is vegetated or fallow with exposed bare ground. From this vantage point the proposed Project site appears completely flat with no structures or landforms. On the northwesterly side and northerly side of the proposed Project site off-site trees are visible. Prominent landforms to the northwest and north are absent and significant landform features area lacking. Distant views of the mountains to the northeast and available depending on the weather conditions and air quality but are largely obscured by intervening vegetation and structures. There are no prominent views of the project site from this location as significant features in the landscape are lacking. Refer to Figure 4.1-2, *Key Observation Point A*.

KOP B - Eastward Views from Houghton Road.

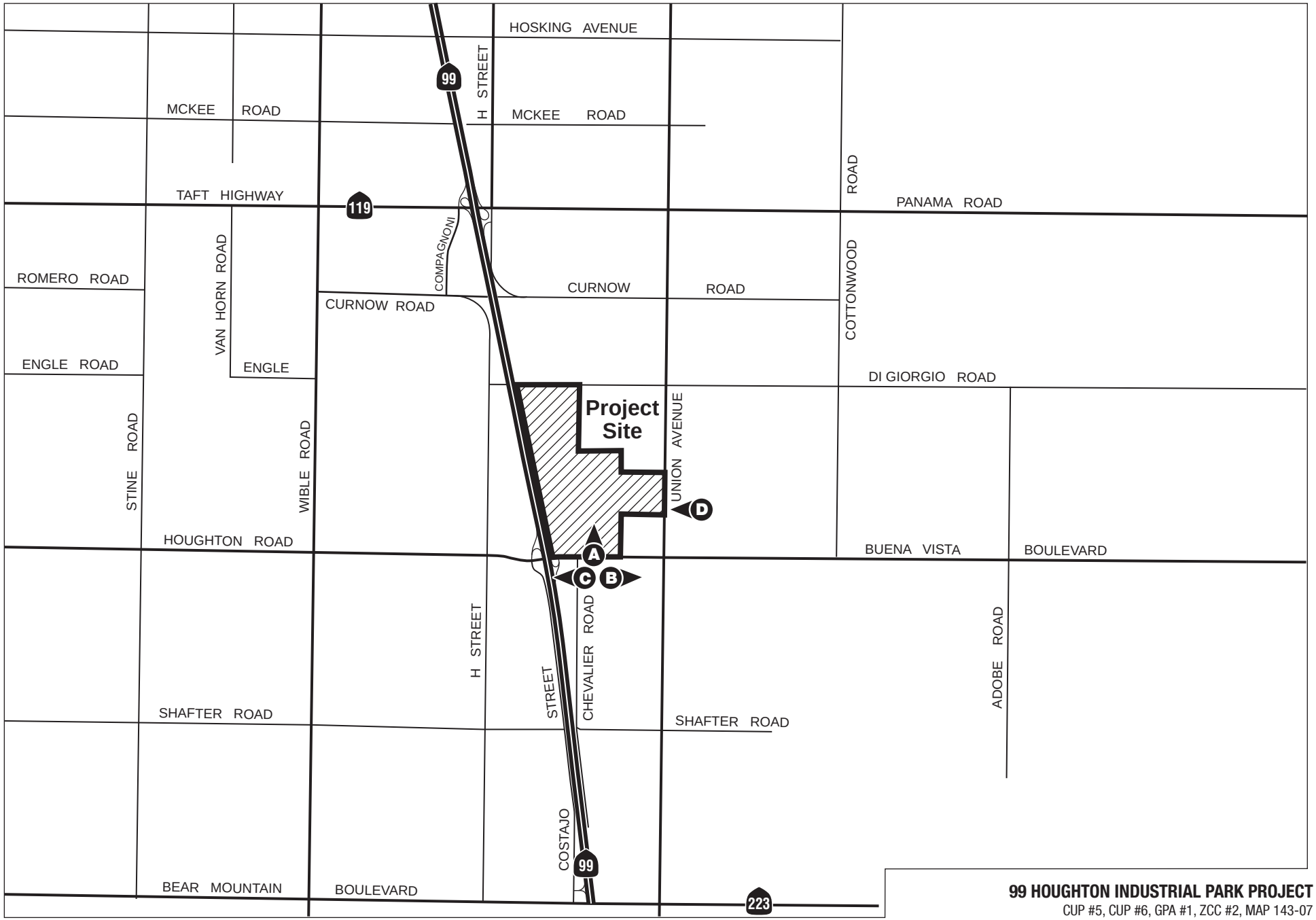
Views eastward and northeasterly toward the project site consist of existing agricultural land that depending on the season is vegetated or fallow with exposed bare ground. The northerly side of the Houghton Road shoulder is heavily disturbed and largely unvegetated and contains wooden utility poles that run along the entire southern project boundary. Approaching Union Avenue views of the automobile wrecking yard come into view and the palm trees lining the eastern project boundary are visible. Distant views of the mountains between the central valley and points east are visible depending on weather and air quality conditions but partially obscured from intervening structures and trees. There are no prominent views of the project site from this location as significant features in the landscape are lacking. Refer to Figure 4.1-3, *Key Observation Point B*.

KOP C - Westward Views from Houghton Road.

Views westward and northwesterly toward the project site consist of existing agricultural land that depending on the season is vegetated or fallow with exposed bare ground. The northerly side of the Houghton Road shoulder is heavily disturbed and largely unvegetated and contains wooden utility poles that run along the entire southern project boundary. Approaching SR-99 there is a dirt road that "T's" with Houghton Road and provides access to the interior of the site. At this point Houghton Road begins to slope upward to provide elevation for the overpass over SR-99. Approaching SR-99 there are trees visible on the westerly side of SR-99. There are no prominent views of the project site from this location as significant features in the landscape are lacking. Refer to Figure 4.1-4, *Key Observation Point C.*

KOP D - Westward Views from Union Avenue.

Views from Union Avenue westward across the project site consist of existing agricultural land that depending on the season is vegetated or fallow with exposed bare ground. The westerly side of Union Avenue is lined with mature palm trees and utility poles that run along the entire southern project boundary (the palm trees are visible in the Photo for KOP-B). Westerly views from Union Avenue approaching Houghton Road consist of a small cluster of single-family rural residential homes with numerous out buildings and other structures, as well as automobile wrecking yard at the northwest corner of the intersection. A sparse tree line on the westerly side of SR-99 is visible, but there are no prominent distant views from this vantage point and there are no significant features in the landscape. Refer to Figure 4.1-4, *Key Observation Point D.*



99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Photo Vantage Point Locations

Figure 4.1-1

View looking north across the Project site from Houghton Road.

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

not to scale

Key Observation Point A

Figure 4.1-2

View looking east along Houghton Road towards Union Avenue.

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Key Observation Point B

Figure 4.1-3

View looking west along Houghton Road towards SR-99 ramps (adjacent to the Project's southern boundary).

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Key Observation Point C

Figure 4.1-4

View looking west across the Project site from Union Avenue.

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Key Observation Point D

Figure 4.1-5

Regional Character

The unincorporated area outside of Metropolitan Bakersfield is currently dominated by agricultural lands (crops and orchards) and other resources designated industrial uses, crisscrossed by country roads, and interspersed with older farmhouses. The majority of housing development and urbanization is taking place within the surrounding planning areas of Metropolitan Bakersfield and the City of Shafter.

Lighting Environment

The Bakersfield area has a nighttime light environment that is visible from great distances, but the character of the nighttime environment changes with increasing distance from the downtown area.

The proposed Project site is devoid of any substantial development. As such, the area produces little light. Light that is produced would be minimally visible from any off-site areas or to drivers on adjacent roadways. Because the majority of the surrounding area is also vacant or have very low residential densities, there are no substantial light sources in the immediate vicinity. Minimal light and glare emanates from the single-family residential uses east of the proposed Project site and the automobile wrecking yard southeast of the Project site. The existing agricultural land to the north and south do not currently create substantial or unusual amounts of light or glare onto the proposed Project site. Additionally, because the surrounding areas are used for agriculture, no sensitive light receptors are located near the proposed Project.

There are two typical types of light intrusion. First, light emanates from the interior of structures and passes out through windows. Second, light projects from exterior sources, such as street lighting, security lighting and landscape lighting. Glare mainly results from sunlight reflection off flat building surfaces, with glass typically contributing the highest degree of reflectivity. Light introduction can be a nuisance to adjacent residential areas and diminish the view of the clear night sky, and if uncontrolled, can disturb wildlife in natural habitat areas. Perceived glare is the unwanted and potentially objectionable sensation as observed by a person as they look directly into the light source of a luminaire.

Light spill-over is typically defined as the presence of unwanted and/or misdirected light on properties adjacent to the property being illuminated.

Economic Environment

To determine whether the proposed Project would create condition for urban decay, the local market and the economic character of existing commercial development are evaluated. The economic setting is based on 2017 The Natelson Dale Group's (TNDG's) Urban Decay Study, which is included as Appendix K of this Recirculated Draft EIR. The analysis in the Urban Decay Study was based on market research and interviews with area real estate brokers, along with other sources of economic data.

Taxable sales in retail stores in Bakersfield accounted for 56 percent of total sales in Kern County in 2014 (TNDG 2017). The City with the next highest retail store sales was the City of Shafter, which had retail stores sales representing six (6) percent of total sales in Kern County. Bakersfield

serves a retail shopping destination for the larger surrounding metropolitan area as well as Kern County as a whole (TNDG 2017).

The overall vacancy rate of retail space in Bakersfield has declined from approximately 14 percent in 2010 to 10.7 percent at the end of 2015. This was up slightly from the 9.6 percent vacancy rate at the end of 2014. The slight uptick in the vacancy rate resulted from the closing of grocery stores, in addition to the construction of several retail shopping centers with speculative space, but not from weakness in the retail market. This slight uptick would likely be temporary as several of the large vacancies are expected to be leased throughout this year (TMDG 2017).

4.1.3 Regulatory Setting

This regulatory framework identifies the federal, State, regional, and local statutes, ordinances, or policies that govern the light, glare, viewshed, and scenic character that must be considered by Kern County during the decision-making process for projects that have the potential to affect aesthetics.

Federal

U.S. Department of Transportation

The U.S. Department of Transportation Act of 1966, Section 4(f), "Protection of Publicly Owned Park, Recreation Area, Wildlife or Waterfowl Refuge, or Land from Historic Sites," was established to provide certain protections to publicly owned parks; recreation areas; wildlife and waterfowl refuges; and land from historic sites of national, State, or local significance. Section 4(f) requires that the federal agency must show that there are no feasible or prudent alternatives to the use of these areas.

The project would not result in the conversion of existing publicly owned park areas. Therefore, project compliance with the U.S. Department of Transportation Act of 1966 was not considered in this analysis.

National Scenic Byways Program

The National Scenic Byways program is part of the U.S. Department of Transportation, Federal Highway Administration (FWHA). The program was established under the Intermodal Surface Transportation Efficiency Act of 1991 and was reauthorized in 1998 under the Transportation Equity Act for the 21st Century. Under the program, the U.S. Secretary of Transportation recognizes certain roads as National Scenic Byways or All-American Roads based on their archaeological, cultural, historic, natural, recreational, or scenic qualities. There are no National Scenic Byways or All-American Roads located within Kern County.

U.S. Department of Agriculture, Forest Service

The National Trails System Act (NTSA) of 1969 seeks to preserve scenic and natural qualities along trails and recognizes the rights of private landowners and provides that "full consideration shall be given to minimizing the adverse effects upon the adjacent landowner or user and his operation" in the development and use of a trail (National Park Service [NPS], 2009).

The NTSA assigns management responsibility for trails to various federal resource agencies, depending on which agency holds jurisdiction over the public lands on which the trail is located in a given area (U.S. Forest Service, U.S. Park Service, or BLM). The Pacific Crest Trail was created under the NTSA to provide for outdoor recreation opportunities and the conservation of significant scenic, historic, natural, or cultural qualities. The Pacific Crest Trail stretches 2,650 miles from Mexico to Canada through California, Oregon, and Washington and is designated in the KCGP as a scenic feature. The U.S. Forest Service administers the Pacific Crest Trail in the vicinity of the project, even though there are no federally owned lands involved with this project. The Pacific Crest Trail is located approximately 24 miles southeast of the project site at its closest point. Therefore, project compliance with the NTSA was not considered in this analysis.

State

California Environmental Quality Act (CEQA)

CEQA Guidelines define a "significant effect" on the environment to mean a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance" (California Code of Regulations [CCR], Title 14, § 15382, 2010).

California Department of Transportation (Caltrans)

The California Department of Transportation (Caltrans) manages the California Scenic Highway Program, which was created in 1963 by the California legislature to preserve and protect scenic highway corridors from changes that would diminish the aesthetic value of lands adjacent to highways. The program includes a list of highways that are eligible for designation as scenic highways or have been designated as such. A highway may be designated as scenic based on certain criteria, including how much of the natural landscape can be seen by travelers, the scenic quality of the landscape, and the extent to which development intrudes on the traveler's enjoyment of the view. State laws governing the Scenic Highway Program are found in the Streets and Highways Code, Sections 260 through 263.

The County does not contain Designated State Scenic Highways or scenic resources. However, the County does include segments of three Eligible State Scenic Highways consisting of SR-14 north of Mojave, SR-58 east of Mojave, and an approximately 5-mile-long segment of SR-41, which crosses through the extreme northwest corner of the County (Caltrans, 2017). The nearest Eligible State Scenic Highway to the proposed project is more than 50 miles east of the proposed project.

Local

Metropolitan Bakersfield General Plan (MBGP)

The Aesthetics Element of the Metropolitan Bakersfield General Plan evaluates the visual and aesthetic setting of Metropolitan Bakersfield and assesses the potential for visual impacts. According to the Aesthetic Element, the proposed Project is not identified as a significant scenic resource.

The Metropolitan Bakersfield General Plan provides goals and policies for the design features of development projects in order to reduce impacts of such projects. The aesthetic goals and policies are discussed in Table 4.1-1, *Metropolitan Bakersfield General Plan Goals and Policies For Aesthetics*, below.

Table 4.1-1. Metropolitan Bakersfield General Plan Goals and Policies for Aesthetics

Goals and Policies: Land Use Element
Goal #3: Accommodate new development which is compatible with and complements existing land uses.
Goal #7: Establish a built environment which achieves a compatible functional and visual relationship among individual buildings and sites.
Policy #21: Encourage a separation of at least one-half mile between new commercial designations.
Policy #26: Encourage adjacent commercial uses to be of compatible height, setback, color and materials.
Policy #28: Require that commercial development provide design features such as screen walls, landscaping and height, setback and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to noise, traffic, parking, and differences in scale.
Policy #30: Street frontages along all new commercial development shall be landscaped.
Policy #34: Provide for the clustering of new industrial development adjacent to existing industrial uses and along major transportation corridors.
Policy #35: Encourage upgrading of visual character of heavy manufacturing industrial areas through the use of landscaping or screening of visually unattractive buildings and storage areas.
Policy #36: Require that industrial uses provide design features, such as screen walls, landscaping and height, setback and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to light, noise, sound and vibration.
Policy #37: Street frontages along all new industrial development shall be landscaped.
Policy #62: Encourage the use of creative and distinctive signage which establishes a distinctive image for the planning area and identifies principal entries to the metropolitan area, unique districts, neighborhoods and locations.
Policy #71: Promote the establishment of attractive entrances into communities, major districts, and transportation terminals, centers, and corridors within the planning area.
Policy #73: Encourage the establishment of design programs which may include signage, street furniture, landscape, lighting, pavement treatments, public art, and architectural design.
Goals and Policies: Public Services and Facilities Element - Street Lighting
Goal #2: Develop uniform Planning area street light location and design standards.
Policy #4: Require developers to install street lighting in all new developments in accord with adopted city standards and county policies.

Kern County Zoning Ordinance

Chapter 19.81, Dark Skies Ordinance (Outdoor Lighting)

Kern County approved a Dark Skies Ordinance in November 2011. The purpose of this ordinance is to maintain the existing character of Kern County by requiring a minimal approach to outdoor

lighting, recognizing that excessive illumination can create a glow that may obscure the night sky and excessive illumination or glare may constitute a nuisance. The ordinance provides requirements for outdoor lighting within specified unincorporated areas of Kern County to accomplish the following objectives:

- **Objective 1**: Encourage a safe, secure, and less light-oriented nighttime environment for residents, businesses, and visitors.
- **Objective 2**: Promote a reduction in unnecessary light intensity and glare and reduce light spillover onto adjacent properties.
- **Objective 3**: Protect the ability to view the night sky by restricting unnecessary upward projections of light.
- **Objective 4**: Promote a reduction in the generation of greenhouse gases by reducing wasted electricity that can result from excessive or unwanted outdoor lighting.

Kern County Development Standards

The Kern County Development Standards have specific regulations pertaining to lighting standards. Lighting shall be designed so that light is reflected away from surrounding land uses so as not to affect or interfere with vehicular traffic, pedestrians or adjacent properties.

4.1.4 Impacts and Mitigation Measures

Methodology

The potential aesthetic, light and glare impacts associated with projects are evaluated on a qualitative basis. The evaluation of Project impacts is based on professional judgment, the *Urban Decay Study* prepared by TNDG in August 2017, the Metropolitan Bakersfield General Plan goals and policies related to visual resources, and the significance criteria established by CEQA.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Have a substantial adverse effect on a scenic vista;
- Substantially damage scenic resources, including but not limited to, trees, rock outcroppings, and historic buildings within a State scenic highway;
- Substantially degrade the existing visual character or quality of the site and its surroundings; and/or
- Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

Project Impacts

Impact 4.1-1: The Project Would Have a Substantial Adverse Effect on a Scenic Vista.

The proposed Project is not designated as, or located near land designated as, visually significant or "scenic" according to the Metropolitan Bakersfield General Plan and the Kern County General Plan. Additionally, development of the proposed Project would not block or preclude views to any area containing important or what would be considered a scenic vista. Therefore, no scenic vista would be affected by development of the proposed Project, and impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.1-2: The Project Would Substantially Alter or Damage Scenic Resources, Including but not Limited to, Trees, Rock outcroppings, and Historic Buildings Within a State Scenic Highway.

According to the Metropolitan Bakersfield General Plan, the proposed Project is not located near what would be considered a visually appealing landform, scenic resource, or state designated scenic highway. The are no scenic trees or rock outcroppings, or historic buildings on the project site. Therefore, impacts are considered to be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.1-3: The Project Would Substantially Degrade the Existing Visual Character or Quality of the Proposed Project Site and Its Surroundings.

Impacts from Site Development

Project construction activities would temporarily disrupt views across the site, from surrounding areas. Graded surfaces, construction debris, construction equipment, and heavy truck traffic would be visible. Soil would be stockpiled and equipment for grading activities would be staged at various locations. These impacts would be short-term and would cease upon Project completion.

Project implementation would alter the nature and appearance of the proposed Project site from agricultural uses and primarily vacant land to light and service industrial development, and highway and general commercial uses. On-site structures would be visible from surrounding areas. This alteration of appearance is permanent and would continue throughout the life of the proposed Project. Views of the primarily vacant agricultural land that currently comprise the proposed Project site are available to motorists and pedestrians along the surrounding roadways. Other than the steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue, the majority of views of the proposed Project site are currently unobstructed, so the change in visual character from open space to developed conditions would be a distinct visual alteration of the Project site.

Although the visual appearance of the proposed Project site may change, visual qualities would not be degraded. The proposed Project would include landscaping requirements and light and glare limiting requirements identified within the Kern County Zoning Ordinance and Development Standards. As shown in the figures presenting the Key Observation Points, views across the project site are largely unobstructed in the foreground and middle ground. Distant views; however, are not prominent and are partially obstructed by intervening vegetation and structures. Additionally, the proposed Project is located near to industrial and commercial uses existing to the east; therefore, the new industrial development would not be inconsistent with the adjacent uses. While placement of new structures associated with the proposed Project would alter the visual character of the site, this would not be considered a substantial degradation of the Project site. Visual changes to the proposed Project site and its surroundings are considered less than significant. To further reduce impacts, the proposed Project would incorporate mitigation related to project design, landscaping, architectural features, and screening. With the implementation of mitigation measures impacts would be further reduced.

Impacts from Urban Decay

Of the approximate 314.3-acre project area, the proposed Project retail components would include zoning classifications of approximately 22 acres for C-2 PD (General Commercial, Precise Development Combining) uses, 25 acres of CH PD (Highway Commercial, Precise Development Combining). The proposed Project would contain approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses, which may draw business from existing commercial centers in the region. This could result in urban decay if other stores close as a result of the loss of business and the buildings remain vacant and unmaintained for extended periods of time.

The Retail Trade Area (RTA) used in this analysis is defined using Regional Statistical Areas (RSA). The RSA's are geographical polygons that have been defined by the Kern County Council of Governments (Kern COG) for the purposes of demographic analysis and regional planning. The RSA's are comprised of smaller geographical units called Transportation Analysis Zones (TAZ) which have also been defined by Kern COG and are comparable in size to census tracts.

The boundaries of the trade areas evaluated in this report are shown on Figure 4.1-6, *Retail Trade Areas*, and are defined as follows:

1. *Retail Trade Area (RTA)*: The RTA is comprised of three RSA's: Metropolitan Bakersfield Southwest, Metropolitan Bakersfield Southeast, and Greater Arvin.

   The RTA includes the bulk of the populated area and retail inventory in Metropolitan Bakersfield. The proposed Project site is near the southern boundary of the RTA. There is very little existing population to the south and more population growth is anticipated in areas to the north. For these reasons, most of the retail demand for the proposed Project is anticipated to come from the north of the site and very little from the south.

   The Urban Decay Study estimated total and net supportable retail space in the RTA. The total supportable retail space in the market area represents retail space that is projected to be supported by future demand. The percent of total supportable retail is an estimation of the proposed Project's share of future total demand, in the form of supportable retail store square footage.

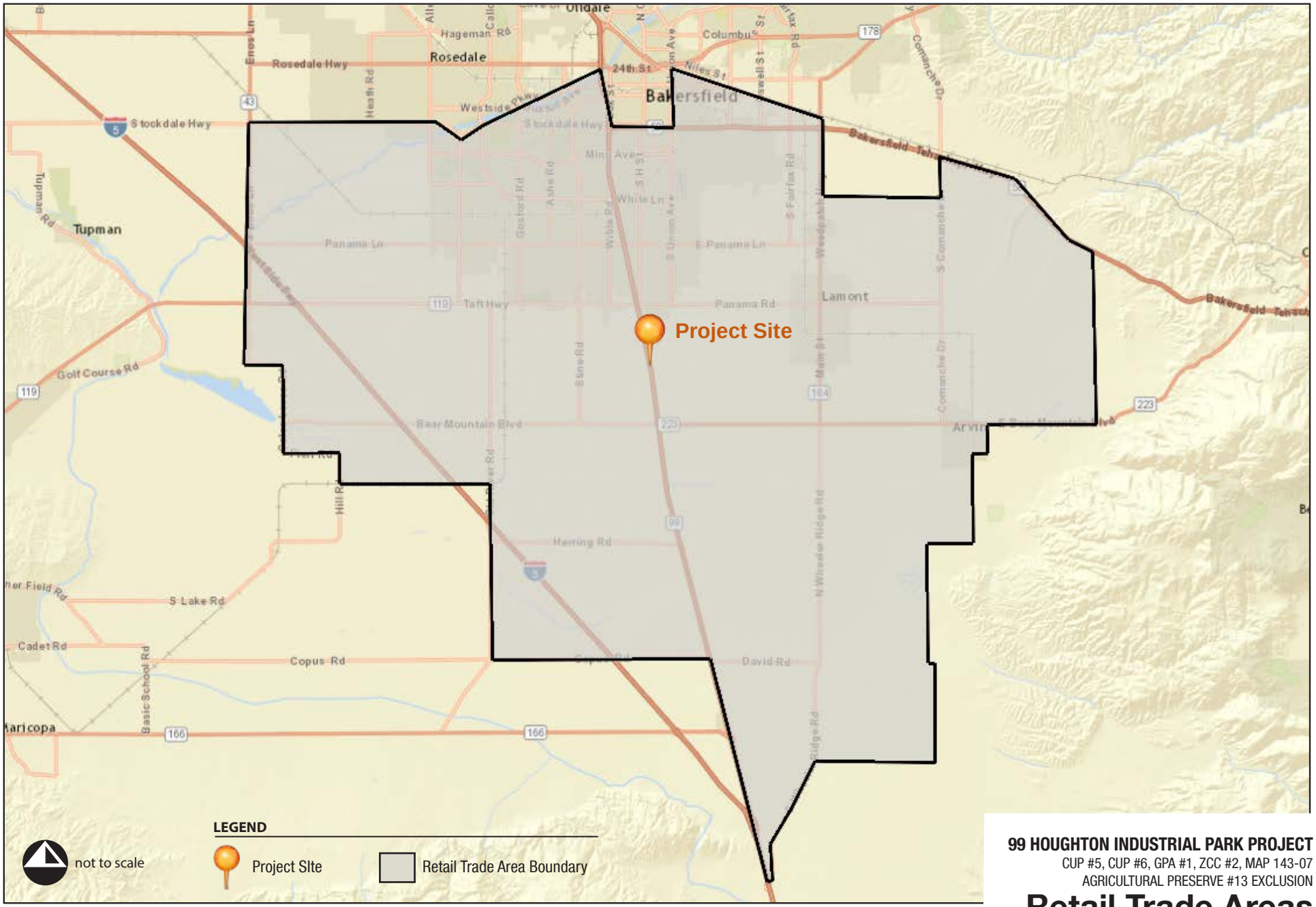
   The square footage projections shown in Table 4.1-2, *Total Supportable Retail Square Footage for the Retail Trade Area, are* based on sales per square foot estimates for each retail category that could potentially be represented by retailers in the proposed Project. The retail categories assessed in the RTA include apparel, general merchandise stores, drug stores, household and home furnishings, household appliance dealers, farm and garden supply stores, specialty/other, food stores, eating and drinking establishments, building materials/hardware, and automotive supplies and parts (TNDG 2010).

Table 4.1-2. Total Supportable Retail Square Footage for the Retail Trade Area

Retail Summary Category	2015	2020	2025	2030	2035
Shopper Goods	4,416,321	4,705,748	5,194,138	5,682,528	6,170,918
Convenience Goods	2,230,928	2,377,133	2,623,846	2,870,559	3,117,272
Heavy Commercial Goods	1,534,626	1,635,198	1,804,909	1,974,619	2,144,330
Total	8,181,875	8,718,079	9,622,893	10,527,706	11,432,520
Proposed Project as Percent of Total Supportable Retail Space					
Proposed Project (square feet)	0	511,380	511,380	511,380	511,380
Percent of Supportable Retail	0.0%	5.9%	5.3%	4.9%	4.5%

Source: Urban Decay Study, The Natelson Dale Group, Inc., August 2017.

From 2015 to 2020, the total supportable retail space in the RTA is projected to increase from approximately 8.2 million square feet to 8.7 million square feet. The proposed Project's retail square footage is projected to represent approximately 5.9 percent of the RTA's total supportable retail square footage in 2020. Based on projected growth in population and retail demand, the proposed Project's share of the RTA's total supportable square footage is projected to decrease to 5.3 percent by 2025 and 4.5 percent by 2035.



99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Retail Trade Areas

Figure 4.1-6

The net supportable retail space is the net growth in available demand from period to period, again as represented by supportable retail space, over base demand in 2015, Refer to Table 4.1-3, *Net Supportable Retail Square Footage for the Primary Retail Trade Area*. The proposed Project's percent of net supportable space shows the proportion of new available (i.e., incremental) demand that would be represented by the proposed Project upon completion and in each period thereafter.

Net supportable retail square footage is based on demand from a combination of two sources: 1) the assumed recaptured of existing demand generated by trade area residents that is currently being spent outside the trade area; plus 2) growth in demand within the trade area based on projected increases in population.

Table 4.1-3. Net Supportable Retail Square Footage for the Primary Retail Trade Area

Retail Summary Category	2015	2020	2025	2030	2035
Shopper Goods	43,939	333,366	821,756	1,310,146	1,798,536
Convenience Goods	228,037	374,243	620,956	867,669	1,114,381
Heavy Commercial Goods	204,816	305,389	475,100	644,810	814,521
Total	476,793	1,012,998	1,917,811	2,822,625	3,727,438
Proposed Project as Percent of Total Supportable Retail Space					
Proposed Project (square feet)	0	511,380	511,380	511,380	511,380
Percent of Supportable Retail	0.0%	50.0%	26.7%	18.1%	13.7%

Source: Urban Decay Study, The Natelson Dale Group, Inc., August 2017.

The RTA is projected to generate approximately 1.01 million square feet of new net supportable retail space between 2015 and 2020 in the RTA. New net supportable retail space is projected to increase to 1.9 million square feet by 2025 and 3.7 million square feet by 2035. The proposed Project's retail square footage is estimated to represent approximately 50.5 percent of net supportable square feet in the RTA in 2020. The proposed Project's proportion of net supportable square footage is expected to decrease to 26.7 percent by 2025 and 13.7 percent by 2035.

The proposed Project does not represent a significant enough proportion of the existing demand in the market place to cause, in and of itself, significant closures of existing retail businesses in the RTA. In addition, existing economic conditions in the area's retail market have largely improved over the past five years, with vacancy rates declining from 14 percent (2010) to 10.7 percent (2015).

Even with relatively modest growth in population, the Urban Decay Study (provided in Appendix K) estimates that future net demand for retail space is more than sufficient to accommodate the proposed Project without significant impact on existing retailers. The proposed Project's retail space represents approximately 50 percent of the new net supportable retail space in the RTA by 2020.

The Urban Decay Study (provided in Appendix K) notes that technically there would be sufficient demand to support the retail components of the proposed Project by 2020. If the proposed Project's retail components are tied to its other proposed light industrial land uses, then it is likely that the retail would be developed at the same time as the other uses. As noted above, the proposed Project is anticipated to be built out over a 25-year development period.

While it is not possible to determine with absolute certainty that the proposed Project would have no economic effects on existing retail businesses in the trade area, it is anticipated that the proposed Project would not have a significant enough impact to cause urban decay. In this context, it is important to note that the terms "economic impact" and "economic effect" refer to loss of sales, or at most, closure of a business. Under CEQA, such purely economic impacts are not in themselves considered significant. To meet the definition of a "significant impact" under CEQA, there must be a substantial *physical* effect. For example, the competitive effects of a new project could result in a substantial economic impact to an existing business, leading to its closure and result in the vacancy of that space. If that space remained vacant for an extended period without regular maintenance such that it was subject to physical deterioration, then urban decay conditions could ultimately ensue. However, it is not anticipated that the proposed Project is likely to be the primary cause of the closure of any existing retailers, much less that it is likely to create conditions severe and prolonged enough to cause closures that would lead to physical urban decay.

Given these findings, it can be concluded that development of the proposed Project would not contribute to urban decay and a degradation of the existing visual character.

Mitigation Measures

MM 4.1-1: Prior to the issuance of building permits, the project operator shall demonstrate compliance with ~~one of~~ the following:

a. The project proponent shall present a plan to color treat the proposed warehouse and office buildings to blend in with the colors found in the surrounding natural landscape while not producing reflection, as approved by the Kern County Planning and Natural Resources Department;

MM 4.1-2: The following aesthetic features shall be required in site plans and building permits for commercial buildings located within 1,000 feet of the State Route 99 corridor:

a. Rooftop screening features shall be installed to create a visual screen for rooftop mechanical equipment, such as a parapet or screening material.

b. Reflective metal exteriors shall not be used as exterior architectural elements in buildings immediately adjacent to State Route 99.

MM 4.1-3: Prior to the issuance of building permits for any facilities on the project site, the project applicant shall submit to the Kern County Planning and Natural Resources Department for approval, a landscape plan that will effectively buffer foreground views of the proposed project site from State Route 99. This landscape plan shall include, but is not limited to, landscape structural elements (such as fencing), and planting materials consistent with current Kern County landscape requirements and shall be cleared of trash and debris at least monthly during the year.

The plan shall also include:

a. Preparation by a licensed Landscape Architect and approval by the Kern County Planning and Natural Resources Department Director prior to buffer planting;

b. The plan shall include California native, drought-tolerant plants.

c. The plan shall provide for an irrigation plan as required under the Kern County Zoning Ordinance 19.86.070.

d. Should perimeter fencing be proposed, fencing materials shall be constructed of any materials commonly used in the construction of fences and walls such as wood, stone, rock, tubular steel, wrought iron, or brick, or other durable materials. Masonry block walls shall be decorative and not bare masonry blocks. Decorative materials can include a façade, colored masonry blocks, or other materials. Fencing proposed around sumps may be chain-link with view obscuring slats. Barbed wire is not permitted.

e. A 20-foot wide perimeter buffer along any visible boundary from the State Route 99 frontage and shall be included as part of the landscape plan. This buffer shall consist of live ground cover, shrubs, or grass, and:

   1) One (1) tree having a minimum planting height of six (6) feet for every fifty (50) lineal feet of buffer;

   2) Shrubs which reach a minimum height of four (4) to six (6) feet.

   3) Live ground cover consisting of low-height plants, or shrubs, or grass shall be planted in the portion of the landscaped area not occupied by trees or evergreen shrubs.

   4) Bare gravel, rock, bark or other similar materials may be used, but are not a substitute for ground cover plantings, and shall be limited to no more than twenty-five (25) percent of the required landscape area.

   5) Landscaping shall be installed prior to final occupancy.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.1-4: The Project Would Create a New Source of Substantial Light and Glare That Would Adversely Affect Daytime or Nighttime Views of the Area.

The proposed Project may introduce new sources of lighting into the Project area. Introduction of new lighting from the proposed Project may include lights within and around the proposed industrial uses (warehousing, distribution, and retail showroom), parking lot lighting, and security lighting. Light sources from the on-site industrial development may have a significant impact on

the surrounding areas. Additionally, on-site light sources may create light spillover and glare impacts on surrounding land uses in the absence of mitigation.

The proposed Project represents an extension of urban growth and development south of the City of Bakersfield. Most of the lighting for the proposed Project would not substantially affect views in this area because the light generated would be typical of industrial development. There are no sensitive receptors to lighting within the proposed Project site, and the majority of the proposed lighting would be consistent with existing lighting in developing areas of Metropolitan Bakersfield. Lighting strategies such as directional lighting and lighting hoods would further minimize light and glare from these sources and reduce spill light and glare on adjacent properties.

Motorists would observe new light and glare in the area, especially in areas where no lights currently exist. Impacts to motorists resulting from lighting would be minimized through compliance with the Kern County Zoning Ordinance, and the goals, policies, and implementation measures of the General Plan. Compliance with the Kern County Dark Skies Ordinance would be required.

The lighting within the proposed Project site would comply with County standards, including Title 19.82.090(K) of the Kern County Zoning Ordinance, which indicates that lighting used to illuminate parking areas shall be directed away from any adjacent properties and streets. In accordance with the goals and policies previously outlined in this section, lights would be focused downward and would not be directed off-site. In addition, implementation of mitigation measures would minimize the potential for spillover lighting to affect motorists adversely to a less than significant level.

Mitigation Measures

MM 4.1-4: The project shall continuously comply with the following: project facility lighting shall comply with the applicable provisions of the *Dark Skies Ordinance* (Chapter 19.81 of the Kern County Zoning Ordinance), and shall be designed to provide the minimum illumination needed to achieve safety and security objectives. All lighting shall be directed downward and shielded to focus illumination on the desired areas only and avoid light trespass into adjacent areas. Lenses and bulbs shall not extend below the shields.

MM 4.1-5: Prior to the issuance of building permits for any facilities on the project site, the project applicant shall submit, and the Kern County Planning and Natural Resources Department shall have approved, plans verifying all outdoor lighting is designed so that all direct lighting is confined to the project site property lines and that adjacent properties and roadways are protected from spillover light and glare.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Impacts from Site Development

Construction of currently approved and pending projects in the Project vicinity would permanently alter the nature and appearance of the area through loss of open space. As development occurs throughout the proposed Project area, residents and visitors would notice the visual effects of urbanization. The significance of these visual and aesthetic changes is difficult to determine, because aesthetic value is subjective and potential impacts are site-specific. Security and parking lot lighting would introduce light and glare potential to the area. Cumulative impacts can be mitigated to less than significant levels with use of building materials that are consistent with the general character of the area, landscaping design and proper lighting techniques to direct light on-site and away from adjacent properties. Additionally, cumulative projects will be designed consistent with the land use designations, zoning requirements, and other requirements of the County. The absence of scenic vistas, major landforms, and scenic resources in the area all contribute to a finding of less than cumulatively significant with implementation of existing Kern County development regulations and Mitigation Measures MM 4.1-1 through MM 4.1-5.

Impacts from Urban Decay

The known active planned and pending retail projects in the PRTA would total approximately 1.4 million square feet of retail space. It is possible that the RTA could become overbuilt during the period between 2020 and 2035, unless aggregate retail development planned during that period is substantially reduced or delayed. If an overbuilt retail environment does develop, there would be a potential for business failures with resulting closures of retail facilities in the RTA. However, most of the future tenants of the proposed Project and planned and pending projects have not yet been identified. As such, it is currently not possible to identify which retail categories might become overbuilt, or to identify existing businesses in those categories which might be forced to close. For the purposes of the State CEQA Guidelines, it is not required, or valid, to engage in speculative analysis.

A more likely cumulative scenario is that infrastructure constraints and retail market conditions would result in a more gradual buildout of planned retail development, such that the pace of retail development would more closely follow the growth in retail demand, an assumption consistent with prevailing industry customs and practices (Appendix K, *Urban Decay Study*). Under this scenario, there is less potential for overbuilt conditions to occur, and consequently a reduced potential for building vacancies and urban decay to follow. Any attempt to identify businesses which might be affected under this scenario, whose closures might ultimately result in urban decay and degradation of visual character would be speculative in nature.

Attempting to predict whether actual retail projects will ultimately be proposed and developed, estimating the square feet of retail development that might ultimately be developed and/or the timing of the potential development would be speculative at best. As such, it is currently not possible to identify which retail categories could possibly become overbuilt, or to identify existing businesses in those categories which might be forced to close if the potential retail components of these projects are ultimately developed. Therefore, any attempt to identify specific vacancies which might possibly result, or to determine the potential for physical deterioration or urban decay, would be speculative in this context. For purposes of evaluating CEQA impacts, it is not required or valid

to engage in speculative analysis. Rather, it is assumed that these potential, yet unplanned, retail sites would be developed only if and when future demand dictates, which assumption is consistent with existing industry customs and practice. Therefore, there would be no significant cumulative impacts to existing or reasonably foreseeable retail facilities regarding urban decay or the degradation of visual character in the RTA with the implementation of mitigation measures.

Mitigation Measures

Implement Mitigation Measures MM 4.1-1 through MM 4.1-5, above.

Level of Significance after Mitigation

Impacts would be less than significant.

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Section 4.2

Agriculture

Section 4.2
Agriculture

4.2.1 INTRODUCTION

The purpose of this section is to document the impacts associated with the conversion of agricultural land to nonagricultural use. This section also discusses the potential conflicts between proposed urban uses and current agricultural activities in the vicinity of the proposed Project. Mitigation measures are recommended to reduce the significance of impacts, where applicable. A Farmland Conversion Study was prepared by McIntosh & Associates in May 2009 (refer to Appendix N). A second Farmland Conversion Study was prepared by McIntosh & Associates in June 2017. See Appendix B, *Farmland Conversion Study*, and Appendix N, *Original Technical Studies*.

4.2.2 Environmental Setting

Regional Agricultural Setting

State of California

California had 80,500 farming operations for the year 2012 (the most recent year available). This number represents less than four percent of the nation's total farming operations, however, these farms account for approximately 12.8 percent of the national gross cash receipts from farming (McIntosh & Associates 2017).

California farmland totaled 25.4 million acres for the year 2010, down less than 0.5 percent from the year 2010 acreage, and the number of farms decreased by 0.4 percent from the year 2005. The average farm size in California is 312 acres, and approximately 400 crops are recognized in the State, including nearly half of the Unites States, fruits, nuts, and vegetables (McIntosh & Associates 2017).

Kern County

The Valley Region of Kern County is highly suitable for agricultural cultivation. Kern County contains 839,079 acres of harvested land. Within that acreage, 73,550 acres were harvested for vegetable crops, 442,146 acres were harvested for fruit crops, and 339,746 acres were harvested for field crops. Agriculture provides the backbone of the County's economy, with a 2015 total value of nearly $6.9 billion dollars, which was a decrease of approximately 9 percent from the 2014 crop value. The total harvested acreage decreased approximately 4.5 percent. The year 2015 top five commodities were grapes, almonds, citrus, milk and cattle (McIntosh & Associates 2017).

From 1990 to 2006 the County was ranked among California's leading counties in total urbanization and loss of farmland and during that time the amount of "important" and "interim" farmland in Kern County decreased by 88,338 acres. Approximately one-third (approximately 29,000 acres) of this decrease was due to urban-related changes, while two-thirds (approximately 58,000 acres) was associated with the idling of farmland. There are many reasons why farmland may be idled in a particular year and it is not necessarily an indication of permanent farmland loss.

Table 4.2-1, *Years 2013-2014 California Land Conservation (Williamson Act)*, provides total acreages of contracted lands in Kern County (McIntosh & Associates 2017).

Table 4.2-1. Years 2013-2014 California Land Conservation (Williamson Act)

Williamson Act Contract	Prime	632,177 acres
	Non-Prime	911,620 acres
Land Conservation Act Nonrenewal (Year 2011)	Prime	48,158 acres
	Non-Prime	31,628 acres
Farmland Security Zone Contract - Urban	Prime	25,316 acres
	Non-Prime	0 acres
Farmland Security Zone Contract – Non-Urban	Prime	133,751 acres
	Non-Prime	0 acres
Farmland Security Zone – Non-contracted*	Prime	13,172 acres
	Non-Prime	0 acres

Source: McIntosh & Associates, 2017.
*These lands have requested non-renewal of their contract and are in the process of "backing out" of the 9-year contract.

As shown above, a large numbers of property owners are continuing to nonrenew contracted acreage, resulting in a loss of 13,172 acres of prime and nonprime property in the last reporting year. The California Department of Finance (DOF) projects the County's population will grow from its January 1, 2017 population of 895,112 to more than 1.06 million in 2030. This growth in population will continue to decrease the amount of agricultural land in Kern County.

Metropolitan Bakersfield Area

Agriculture in the Metropolitan Bakersfield area has been extensive since the introduction of livestock in the 1860s. Livestock raising on large land grants and some production of grain under dry-farming methods were the chief agricultural pursuits until about 1880. Rapid agricultural development occurred after 1880 due to the development of irrigation (harnessing the uncontrolled flow of water from the Kern River), inexpensive land, favorable crop yields, the advent of two railroads, the development of the petroleum industry and access to markets. A review of the California Department of Food and Agriculture Annual Crop Reports indicates a history of high agricultural production for many crops over the years, continuing to the present time. Factors that have in the past influenced high agricultural productivity and continue today include climate, availability of water, dependable market demand and good soils.

Local Setting and Historic Uses

The proposed Project is generally located between Houghton Road to the south, Di Giorgio Road to the north, State Route (SR) 99 along the western edge, and South Union Avenue (SR-204) along the eastern frontage. Existing adjacent land uses include vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard (Higgins Auto Wrecking) located south/southeast of proposed Project site. A dairy (Richmar Farms #2) is located approximately 1.25 miles southeast of the proposed Project at the northeast corner of South Union Avenue and Shafter Road. Existing dairies are generally located more than two miles east and southwest of the proposed Project.

The proposed Project includes approximately 314.30 acres of agricultural land. The Project site is currently designated R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial), and is zoned A (Exclusive Agriculture). Historically, the Project site has been used for alfalfa and grain production, and sheep grazing. A steel storage building associated with agricultural activities is located in the eastern portion of the Project site, near South Union Avenue (SR-204). In addition, two active, 150 horsepower diesel-powered irrigation wells are located on the Project site. According to the Kern County Agricultural Commissioners Office permit records and information provided by the farmer, the information in Table 4.2-2, *Crops Planted on Proposed Project Site (2003-2015)*, lists the crops grown and pesticides permitted on the proposed Project site from 2004 to 2015:

Table 4.2-2. Crops Planted on Proposed Project Site (2003 - 2015)

Year(s)	Farming Company	Crops Planted	Pesticide and/or Chemical Use
2015	Mitchell Property Management, LP Permit No. 1502896	Alfalfa, Wheat, Fallow	Yukon, Lomite, Fusilade DX, Oroboost, Trifluralin, Boric Acid, MCPA, Dimethylamine Salt, Bromoxynil Octanoate, Ammonium Sulfate, Glyphosate, Isopropylamine Salt, Mepiquat Chloride, Thidiazuron, Fenproatin, Avermectin, Bifenthrin, Pyrithiobac-Sodium, Pyriproxyfen, Dicamba, Diglycolamine Salt, Prometryn, Indoxacarb, Acetamiprid, Glyphosate, Potassium Salt, Pyraflufen-Ethyl, Prowl, Roundup, Leaf Life
2014	Mitchell Property Management, LP Permit No. 1502896	Alfalfa, Corn / Fod	
2013	Mitchell Property Management, LP Permit No. 1502896	Alfalfa, Corn / Fod	
2012	Mitchell Property Management, LP Permit No. 1502896	Alfalfa	
2011	Mitchell Property Management, LP Permit No. 1502896	Alfalfa, Corn / Fod	
2010	Mitchell Property Management, LP Permit No. 1502896	Alfalfa, Oat, Fallow	
2009	Mitchell Property Management, LP Permit No. 1502896	Corn / Fod, Oat / Fod, Alfalfa, Sudan Grass	
2008	Doug Kaiser Farms Permit No. 1500895	Wheat, Alfalfa, Corn / Fod	
2007	Doug Kaiser Farms Permit No. 1500895	Alfalfa, Corn / Fod, Grain	
2006	Jerry P. Mitchell Family Part. L.P. Permit No. 1502896	Alfalfa	
2005	Jerry P. Mitchell Family Part. L.P. Permit No. 1502896	Grain, Alfalfa	
2004	Jerry P. Mitchell Family Part. L.P. Permit No. 1502896	Grain, Alfalfa	
2004	Jerry P. Mitchell Family Part. L.P. Permit No. 1502896	Alfalfa	

Source: Farmland Conversion Study, McIntosh & Associates, May 2009 (refer to Appendix N) and June 2017 (refer to Appendix B).

Additionally, the majority of the proposed Project site (approximately 257.57 acres) is within Agricultural Preserve No. 13 (Refer to Figure 3-7). The proposed Project site is not under a Williamson Act Land Use Contract.

The soil types that occupy the proposed Project consist of Bakersfield fine sandy loam (170.22 acres) and Cajon sandy loam (144.08 acres). The Bakersfield find sandy loam consists of very deep,

poorly drained soil with 0 to 1 percent slopes. The Cajon sandy loam consists of very deep, somewhat excessively drained soils with 0 to 2 percent slopes.

4.2.3 Regulatory Setting

State Regulations

Farmland Mapping and Monitoring Program (FMMP)

Maps of Important Farmlands are prepared by the California Department of Conservation as part of its Farmland Mapping and Monitoring Program (FMMP). Important Farmland maps are prepared periodically for most of the State's agricultural areas based on information from the Natural Resource Conservation Service's soil survey maps, land inventory, and monitoring criteria developed by the Natural Resource Conservation Service and land use information mapped by the California Department of Water Resources. These criteria generally are expressed as definitions that characterize the land's suitability for agricultural production, physical and chemical characteristics of the soil, and actual land use. Important farmland maps are generally updated every two years. The following provides descriptions for the eight mapping categories, five related to farmlands and three associated with nonagricultural purposes:

- *Prime Farmland*: Lands with the combination of physical and chemical features best able to sustain long-term production of agricultural crops. The land must be supported by a developed irrigation water supply that is dependable and of adequate quality during the growing season. It also must have been used for production of irrigated crops at some time during the four years before mapping data was collected.
- *Farmland of Statewide Importance*: Lands with agricultural land use characteristics, irrigation water supplies and physical characteristic similar to those of Prime Farmland but with minor shortcomings, such as a steeper slope or less ability to retain moisture.
- *Unique Farmland*: Lands with lesser-quality soils used for the production of California's leading agricultural cash crops. These lands usually are irrigated but may include non-irrigated orchards or vineyards, as found in some of the state's climatic zones.
- *Farmland of Local Importance*: Lands of importance to the local agricultural economy, as determined by each county's board of supervisors and a local advisory committee.
- *Grazing Land*: Lands in which the existing vegetation is suited to the grazing of livestock.
- *Urban and Built-up Land*: Lands occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10-acre parcel. These lands are used for residential, industrial, commercial, construction, institutional, public administration, railroad and other transportation yards, cemeteries, airports, golf courses, sanitary landfills, sewage treatment, water control structures, and other developed purposes.
- *Other Land*: Lands not included in any of the other mapping category.
- *Water*: Perennial water bodies with an extent of at least 40 acres.

Unless otherwise noted, a minimum of 10 acres is mapped for each category. A total of 48 counties covering 44.1 million acres are mapped every two years. Current land use information is gathered using aerial photographs, a computer mapping system, public review, and field reconnaissance. The conversion of prime farmland is considered very important at both local and statewide levels.

According to the 1998 through 2014 Kern County General Plan and Housing Element Annual Progress Reports, the total permanent conversion of agricultural designations in the unincorporated Kern County, outside the Metropolitan Bakersfield area, to urban uses is 19,973 acres (outside the Metropolitan Bakersfield area). Refer to Table 4.2-3, *Planned Land Use Designations Conversions to Non-Agricultural Use from 1998-2014 (in acres),* for a yearly breakdown of agricultural conversions for Kern County General Plans from 1998-2014.

Table 4.2-3. Planned Land Use Designations Conversions to Non-Agricultural Use from 1998-2014 (in Acres)

	Acres Converted to non-resources map codes designations (Loss)	Acres Converted to Soild Waste Buffer Area (Loss)	Acres Converted to Solar	Acres Converted to Resource Map Code Designations (Gained)	Total Acres Converted (Loss or Gain)
1998-1999	221	111		413	Gain of 81
1999-2000	23	2,285			Loss of 2,308
2000-2002	57	119		1,011	Gain of 835
2002-2003	1,163	253			Loss of 1,416
2003-2004	43				Loss of 43
2004-2005	87			125	Gain of 38
2005-2007	119				Gain of 871
2008	14			9	Loss of 23
2009	53	801	430		Gain of 4,001
2010	117		7,477		Loss of 6,634
2011	50		8,803		Loss of 8,694
2012			434		Loss of 434
2013	1,434	128	1,383		Loss of 2,547
2014	56.38		3,968		Loss of 3,700
Total:	3,387.38				25,799 5,826

Source: County of Kern General Plan EIR (2004) & Annual GPA Update Reports (2004-2014)

The CEQA statute defines "agricultural land" for the purposes of assessing environmental impacts using the FMMP categories of "prime farmland," "farmland of statewide importance," or "unique farmland." (Pub. Resources Code § 21060.1) (a).) Where land has not been surveyed by the FMMP, "agricultural land" is defined consistent with the Williamson Act's definition of "prime agricultural land." (Pub. Resources Code § 21060.1 (b).)

California Land Conservation Act (Williamson Act)

The California Land Conservation Act (Williamson Act) was adopted initially by the State of California in 1965, with the basic intent of encouraging the preservation of the State's agricultural lands in view of the increasing trends toward their urbanization. The Williamson Act established a land contract procedure whereby the County Board of Supervisors could stabilize (i.e., not increase) taxes on certain qualifying lands in return for an owner's guarantee to keep the lands in agricultural preserve status for a ten-year period. A Williamson Act contract is automatically renewed each year, unless a notice of non-renewal is initiated by the land owner or the County. Once a notice of

non-renewal is given, the contract remains in place on the land for the remaining nine-year term. After the nine years, the land is no longer restricted to agricultural or open space uses. Additionally, once a notice of non-renewal is submitted, the taxes on the land are annually reassessed in accordance with a formal set in the Williamson Act.

The Williamson Act defines "prime agricultural lands" as follows:

- All land that qualifies for rating as Class I or Class II in the Natural Resource Conservation Service Land Use Capabilities Classifications;
- Land that qualifies for rating 80 through 100 in the Storie Index Rating (a numerical value indicating the relative suitability of a soil group for general agricultural practices);
- Land that supports livestock used for the production of food and fiber and that has an annual carrying capacity equivalent to at least one animal unit per acre, as defined by the United States Department of Agriculture;
- Land planted with fruit- or nut-bearing trees, vines, bushes, or crops that have a nonbearing period of less than five years and will normally return during the commercial bearing period from the production of unprocessed agricultural plant production not less than two hundred dollars ($200) per acre per year; and
- Land that has returned from the production of unprocessed agricultural plant products a gross value of not less than two hundred dollars ($200) per acre per year for three of the previous five years.

As of December 2015, 14.8 million acres of farm and ranch land of the State's 30 million acres were protected by Williamson Act contracts. This is a slight decrease in reported enrollment compared with approximately 15.4 million acres reported in the 2014 Status Report. This cumulative nonrenewal acreage constitutes 3.8 percent of the Williamson Act enrollment (DOC, 2016). At a County level, according to the Kern County 2014-2015 Williamson Act Open Space Subvention Report, a total of 1,468,900 acres of farmland is currently enrolled in Williamson Act contracts. Of this total, 99.31 acres are in the non-renewal process. The majority of the proposed Project site (approximately 257.57 acres) is within Agricultural Preserve No. 13; however, the site is not under a Williamson Act Land Use Contract.

Farmland Security Zone Contract

The California Department of Conservation passed the Farmland Security Zone legislation (Govt. Code Sec. 51296) in 1998. The Farmland Security Zone allows counties to establish an additional program for farmlands to enter into contracts with the State. This legislation allows landowners whose land is under a Williamson Act contract to petition to the county board of supervisors to annul the Williamson Act contract for a Farmland Security Zone Contract. A Farmland Security Zone Contract is a 20-year contract that allows the property owner to receive 35 percent more in tax savings than a Williamson Act contract. According to the Kern County Williamson act Open Space Subvention Report for the years 2014-2015, 1,468,900 acres have been enrolled in Farmland Security Zone Contracts.

Public Resources Code Section 21060.1

The Public Resources Code Section 21060.1 defines agricultural land for the purposes of assessing environmental impacts using the FMMP. The FMMP was established in 1982 to assess the location, quality and quantity of agricultural lands and the conversion of these lands. The FMMP provides analysis of agricultural land use and land use changes throughout California.

Farmland Conversion Report: 2004 to 2006

- According to the Farmland Conversion Report: 2004 to 2006, prepared by the Farmland Mapping and Monitoring Program in the Department of Conservation, Farmland of Local Importance is classified as:

  "Farmland of Local Importance is land of importance to the local economy, as defined by each county's local advisory committee and adopted by its Board of Supervisors.

- Farmland of Local Importance is either currently producing, or has the capability of production, but does not meet the criteria of Prime Farmland, Farmland of Statewide Importance or Unique Farmland. Authority to adopt or to recommend changes to the category of Farmland of Local Importance rests with the Board of Supervisors in each county."

Local Regulations

The area of the proposed Project is governed by agricultural and farmland regulations established by the State of California. The Metropolitan Bakersfield General Plan and the Kern County Zoning Ordinance, control local land uses within agricultural areas. These documents identify the types of land uses permitted in agricultural zones and define the development parameters within each land use category.

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan identifies goals and policies that are intended to provide for the planned management, conservation and wise utilization of agricultural land within the Planning area. Implementation of these goals and policies serve to direct growth and promote agricultural conservation through development in accordance with the Metropolitan Bakersfield General Plan. Refer to Table 4.2-4, *Metropolitan Bakersfield General Plan Goals and Policies for Agricultural Land*.

Table 4.2-4. Metropolitan Bakersfield General Plan Goals and Policies for Agricultural Land

Goals and Policies: Land Use, Open Space, and Conservation Element
Goal #1: "Provide for the planned management, conservation, and wise utilization of agricultural land in the planning area."
Goal #2: "Promote soil conservation and minimize development of prime agricultural land as defined by the following criteria: Capability Class I and/or II irrigated soils, 80-100 Storie Index rating, Gross crop return of $200 or more per acre per year, and Annual carrying capacity of one animal per acre per year."
Goal #3: "Establish urban development patterns and practices that promote soil conservation and that protect areas of agricultural production of food and fiber crops, and nursery products."
Policy #1: "Determine the extent and location of all prime agricultural land within the study area."
Policy #2: "Review projects that propose subdividing or urbanizing prime agricultural land to ascertain how continued commercial agricultural production in the project vicinity would be affected."
Policy #3: "Protect areas designated for agricultural use, which includes Class I and II agricultural soils having surface delivery water systems, from the encroachment of residential and commercial subdivision development activities."
Policy #4: "Monitor the amount of prime agricultural land taken out of production for urban uses or added within the plan area."
Policy #6: "Continue implementing land grading ordinances that reduce soil erosion/siltation commonly associated with land development."
Policy #7: "Land use patterns, grading, and landscaping practices shall be designed to prevent soil erosion while retaining natural watercourses when possible."
Policy #9: "Protect prime agricultural lands against unplanned urban development by adopting agricultural zoning, general plan agriculture designation, and by encouraging use of the Williamson Act and supporting programs and policies that provide tax and economic incentives to ensure the long-term retention of agricultural lands."
Policy #10: "Encourage landowners to retain their lands in agricultural production."
Policy #12: "Prohibit premature removal of ground cover in advance of development and require measures to prevent soil erosion during and immediately after construction."
Policy #13: "Minimize the alteration of natural drainage and require development plans to include necessary construction to stabilize runoff and silt deposition through enforcement of grading and flood protection ordinances."
Policy #14: "When considering proposal to convert designated agricultural lands to non-agricultural use, the decision-making body of the city and County shall evaluate the following factors to determine the appropriateness of the proposal: • Soil quality; • Availability of irrigation water; • Proximity to non-agricultural uses; • Proximity to intensive parcelization; • Effect on properties subject to "Williamson Act" land use contracts; • Ability to be provided with urban services (sewer, water, roads, etc.); • Ability to effect the application of agricultural chemicals on nearby agricultural properties; • Ability to create a precedent-setting situation that leads to the premature conversion of prime agricultural lands; • Demonstrated project need; and • Necessity of buffers such as lower densities, setbacks, etc.

Kern County Zoning Ordinance (Title 19 of the Ordinance Code of Kern County)

Chapter 19.12 Exclusive Agriculture (A) District

The purpose of the Exclusive Agriculture (A) District (Chapter 19.12) is to designate areas suitable for agricultural uses and to prevent the encroachment of incompatible uses onto agricultural lands and the premature conversion of such lands to non-agricultural uses. Uses in the Exclusive Agriculture (A) district are limited primarily to agricultural uses and other activities compatible with agricultural uses. Allowable land uses within the Exclusive Agriculture (A) district are set forth in Sections 19.12.020 and 19.12.030 and include those associated with growing and harvesting of crops, breeding and raising animals, agricultural industries, residential uses to house farm workers or the landowner, Christmas tree farms, utility corridors, resource extraction, waste facilities, institutional/educational uses, and various miscellaneous uses such as animal shelters and clubs. Facilities permitted on properties zoned for Exclusive Agricultural (A) with approval of a conditional use permit (CUP) include those associated with recreation, entertainment, and tourist facilities, utilities and communications, resource extraction and energy development (i.e., wind and solar generators, mining, dams, batch plants), institutional uses (i.e., churches, zoos, government facilities), and schools.

4.2.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative and quantitative basis through a comparison of the anticipated Project effects on agricultural activities. A change in the land use will normally be determined to be significant if the effects described in the Thresholds of Significance occur (see California Code of Regulations, title 14 §15064.7(a)). The evaluation of Project impacts as based on professional judgment, analysis of the County's agricultural resources policies and the significance criteria established by Appendix G of the State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist state that a project could potentially have a significant effect if it would:

- Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to nonagricultural use;
- Conflict with existing zoning for agricultural use or a Williamson Act contract;
- Conflict with existing zoning for, or cause rezoning of forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined in Public Resources Code section 4526);

- Result in the loss of forest land or conversion of forest land to non-forest use;
- Involve other changes in the existing environment which, due to their location or nature, could result in conversion of farmland, to non-agricultural use or conversion of forest land to non-forest use; and/or
- Results in the cancellation of an open space contract made pursuant to the Williamson Act or Farmland Security Zone contract for any parcel of 100 or more acres (Section 15206(b)(3) Public Resources Code).

Project Impacts

Impact 4.2-1: The Project Would Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as Shown on the Maps Prepared Pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to Nonagricultural Use.

The Metropolitan Bakersfield General Plan area has been experiencing intense urbanization for the last two decades, and is actively annexing properties by providing the infrastructure needed to serve more densely populated communities. Urbanization in farming areas typically begins with conversion of one or a few parcels adjacent to the city limit line. The encroachment of urban uses on existing agricultural areas is prevalent adjacent to the City, where both farmers and urban neighbors operate with both negative and positive consequences. The challenge is to minimize the negative interactions and create the conditions for a long-term and mutually beneficial coexistence between farmers and urban residents. The negative interactions can be divided into the impacts that farmers can have on urban neighbors and the impacts that urban neighbors can have on farmers.

Kern County has ranked among the leading counties in California for urbanization and net loss of farmland. From 1990 to 2006, the amount of important and interim farmland in Kern County decreased by 88,338 acres. About one-third of this decrease was due to urban-related changes, while two-thirds was associated with the idling of farmland.

As previously discussed, from the years 1998 to 2015, a total of 3,387.38 acres were converted from agricultural to non-resource map code designations, outside the Metropolitan Bakersfield area. This proposed Project would convert approximately 314.30 acres of farmland in order to accommodate industrial development. These 314.30 acres include approximately 170.22 acres of soil capability Class II irrigated prime agricultural land and approximately 144.08 acres of soil capability Class III.

The Department of Conservation's FMMP designates the proposed Project as "prime." However, the FMMP maps the County at such a large scale that much of the smaller scale soil information is lost. The FMMP also focuses exclusively on soils, and does not consider any other indicator or agricultural viability. Therefore, additional analysis of the value of the proposed Project site for agricultural production is appropriate.

California Land Evaluation and Site Assessment Model (LESA)

The California Land Evaluation and Site Assessment Model (LESA) was applied to determine if the conversion of approximately 314.30 acres of farmland was significant. The Project's Farmland Conversion Study utilizes LESA to aid in determining the significance of the proposed Project's conversion of agricultural lands. LESA provides guidelines for rating the relative quality of land resources based on specified measurable features. Additionally, it is intended "to provide lead agencies with an optional methodology to ensure that significant effects on the environment of agricultural land conversions are quantitatively and consistently considered in the environmental review process." The LESA comprises two categories, Land evaluation (Land Capability Classification [LCC] and Storie Index Rating) and Site Assessment (project size, water resources, surrounding agricultural lands and protected resources lands). The following describes each category and the on-site scores (any site that scores between 80 and 100 points is significant).

Land Evaluation

The LLC analyzes suitability of soils for most kinds of crops. Determinations are made according to the limitations of the soils when used to grow crops and the risk of damage to soils when they are in agriculture. The Storie Index provides a numeric rating (out of 100 points) of the relative degree of suitability of value of a given soil for intensive agriculture. The soil types that occupy the proposed Project consist of Bakersfield fine sandy loam and Cajon sandy loam. According to the USDA Soil Survey of Kern County, California – Southwestern Part, the soil units within the proposed Project meet the requirements for prime farmland. The USDA Soil Survey of Kern County, California – Southwestern Part, does not include the Storie Index for each soil unit, therefore, the LE portion for the analysis accounts for 50 percent of the LESA score. The LCC score is 31.28; therefore, the land evaluation subtotal is 31.28 out of 50.

Site Assessment

The Site Assessment provides information on size, water availability, and surrounding land uses. The proposed Project produces a project size rating of 15; water resource availability rating of 15; a surrounding agricultural lands rating of 13.95; and a protected resource lands rating of zero. The combined Assessment score is 43.95 out of 50.

The LESA score for the proposed Project site is 75.23. This is considered significant because neither of the land assessment or site assessment sub-scores are less than 20 points.

Metropolitan Bakersfield General Plan Farmland Conversion Criteria

In order to determine whether the conversion of approximately 314.30 acres of FMMP designated prime land is in fact a significant impact, the proposed Project's consistency with the Metropolitan Bakersfield General Plan's policies regarding farmland conversion were considered. This analysis used the following criteria to evaluate the significance of this 314.30-acre conversion of farmland:

- soil quality;
- availability of irrigation water;
- proximity to nonagricultural uses;

- proximity to intensive parcelization;
- effect on properties subject to the "Williamson Act" land use contracts;
- ability to be provided with urban services (sewer, water, roads, etc.);
- ability to affect the application of agricultural chemicals on nearby agricultural properties;
- ability to create a precedent-setting situation that leads to the premature conversion of prime agricultural lands;
- demonstrated project need; and
- necessity of buffers such as lower densities, setbacks, etc.

Soil Quality

The Metropolitan Bakersfield General Plan's Conservation/Soils and Agriculture Element states among its goals to promote soil conservation and minimize development of prime agricultural land as defined by the following criteria:

- Capability Class I and/or II irrigated soils;
- 80-100 Storie Index rating;
- Gross crop return of $200 or more per acre per year; and
- Annual carrying capacity of one animal unit per acre per year.

The definition of "prime agricultural land" in the Williamson Act (Gov. Code §51201) is consistent with the Metropolitan Bakersfield General Plan's Conservation/Soils and Agriculture Element.

Implementation of the proposed Project would result in the conversion of approximately 314.30 acres of farmland to urban uses. The 314.30 acres include approximately 170.22 acres of Bakersfield fine sandy loam. This soil is classified by the USDA Soil Conservation Service as Class II which means it is prime agricultural land. Approximately 144.08 acres include Cajon sandy loam, which is classified by the USDA Soil Conservation Service as Class III, which means approximately 314.30 acres (or 100 percent of the proposed Project) would meet the requirements for prime farmland if undeveloped and water for irrigation is available. Based on the Farmland Conversion Study, Table 6, the proposed Project does not exceed the gross crop threshold of gross crop return of $200 or more a year. In 2015, the unit value per ton (of crop) was $135 for wheat and $169 for alfalfa (McIntosh & Associates 2017).

Approval and implementation of the proposed Project would result in a significant impact from the conversion of approximately 314.30 acres of soil that meets the requirements for prime farmland if water for irrigation were available.

Availability of Irrigation Water

The most recent data provided by the California Department of Water Resources indicates that the unconfined water table is approximately 100 to 105 feet below ground surface (bgs) beneath the project site. Two active, (150 horsepower) diesel-powered irrigation wells are situated on the project site. The west well is located adjacent to SR-99 where a concrete-lined ditch also serves as an identifying landmark. The northwest well is located near the northwest corner of the proposed Project site. The main sources of water for irrigation are the two water wells located on the site. In addition, water from the Kern Island Canal, located on the west side of SR-99 is used when available. The methods of irrigation used on the proposed Project site is flood irrigation.

The availability of irrigation water at the proposed Project site contributes to the conclusion that conversion of the site from agricultural to a nonagricultural use would be significant.

Proximity to Non-Agricultural Uses

Planned future development and planned roadway system expansion near and within the proposed Project indicates that the site is in the logical path of development. The following factors indicate that the proposed Project area and adjacent properties will be affected by existing and planned urban development.

The proposed Project is bound by the DiGorgio Road alignment to the north, South Union Avenue to the east, Houghton Road to the south, and SR-99 to the west. The proposed future South Beltway alignment would be adjacent to the southern boundary of the proposed Project. In addition, a 56.33-acre residential development is proposed to the northwest, a 62-acre residential development is proposed to the north; a 17.89-acre general commercial development is proposed to the northeast; a 28.67-acre medium industrial development is proposed to the east; and a 36-acre residential development, along with a 20-acre light industrial development are proposed south of the proposed Project. Approved tracts and proposed projects near the Project site (within the County of Kern) indicate that the site is in the logical path of urbanization.

Given the adjacent existing and proposed residential, commercial, and industrial development surrounding the proposed Project site, implementation of the proposed Project would represent an extension of existing nonagricultural uses and is considered a less than significant impact.

Proximity to Intensive Parcelization

The encroachment of urban uses on existing agricultural areas can result in negative interactions between farmers and urban neighbors. Farming operations can affect urban neighbors by creating inconveniences or discomforts such as equipment noise, odors from manure, and other chemicals and dust or smoke. Urban uses can create adverse impacts to farmers such as the introduction of pests, disease and weeds, increased complaints about noise, dust, smoke, odors and spray drift from pesticide and fertilizer use, restrictions to the application of pesticides and chemicals, increased flooding and siltation increase traffic, vandalism and trespassing.

The proposed Project would be significantly and unavoidably affected by the close proximity of urbanized areas. Farming practices will be more restricted as to the manner of application and type

of herbicides and pesticides that can be utilized in the vicinity of these urbanized areas. The proposed Project, as well as others in the area, is the next logical step for urbanization in this area due to the planned urban development near the property and its significant impacts to the crop production.

Effect of Properties Subject to Williamson Act Land Use Contracts

As of 2015, the County of Kern has determined that 1,468,900.00 acres of land in Kern County are under Williamson Act Land Use Contracts and 144,339.68 acres under the Farmland Security Zone contract. Non-renewals initiated for the year totaled 99.31 acres of prime and non-prime property. Both of these contracts require that lands be within an established Agricultural Preserve. Agricultural lands that are not in a preserve face the greatest threat of conversion, as they are assessed higher property taxes due to their proximity to urbanization.

The proposed Project is not under a Williamson Act Land Use Contract. Between the years 2009-2015, many of the properties under existing Williamson Act Land Use Contracts (in the vicinity of the proposed Project) had planned for the eventual urbanization of those lands by nonrenewing their contracts. However, there are numerous properties to the east (including one parcel that is directly adjacent to the proposed Project) and west of the proposed Project site that are under Williamson Act Contracts. Therefore, resultant impacts to agricultural resources as a result of proposed Project implementation are considered less than significant because existing restrictions and limitations have already been placed on local growers by these uses.

Ability to be Provided with Urban Services

The existing water purveyor, who provides irrigation solely for agricultural purposes, will not service the proposed Project with domestic water. Instead, the domestic water would be provided by an on-site private well with water treatment and distribution facilities. A private package sewer treatment plant is proposed to provide sewer services for the Project site.

The proposed Project is generally located north of Houghton Road (an arterial), east of SR-99, west of South Union Avenue (SR-204) (an arterial), and south of DiGiorgio Road (an arterial). Additionally, the County of Kern and City of Bakersfield have adopted the alignment of the West Beltway as a Specific Plan line approximately which is adjacent to the southern boundary of the proposed Project. This indicates that further urbanization is expected for the proposed Project area. Therefore, the conversion of the proposed Project site to urbanization is appropriate for the area, as it has the ability to be provided with urban services.

Ability to Affect the Application of Agricultural Chemicals on Nearby Agricultural Properties

Urban encroachment affects adjacent lands remaining in agricultural production as conflicts arise from the infringement of the new users, which include people and animals, into the area. Resultant impacts to agricultural resources as a result of proposed Project implementation are considered less than significant due to restrictions and limitations that have been placed on local growers within the proximity of planned urban developments.

Ability to Create a Precedent-Setting Situation that Leads to the Premature Conversion of Prime Agricultural Lands

Proposed urban development on properties adjacent to and near the proposed Project indicate that it is in an area of potential growth. Although agricultural lands nearby are currently producing agricultural crops, implementation of the proposed Project would not create a precedent-setting situation given the site is located adjacent to urban land use designations identified within the Metropolitan Bakersfield General Plan. There are a number of proposed residential, commercial, and industrial development projects, including the proposed West Beltway transportation corridor, and a number of properties that have indicated their intent to cease farming activities in the area by filing for non-renewal of their existing Williamson Act Land Use Contracts near the proposed Project.

Demonstrated Project Need

The Metropolitan Bakersfield General Plan states that the Bakersfield Planning Department projects the population of the plan area to be 468,175 in the year 2030. Population growth will result in the need for additional housing within the plan area; however, development of the proposed Project consists of non-residential uses and will not contribute to meet the Metropolitan Bakersfield's existing and future housing demand.

It is assumed that future development in the Metropolitan Bakersfield General Plan planning area would continue to include "prime" agricultural soils that exist on the Valley floor. This loss has not limited itself to Metropolitan Bakersfield but has become an issue of statewide concern. The Metropolitan Bakersfield General Plan concludes that conversion of prime agricultural lands to urban uses will result in a reduction of the regional agricultural economy and is considered a significant adverse impact. The Metropolitan Bakersfield General Plan currently designates the Project site as R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial). Approval and implementation of the proposed Project would result in a significant impact from the conversion of approximately 314.30 acres of soil that meet the requirements for prime farmland if water for irrigation were available.

Planned urban development located northwest and within close proximity to the proposed Project indicates that this Project is on the logical path of development. The Metropolitan Bakersfield General Plan encourages the orderly outward expansion of new urban development that maintains continuity of existing development and allows incremental expansion of infrastructure and public services. The proposed Project complies with the Metropolitan Bakersfield General Plan's criteria.

Necessity of Buffers Such as Lower Densities, Setbacks, Etc.

If urban developments do not include buffer zones in their design, growers must sometimes allocate a portion of their land to the creation of a buffer zone adjacent to agricultural fields. As an example, growers might be required to refrain from spraying or harvesting the outside rows of their crops. In those cases, buffer zones represent a loss to the farmer of both crop production and income.

Buffer zones can consist of roads, canals, walls, easements, setbacks, etc. The future development of the Project is not proposing the creation of a buffer zone. However, the Kern County Zoning and

Land Division Ordinances will guarantee that adequate buffers be provided to avoid conflict between agricultural and urban uses. In addition, the proposed Project is bound by Di Giorgio Road alignment to the north, SR-99 to the west, South Union Avenue to the east, and Houghton Road to the south. These roadways will contribute to buffer the proposed Project from adjacent land uses.

Significance Conclusion

Due to the soil quality coupled with the availability of irrigation water at the proposed Project site, the Project site is considered prime farmland; therefore, conversion of the site to nonagricultural use would be a significant impact.

Mitigation Measures

MM 4.2-1: Prior to issuance of a grading or building permit, whichever occurs first, the project proponent shall provide written evidence of completion of one or more of the following measures to mitigate the loss 314.30 acres of agricultural land before conversion, at a one-to-one ratio.

- Funding and/or purchase of agricultural conservation easements (will be managed and maintained by an appropriate entity);
- Purchase of credits from an established agricultural farmland mitigation bank;
- Contribution of agricultural land or equivalent funding to an organization that provides for the preservation of farmland in California; or
- Participation in any agricultural land mitigation programs adopted by Kern County that provides equal or more effective mitigation than the measures listed above.

Mitigation land shall meet the definition of prime farmland or farmland of statewide importance established by the State Department of Conservation. Completion of the selected measure(s), or with the Planning Director's approval, a combination of the selected mitigation measures, can be on qualifying agricultural land within the San Joaquin Valley (San Joaquin, Stanislaus, Merced, Fresno, Madera, Kings, Tulare, Kern Counties) or outside the San Joaquin Valley with written evidence that the same or equivalent crops can be produced on the mitigation land.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

Impact 4.2-2: The Project Would Conflict with Existing Zoning for Agricultural Use, or a Williamson Act Contract.

According to the Kern County Zoning Ordinance, the proposed Project is zoned A (Exclusive Agriculture). The proposed Project is located within an Agricultural Preserve area. The majority of the proposed Project site (approximately 257.57 acres) is within Agricultural Preserve No. 13. However, the proposed Project is not under a Williamson Act Land Use Contract. The proposed

Project would not conflict with existing zoning for agricultural, nor a Williamson Act Land Use Contract.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.2-3: The Project Would Conflict with Existing Zoning for, or Cause Rezoning of, Forest Land (as Defined in Public Resources Code Section 12220(g)) or Timberland (as Defined in Public Resources Code Section 4526).

The proposed Project is not located on forest land as defined in Public Resources Code Section 12220(g), nor is the property zoned for such use as identified in the Kern County Zoning Ordinance. Implementation of the proposed Project would not result in the loss of forest land. No impact would occur.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

No impacts would occur.

Impact 4.2-4: The Project Would Result in the Loss of Forest Land or Conversion of Forest Land to Non-Forest Use.

The proposed project is not located on forest land as defined in Public Resources Code Section 12220(g), nor is the property zoned for such use as identified in the Kern County Zoning Ordinance. Implementation of the project would not result in the loss of forest land. No impact would occur.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

No impacts would occur.

Impact 4.2-5: The Project Would Involve Other Changes in the Existing Environment Which, Due to Their Location or Nature, Could Result in Conversion of Farmland, to Non-Agricultural Use or Conversion of Forest Land to Non-Forest Use.

The proposed development would occur within the Project site. No other changes in the existing environment would result from the proposed Project. The following provides a description of the existing and planned land uses surrounding the proposed Project site:

- The Proposed South Beltway Alignment is located along the southern project boundary.
- General Plan Amendment and Zone change is proposed for 28.67 acres west of the project site to allow for Light Industrial uses.
- General Plan Amendments located northwest of the site to allow for Service Industrial uses.
- General Plan Amendment located at the northeast corner of Hosking Road and Highway 99 to allow for retail commercial center with approximately 1 million square feet of leasable commercial space and a 300-room hotel (140,000 square feet) on 109 acres.
- General Plan Amendment located at Taft Highway and Chevalier to allow for General Commercial, Office Commercial and High Density residential.
- Zone Change located South of Taft Highway and Chevalier to allow for Commercial and Residential development.

Although some of the surrounding agricultural properties have filed a notice of non-renewal for the Williamson Act land use contract property, others have not. Implementation of this project would further encourage those properties who have already filed for non-renewal of their Williamson Act property to discontinue agricultural production on-site and may encourage the property directly north to abandon its agricultural use. Although the proposed industrial use is compatible with agricultural production and there are a number of similar uses scattered throughout the project vicinity, implementation of the project may result in changes to the environment which could result in conversion of additional farmland to nonagricultural use. As such, impacts are considered significant and unavoidable.

Mitigation Measures

Implement MM 4.2-1.

Level of Significance after Mitigation

Impacts are considered significant and unavoidable.

Impact 4.2-6: The Project Would Result in the Cancellation of an Open Space Contract Made Pursuant to the California Land Conservation Act of 1965 or Farmland Security Zone Contract for Any Parcel of 100 or More Acres (Section 1526(b)(3) Public Resources Code.

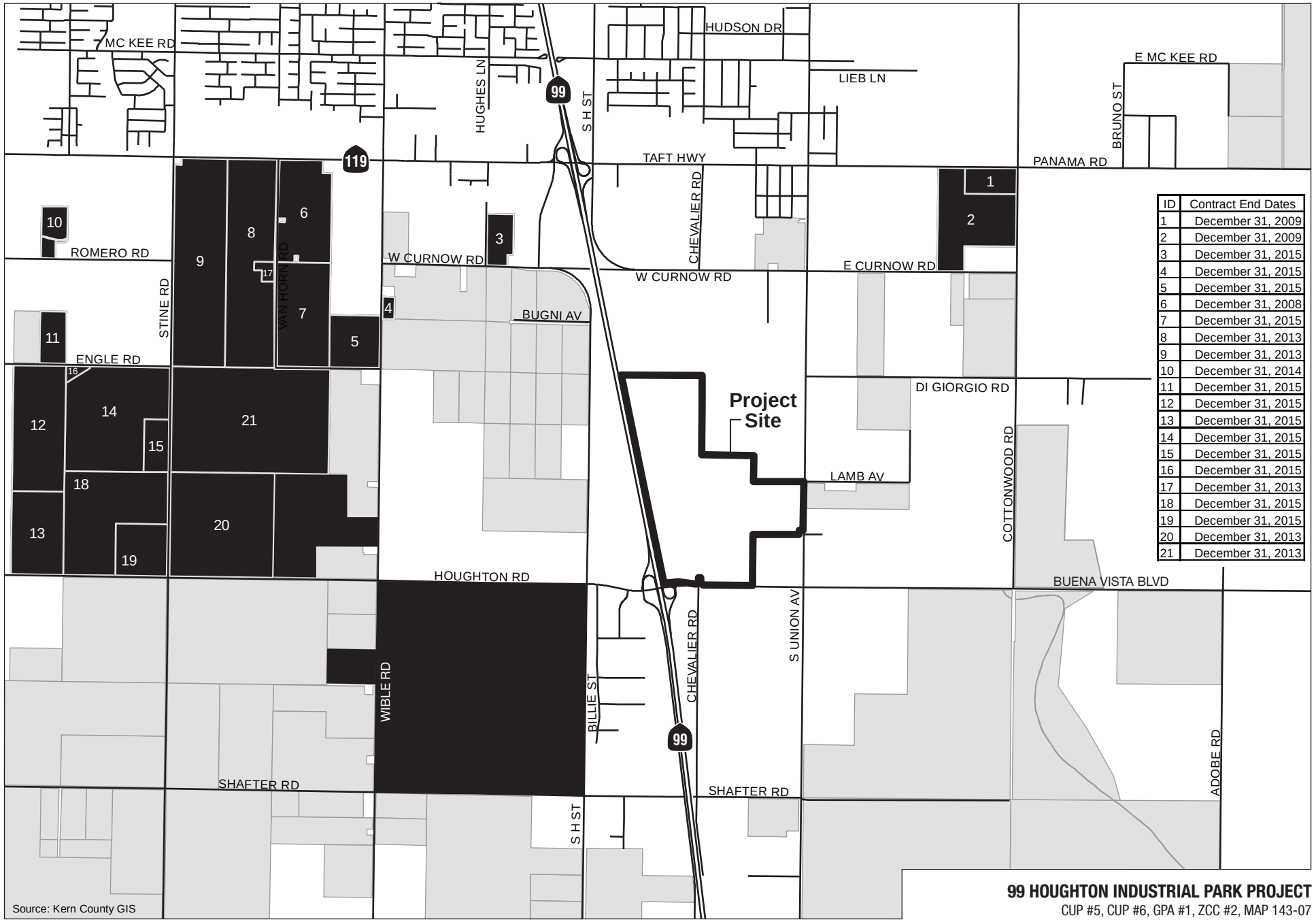
The proposed Project is not under a Williamson Act Land Use Contract. Many of the properties under existing Williamson Act Land Use Contracts (in the vicinity of the proposed Project) have already planned for the eventual urbanization of those lands by non-renewing their contracts. From 2009 to 2015, these properties were planning to end their Williamson Act Contracts (refer to Figure 4.2-1, *Williamson Act Contracts*). There are numerous properties to the east (including one parcel that is directly adjacent to the proposed Project) and west of the proposed Project site that are under Williamson Act Contracts.

Mitigation Measures

Implement MM 4.2-1.

Level of Significance after Mitigation

Impacts are considered less than significant.



ID	Contract End Dates
1	December 31, 2009
2	December 31, 2009
3	December 31, 2015
4	December 31, 2015
5	December 31, 2015
6	December 31, 2008
7	December 31, 2015
8	December 31, 2013
9	December 31, 2013
10	December 31, 2014
11	December 31, 2015
12	December 31, 2015
13	December 31, 2015
14	December 31, 2015
15	December 31, 2015
16	December 31, 2015
17	December 31, 2013
18	December 31, 2015
19	December 31, 2015
20	December 31, 2013
21	December 31, 2013

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07

AGRICULTURAL PRESERVE #13 EXCLUSION

Williamson Act Contracts

Figure 4.2-1

Cumulative Impacts

Kern County has ranked among the leading counties in California for urbanization and net loss of farmland. For the years 2013-2014, the amount of important and interim farmland in Kern County decreased by 88,338 acres. About one-third of this decrease was due to urban-related changes, while two-thirds was associated with the idling of farmland.

The Metropolitan Bakersfield General Plan EIR also acknowledges that some of the Williamson Act contracted lands within the Metropolitan Bakersfield area will be lost to future development. The Farmland Conversion Study concluded that the proposed Project would not result in pressures to develop neighboring Williamson Act lands and is considered appropriate for the conversion as proposed.

As seen in Chapter 3, *Project Description*, Table 3-5, *Cumulative Projects List*, there are more than 100 proposed and/or pending Projects within a six-mile radius of the proposed Project. The conversion of approximately 314.30 acres of farmland within the Project site would increase the total acreage of urban uses. Additionally, the conversion of this property from agricultural use to commercial/industrial use is expected to create cumulative or growth-inducing impacts to other adjacent farmlands. The existing and planned land uses surrounding the proposed Project site, as previously discussed, illustrate that the proposed Project site is in an area that is experiencing some growth.

Although the Metropolitan Bakersfield General Plan has various land use policies that direct development to encourage site compatibility with surrounding uses, the cumulative loss of agricultural land results in a significant and unavoidable impact. Therefore, Project implementation, when combined with the potential loss of other agricultural lands within the Planning area, over time, would remain a significant and unavoidable impact.

Mitigation Measures

Implement MM 4.2-1.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

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Section 4.3

Air Quality

Section 4.3
Air Quality

4.3.1 Introduction

This section of the RDEIR analyzes the potential air quality impacts associated with the proposed Project. The air quality section is divided into the following subsections: Environmental Setting, Regulatory Setting, and Impacts and Mitigation Measures. This section evaluates the short and long-term air quality impacts associated with the build out of the proposed Project site and discusses mitigation where required to avoid or lessen the project's impacts.

Insight Environmental Consultants completed an Air Quality Impact Analysis in June 2009 that evaluated the proposed Project's potential impacts on air quality. A second Air Quality Impact Analysis was prepared by Insight Environmental Consultants in July 2017. See Appendix C, Air Quality Impact Analysis, and Appendix N, Original Technical Studies. Information supporting this analysis is also contained in the San Joaquin Valley Air Pollution Control District (SJVAPCD) 2015 Guidance for Assessing and Mitigating Air Quality Impacts (GAMAQI) and Kern County's Guidelines for the Preparation of Air Quality Assessment for Environmental Impact Reports.

4.3.2 Environmental Setting

The California Air Resources Board (CARB) has divided California into regional air basins according to topographic drainage features. The proposed Project site is located in the western portion of Kern County, within the San Joaquin Valley Air Basin (SJVAB) and is under the jurisdiction of the SJVAPCD. The SJVAB, which is 250 miles long and 35 miles wide, is the second-largest air basin in the state.

Topography and Meteorology

Air pollution, especially the dispersion of air pollutants, is directly related to a region's topographic features, which also make up the SJVAB boundaries. The SJVAB lies in the central region of the State of California and is bounded to the east by the Sierra Nevada Mountain Range (8,000 to 14,000 feet in elevation), to the west by the Coast Mountain Range (averaging 3,000 feet in elevation), and to the south by the Tehachapi Mountain Range (6,000 to 8,000 feet in elevation). Between these boundaries is a relatively flat valley floor that opens to the sea at the Carquinez Strait where the San Joaquin-Sacramento Delta (Delta) empties into San Francisco Bay.

Localized air quality can be greatly affected by elevation and topography. For the majority of the San Joaquin Valley, air movement through and out of the SJVAB is restricted by the hills and the mountains surrounding it. Although marine air generally flows into the SJVAB from the San Joaquin–Sacramento Delta, the Coast Range hinders wind movement into the SJVAB from the west, the Tehachapi Mountains prevent the southerly passage of airflow, and the Sierra Nevada is a significant wind barrier to the east. These topographic features result in weak airflow into the valley, which

becomes vertically blocked by high barometric pressure over the SJVAB. As a result, the majority of the SJVAB is highly susceptible to pollutant accumulation over time. Furthermore, most of the surrounding mountains are above the normal height of the summer inversion layer.

Wind speed and direction play an important role in the dispersion and transport of air pollutants. Ozone (O_3) and inhalable particulates (particulate matter 10 microns or less in diameter [PM_{10}] and particulate matter 2.5 microns or less in diameter [$PM_{2.5}$]) are classified as regional pollutants because they can be transported away from the emission source before concentrations peak. In contrast, local pollutants, such as carbon monoxide (CO), tend to have their highest concentrations near the source of emissions and dissipate easily; therefore, their highest concentrations occur during low wind speeds.

Wind speed and direction data indicate that during the summer, winds usually originate at the north end of the SJVAB and flow in a south/southeasterly direction through the Tehachapi Pass and into the Southeast Desert Air Basin. During the winter, winds occasionally originate from the south end of the SJVAB and flow in a north/northwesterly direction. Also, during winter, the SJVAB experiences light, variable winds, typically less than 10 miles per hour. Low wind speeds, combined with low inversion layers in the winter, create a climate that is conducive to high CO and inhalable PM_{10} concentrations.

The vertical mixing of air pollutants is limited by the presence of persistent temperature inversions. Inversions may be either at ground level or elevated. Ground-level inversions occur frequently during fall and early winter (i.e., October through January). High concentrations of primary pollutants, which are those emitted directly into the atmosphere (e.g., CO), may be found during these times. Elevated inversions act as a lid over the basin and limit vertical mixing. Severe air stagnation occurs as a result of these inversions. Elevated inversions contribute to the occurrence of high levels of O_3 during the summer months.

The SJVAB enjoys an inland Mediterranean climate, averaging more than 260 sunny days per year. The valley floor is characterized by warm, dry summers and cooler winters. Average daily temperatures in the basin range from 41.7 degrees Fahrenheit (°F) in December to 98.7°F in July. Summer highs often exceed 100°F, averaging in the low 90s in the northern valley and high 90s to the south. Although the SJVAB enjoys a high percentage of sunshine, a reduction in sunshine occurs during December and January because of fog and intermittent stormy weather. Nearly 90 percent of the annual precipitation falls in the six months between October and May. Precipitation is low because the mountains to the west and south produce a rain shadow effect by intercepting prefrontal, moisture-laden western and southern winds. The southern valley receives precipitation primarily from cold, unstable, northwesterly flows that usually follow a frontal passage.

Sensitive Receptors

Some people are considered more sensitive to air pollutants than others, including those with pre-existing health problems, those who are close to an emissions source, or those who are exposed to air pollutants for long periods of time. The SJVAPCD GAMAQI defines sensitive receptors as those that are more susceptible to the effects of air pollution than the population at large and include “facilities that house or attract children, the elderly, and people with illnesses, hospitals, schools, convalescent

facilities, and residential areas are examples of sensitive receptors" (SJVAPCD, 2015). Land uses such as primary and secondary schools, hospitals, and convalescent homes are considered to be relatively sensitive because the very young, the old, and the infirm are more susceptible to respiratory infections and other air quality–related health problems than the general public. Residential areas are considered sensitive to poor air quality because people in residential areas are often at home for extended periods. Recreational land uses are moderately sensitive to air pollution because vigorous exercise associated with recreation places a high demand on the human respiratory function.

There are residential areas within one mile or less to the north, east, and south of the proposed Project, with the closest residential structures located within properties adjacent to the Project site, approximately 500 feet from the Project boundaries. There are four non-residential sensitive receptors within two miles of the proposed Project as follows:

- General Shafter Elementary School, 1.09 miles southwest;
- McKee Middle School, 1.35 miles northeast;
- Golden Valley High School, 1.76 miles north; and
- Horizon Elementary School, 2.00 miles north.

National and State Ambient Air Quality Standards

Both the State of California and the federal government have established ambient air quality standards for several different pollutants. A summary of state and national ambient air quality standards (CAAQS and NAAQS, respectively) is shown in Table 4.3-1, *National and California Ambient Air Quality Standards.* For some pollutants, separate standards have been set for different periods. Most standards have been set to protect public health. For other pollutants, standards have been based on other values (such as protection of crops, protection of materials, or avoidance of nuisance conditions).

Table 4.3-1. National and California Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards[a]	California Standards[b]
Ozone (O_3)	8 Hours	0.070 ppm (137 µg/m^3)[c]	0.070 ppm (137 µg/m^3)
	1 Hour	--[d]	0.09 ppm (180 µg/m^3)
Carbon Monoxide (CO)	8 Hours	9 ppm (10 mg/m^3)	9.0 ppm (10 mg/m^3)
	1 Hour	35 ppm (40 mg/m^3)	20 ppm (23 mg/m^3)
Nitrogen Dioxide (NO_2)	Annual Average	53 ppm (100 µg/m^3)	0.030 ppm (56 µg/m^3)
	1 Hour	100 ppb (188.68 µg/m^3)	0.18 ppm (338 µg/m^3)
Sulfur Dioxide (SO_2)	3 Hour	0.5 ppm (1,300 µg/m^3)	--
	24 Hours	0.14 ppm (365 µg/m^3)	0.04 ppm (105 µg/m^3)

Table 4.3-1. National and California Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards[a]	California Standards[b]
	1 Hour	75 ppb (196 µg/m^3)	0.25 ppm (655 µg/m^3)
Particulate Matter (PM_{10})	Annual Arithmetic Mean	--[e]	20 µg/m^3
	24 Hours	150 µg/m^3	50 µg/m^3
Particulate Matter—Fine ($PM_{2.5}$)	Annual Arithmetic Mean	12.0 µg/m^3	12 µg/m^3
	24 Hours	35 µg/m^3	--
Sulfates (SO_4)	24 Hours	--	25 µg/m^3
Lead[f] (Pb)	Rolling Three Month Average	0.15 µg/m^3	--
	30-day Average	--	1.5 µg/m^3
Hydrogen Sulfide (H_2S)	1 Hour	--	0.03 ppm (42 µg/m^3)
Vinyl Chloride (chloroethene)	24 Hours	--	0.01 ppm (26 µg/m^3)
Visibility-Reducing Particles (VRPs)	8 Hours (1000 to 1800 PST)	--	--[g]

ppm = parts per million; ppb = parts per billion; mg/m^3 = milligrams per cubic meter; µg/m^3= micrograms per cubic meter.
[a] 1-Hour O3 standard revoked effective June 15, 2005.
[b] Annual PM 10 standard revoked effective December 18, 2006.
[c] EPA finalized the revised (2008) 8-hour O3 standard of 0.075 ppm on March 27, 2008. The 1997 8-hour O3 standard of 0.08 ppm has not been revoked. In the January 19, 2010 Federal Register, EPA proposed to revise the 2008 O3 NAAQS of 0.075 ppm to a NAAQS in the range of 0.060 to 0.070 ppm. EPA expects to finalize the revised NAAQS, which will replace the 0.075 ppm NAAQS, by July 29, 2011.
[d] On October 15, 2008, EPA strengthened the Pb standard.
[e] Statewide Visibility Reducing Particle Standard (except Lake Tahoe Air Basin): Particles in sufficient amount to produce an extinction coefficient of 0.23 per kilometer when the relative humidity is less than 70 percent. This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range.

Source: Insight Environmental Consultants, 2017.

Local Standards

CARB operates the local meteorological and air quality monitoring stations in the Project vicinity. Table 4.3-2, *San Joaquin Valley Air Bain Attainment Status*, lists the air quality attainment status for the SJVAB. Pursuant to the methodologies prescribed by the SJVAPCD's GAMAQI, the analysis within this section primarily models and analyzes reactive organic gases (ROG), nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$) and sulfur oxides (SO_X). In accordance with the January 2015 GAMAQI technical guidance document, the SJVAPCD no longer monitors lead in the ambient air of the SJVAB since the used of leaded fuel has been mostly phased out. Hydrogen sulfide (H_2S) is associated with geothermal activities, oil and gas production, refining, sewage treatment plants and confined animal feeding operations; however, CARB does not have a measuring method to accurately designate areas in the state (i.e., attainment or nonattainment). Sulfate data collected in the SJVAB demonstrated levels of sulfates significantly less than the health standards.

Areas can be classified as in attainment (air pollutant levels consistently below the standard) or as nonattainment (levels of air pollutant consistently violate the standard). Areas that do not meet the standards shown in Table 4.3-1 are classified as nonattainment areas. The determination of whether an area meets the State and National standards is based on air quality monitoring data. Some areas

are unclassified, which means that not enough data available to determine whether the standard is exceeded in an area. Unclassified areas are typically treated as being in attainment. Because the attainment/nonattainment designation is pollutant specific, an area may be classified as a nonattainment area for one pollutant and an attainment area for another. Similarly, because the State and National standards differ, an area could be classified as an attainment area for the National standards of a pollutant and as a nonattainment area for the state standards of the same pollutant. As presented in Table 4.3-2, the SJVAB is currently in severe nonattainment for the one-hour State standard for ozone (O_3), extreme nonattainment and nonattainment for the eight-hour federal and State standard for O_3, respectively, and nonattainment for State standard for PM_{10}. The area is also in nonattainment for the federal and State standards for particulate matter 2.5 microns or less in diameter ($PM_{2.5}$).

Table 4.3-2. San Joaquin Valley Air Quality Attainment Status

Pollutant	Federal Standards[1]	State Standards[2]
Ozone—1 hour	No federal standard[3]	Nonattainment - Severe
Ozone—8 hour	Nonattainment – Extreme[4]	Nonattainment
PM_{10}	Attainment[5]	Nonattainment
$PM_{2.5}$	Nonattainment[6]	Nonattainment
CO	Attainment /Unclassified	Attainment/Unclassified
Nitrogen dioxide	Attainment/Unclassified	Attainment
Sulfur dioxide	Attainment/Unclassified	Attainment
Lead (Particulate)	No designation/classification	Attainment
Hydrogen sulfide	No federal standards	Unclassified
Sulfates	No federal standards	Attainment
Visibility-reducing particulates	No federal standards	Unclassified
Vinyl Chloride	No federal standard	Attainment

[a] See 40 CFR Part 81

[b] See CCR Title 17 Sections 60200-60210

[c] On September 25, 2008, EPA redesignated the San Joaquin Valley to attainment for the PM_{10} National Ambient Air Quality Standard (NAAQS) and approved the PM10 Maintenance Plan.

[d] The Valley is designated nonattainment for the 1997 PM2.5 NAAQS. EPA designated the Valley as nonattainment for the 2006 $PM_{2.5}$ NAAQS on November 13, 2009 (effective December 14, 2009).

[e] Though the Valley was initially classified as serious nonattainment for the 1997 8-hour O_3 standard, EPA approved Valley reclassification to extreme nonattainment in the Federal Register on May 5, 2010 (effective June 4, 2010).

[f] Effective June 15, 2005, the EPA revoked the federal 1-hour O_3 standard, including associated designations and classifications. EPA had previously classified the SJVAB as extreme nonattainment for this standard. EPA approved the 2004 Extreme Ozone Attainment Demonstration Plan on March 8, 2010 (effective April 7, 2010). Many applicable requirements for extreme 1-hour O3 nonattainment areas continue to apply to the SJVAB.

Source: Insight Environmental Consultants, 2017.

In order to reach attainment for the State and National ambient air quality standards, the Extreme Ozone Attainment Demonstration Plan (Extreme OADP) was published by the SJVAPCD and approved by CARB and the United States Environmental Protection Agency (EPA). The Extreme OADP was prepared to fulfill the requirements of the Federal Clean Air Act (CAA) and attain the federal one-hour O_3 ambient air quality standards in the SJVAB by November 15, 2010. It identifies control measures needed to reduce emissions and projects future air quality impacts with implementation of those controls. The SJVAPCD and CARB implement control measures needed to

achieve emission reductions, with the SJVAPCD implementing some of the control measures as listed in the Extreme OADP as rules.

Regional Air Quality

The SJVAPCD is the regional agency responsible for the regulation and enforcement of federal, state, and local air pollution control regulations in the SJVAB. The SJVAPCD jurisdiction includes all of Merced, San Joaquin, Stanislaus, Madera, Fresno, Kings, and Tulare counties, and the San Joaquin Valley portion of Kern County. The SJVAPCD has identified quantitative emission thresholds for CO, nitrogen oxides (NO_X), ROGs, SO_x, PM_{10}, and $PM_{2.5}$ to determine whether the potential air quality impacts of a project may produce a significant impact. The air quality threshold for CO is 100 tons per year, NO_x and ROG is 10 tons per year, SO_x is 27 tons per year, and for PM_{10} and $PM_{2.5}$ is 15 tons per year, which establish the limit at which an impact to the SJVAB may occur.

Additionally, the SJVAPCD's GAMAQI considers construction emissions and operational emissions as separate and distinct in that construction emissions are considered short-term impacts and temporary in nature while operational and area source emissions are considered long-term.

The SJVAPCD has set up the Indirect Source Review (ISR) Program in order to address new development projects that have not yet gained discretionary approval from the applicable public agency. The ISR Program is based on SJVAPCD Rules 9510 and 3180, which provide a methodology for assessing the air quality impacts created by a new development; regulations to limit the emissions of pollutants during the construction process; and the option of onsite emissions reduction measures and offsite emission reduction through fees, which are used to fund offsite emission reduction projects, or some combination of both options; refer to Appendix C.

Local Air Quality

Under authority and oversight from the EPA pursuant to 40 CFR Part 58, the SJVAPCD and CARB maintain ambient air quality monitoring stations throughout the SJVAB, with ten sites in Kern County (Arvin-DiGiorgio, Bakersfield (four sites), Edison, Lebec, Maricopa, Oildale, and Shafter). Not all air pollutants are monitored at each station; thus, data from the closest representative station that monitors a specific pollutant are summarized.

Table 4.3-3, *Existing Air Quality Monitoring Data for 2013-2015,* shows the Kern County monitoring stations and the pollutants monitored. The locations of these stations were chosen to meet monitoring objectives. The monitoring objectives call for stations that monitor the highest pollutant concentrations, representative concentrations in areas of high population density, the impact of major pollution emissions sources, and general background concentration levels (Insight Environmental Consultants 2016).

The Air Quality Impact Analysis (Insight Environmental Consultants 2017) relied on data collected from 2013 to 2015 at the CARB monitoring stations that are located in the closest proximity to the proposed Project. Table 4.3-3, provides the background concentrations for O_3, PM_{10}, $PM_{2.5}$, CO, NO_2, SO_2, and lead (Pb) as of November 2015 as well as the number of days that thresholds were exceeded. Information is provided for the Bakersfield-5558 California Avenue; Arvin-Di Giorgio,

Oildale – 3311 Manor Street; Bakersfield – 410 E. Planz Road; Bakersfield-Municipal Airport; Bakersfield – Golden State Highway; Edison, Shafter – Walker Street; Maricopa-Stanislaus Street; and Sacramento – Del Paso Manor monitoring stations for 2013 through 2015. No data are available for hydrogen sulfide, vinyl chloride, or other toxic air contaminants (TACs) in Kern County. Detailed air quality data are included in Appendix C, *Air Quality Impact Assessment*.

Table 4.3-3. Existing Air Quality Monitoring Data for 2013-2015

Pollutant and Monitoring Station Location	Maximum Concentration			Days Exceeding Standard		
	2013	2014	2015	2013	2014	2015
Ozone: Maximum 1-Hour (CAAQS 0.09 ppm)						
Bakersfield-5558 California Ave.	0.107	0.102	0.104	3	3	6
Bakersfield – Municipal Airport	0.109	0.108	0.118	6	10	23
Arvin-DiGiorgio	0.109	0.109	0.124	14	15	16
Edison	0.101	0.107	0.112	2	15	17
Maricopa - Stanislaus	0.089	0.090	0.094	0	0	0
Shafter- Walker Street	0.112	0.100	0.104	1	2	3
Oildale – 3311 Manor St.	0.099	0.093	0.099	1	0	2
Ozone: Maximum 8-Hour (CAAQS 0.07 ppm)						
Bakersfield-5558 California Ave.	0.099	0.093	0.097	47	39	54
Bakersfield – Municipal Airport	0.103	0.095	0.106	56	60	73
Arvin-DiGiorgio	0.095	0.092	0.101	68	69	55
Edison	0.086	0.092	0.099	21	55	45
Maricopa - Stanislaus	0.084	0.084	0.088	23	25	32
Shafter- Walker Street	0.097	0.087	0.091	19	28	34
Oildale – 3311 Manor St.	0.090	0.085	0.092	15	25	33
Ozone: Maximum 8-Hour (NAAQS 0.07 ppm)						
Bakersfield-5558 California Ave.	0.098	0.092	0.096	43	36	52
Bakersfield – Municipal Airport	0.102	0.095	0.106	55	58	69
Arvin-DiGiorgio	0.094	0.091	0.101	64	65	53
Edison	0.086	0.091	0.099	19	52	42
Maricopa - Stanislaus	0.083	0.083	0.087	23	24	32
Shafter- Walker Street	0.096	0.087	0.090	17	24	34
Oildale – 3311 Manor St.	0.090	0.085	0.092	13	24	33
PM_{10}: 24-Hour (CAAQS 50 µg/m^3)						
Bakersfield-5558 California Ave.	116.9	419.5	103.6	16	69	20
Bakersfield – Golden State Hwy.	*	*	94.6	0	0	16
Oildale – 3311 Manor Street	138.0	335.6	104.4	27	20	26
PM_{10}: 24-Hour (NAAQS 150 µg/m^3)						
Bakersfield-5558 California Ave.	120.07	430.1	104.7	0	1	0
Bakersfield – Golden State Hwy.	*	*	100.5	0	0	0
Oildale – 3311 Manor Street	134.3	336.4	98.5	0	3	0
$PM_{2.5}$: 24-Hour (NAAQS 35 µg/m^3)						
Bakersfield – 410 East Planz Road	167.3	91.0	83.2	15	15	13
Bakersfield – 5558 California Avenue	111.7	101.9	107.8	44	37	29
Bakersfield – Golden State Highway	*	107.2	91.1	*	2	9
CO: 8-hour (CAAQS & NAAQS 9.0 ppm)						
Fresno – 1st Street	n/a	n/a	n/a	n/a	n/a	n/a

Table 4.3-3. Existing Air Quality Monitoring Data for 2013-2015

Pollutant and Monitoring Station Location	Maximum Concentration			Days Exceeding Standard		
	2013	2014	2015	2013	2014	2015
NO_2: 1-Hour (CAAQS 0.18 ppm)						
Bakersfield – 5558 California Avenue	0.055	0.060	0.054	0	0	0
Shafter – Walker Street	0.058	0.058	0.045	0	0	0
Edison	0.047	0.035	0.046	0	0	0
Bakersfield – Municipal Airport	0.065	0.064	0.055	0	0	0
NO_2: 1-Hour (NAAQS 0.10 ppm)						
Bakersfield – 5558 California Avenue	0.055	0.061	0.055	0	0	0
Shafter – Walker Street	0.059	0.059	0.045	0	0	0
Edison	0.047	0.035	0.047	0	0	0
Bakersfield – Municipal Airport	0.065	0.064	0.055	0	0	0
SO_2: 24-Hour Concentration (CAAQS 0.04 ppm; NAAQS 0.14 ppm)[1]						
Sacramento – Del Paso Manor	n/a	n/a	n/a	n/a	n/a	n/a
Pb – Maximum 30-Day Concentration (CAAQS 1.5 µg/m^3)						
Bakersfield – 5558 California Avenue	0.0067	0.0140	0.0095	*	*	*

Notes: ppm= parts per million

* There was insufficient (or no) data available to determine the value.

[1] SJVAB did not have any monitoring stations that measured SO_2 during the years of 2012-2014.

Source: Insight Environmental Consultants 2017.

Common Air Pollutants

The following is a general description of the sources, and the physical and health effects, for air pollutants expected from this proposed Project.

Ozone

Ozone (O_3) occurs in two layers of the atmosphere. The layer surrounding the earth's surface is the troposphere. In the troposphere, ground level, or "bad," ozone is an air pollutant that damages human health, vegetation, and many common materials. It is a key ingredient of urban smog. The troposphere extends to a level about 10 miles up, where it meets the second layer, the stratosphere. The stratospheric, or "good," ozone layer extends upward from about 10 to 30 miles and protects life on earth from the sun's harmful ultraviolet rays.

"Bad" ozone is what is known as a photochemical pollutant. It needs ROG, NO_x, and sunlight. ROG and NO_x are emitted from various sources throughout Kern County. In order to reduce ozone concentrations, it is necessary to control the emissions of these ozone precursors. Significant ozone formation generally requires an adequate amount of precursors in the atmosphere and several hours in a stable atmosphere with strong sunlight. High ozone concentrations can form over large regions when emissions from motor vehicles and stationary sources are carried hundreds of miles from their origins.

O_3 is a regional air pollutant and the SJVAB has high concentrations of ozone. It is generated over a large area and transported and spread by the wind. As the primary constituent of smog, ozone is the most complex, difficult to control, and pervasive of the criteria pollutants. Ozone is a photochemical pollutant that is not emitted directly into the earth's lower atmosphere, but formed by a complex series

of chemical reactions between ROG, NO_X and sunlight. Ozone precursors (ROG and NO_X) can come from a variety of sources throughout the Valley including; automobiles, solvents, and fuel combustion; therefore, ozone is a regional pollutant because ozone precursors are transported and diffused by wind concurrently with the reaction process. The highest ozone concentrations are generally found downwind from emission sources, generally located in the metropolitan areas.

Health Effects

While ozone in the upper atmosphere protects the earth from harmful ultraviolet radiation, high concentrations of ground-level ozone can adversely affect the human respiratory system. Many respiratory ailments, as well as cardiovascular disease, are aggravated by exposure to high ozone levels. Ozone also damages natural ecosystems, such as forests and foothill communities; agricultural crops; and some man-made materials, such as rubber, paint, and plastic. High levels of ozone may negatively affect immune systems, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia. Ozone accelerates aging and exacerbates pre-existing asthma and bronchitis and, in cases with high concentrations, can lead to the development of asthma in active children. Active people, both children and adults, appear to be more at risk from ozone exposure than those with a low level of activity. Additionally, the elderly and those with respiratory disease are also considered sensitive populations for ozone.

Ozone is a powerful oxidant; it can be compared to household bleach, which can kill living cells (such as germs or human skin cells) upon contact. Ozone can damage the respiratory tract, causing inflammation and irritation, and it can induce symptoms such as coughing, chest tightness, shortness of breath, and worsening of asthmatic symptoms. Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. Exposure to levels of ozone above the current ambient air quality standard leads to lung inflammation and lung tissue damage and a reduction in the amount of air inhaled into the lungs. Recent evidence has, for the first time, linked the onset of asthma to exposure to elevated ozone levels in exercising children. Elevated ozone concentrations also reduce crop and timber yields, damage native plants, and damage materials such as rubber, paints, fabric, and plastics.

Reactive Organic Gases (ROG) and Volatile Organic Compounds (VOC)

Hydrocarbons are organic gases that are formed solely of hydrogen and carbon. There are several subsets of organic gases, including volatile organic compounds (VOCs) and ROGs, which include all hydrocarbons except those exempted by CARB. Therefore, ROGs are a set of organic gases based on state rules and regulations. VOCs are similar to ROGs in that they include all organic gases except those exempted by Federal law. The list of compounds exempt from the definition of a VOC is presented in District Rule 1102.

Both VOCs and ROGs are emitted from incomplete combustion of hydrocarbons or other carbon-based fuels. Combustion engine exhaust, oil refineries, and oil-fueled power plants are the primary sources of hydrocarbons. Another source of hydrocarbons is evaporation from petroleum fuels, solvents, dry cleaning solutions, and paint.

Health Effects

The primary health effects of hydrocarbons result from the formation of ozone and its related health effects (see the ozone health effects discussion above). High levels of hydrocarbons in the atmosphere can interfere with oxygen intake by reducing the amount of available oxygen through displacement. There are no separate federal or California ambient air quality standards for ROG. Carcinogenic forms of ROG are considered TACs. An example is benzene, which is a carcinogen. The health effects of individual ROGs are described under the toxic air contaminants heading below.

Carbon Monoxide (CO)

Carbon monoxide (CO) is emitted by mobile and stationary sources as a result of incomplete combustion of hydrocarbons or other carbon-based fuels. CO is an odorless, colorless, poisonous gas that is highly reactive.

CO is a byproduct of motor vehicle exhaust, which contributes more than two-thirds of all CO emissions nationwide. In cities, automobile exhaust can cause as much as 95 percent of all CO emissions. Vehicular emissions can result in high background concentrations of CO, particularly in local areas with heavy traffic congestion. Other sources of CO emissions include industrial processes and fuel combustion from sources such as boilers and incinerators. Despite an overall downward trend in concentrations and emissions of CO, some metropolitan areas still experience high levels of CO.

Health Effects

CO enters the bloodstream and binds more readily to hemoglobin than oxygen, reducing the oxygen-carrying capacity of blood and thus reducing oxygen delivery to organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected but only at higher levels of exposure. CO binds strongly to hemoglobin, the oxygen-carrying protein in blood, and thus reduces the blood's capacity for carrying oxygen to the heart, brain, and other parts of the body. Exposure to CO can cause chest pain in heart patients, headaches, and reduced mental alertness. At high concentrations, CO can cause heart difficulties in people with chronic diseases and can impair mental abilities. Exposure to elevated CO levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, difficulty performing complex tasks, and in prolonged, enclosed exposure, death.

The adverse health effects associated with exposure to ambient and indoor concentrations of CO are related to the concentration of carboxyhemoglobin (COHb) in the blood. Health effects observed may include an early onset of cardiovascular disease; behavioral impairment; decreased exercise performance of young, healthy men; reduced birth weight; sudden infant death syndrome (SIDS); and increased daily mortality rate (Fierro et al. 2001).

Most of the studies evaluating adverse health effects of CO on the central nervous system examine high-level poisoning. Such poisoning results in symptoms ranging from common flu and cold symptoms (shortness of breath on mild exertion, mild headaches, and nausea), to unconsciousness and death.

Oxides of Nitrogen (NO_x)

NO_X is a family of highly reactive gases that are primary precursors to the formation of ground-level ozone and react in the atmosphere to form acid rain. NO_X is emitted from the use of solvents and combustion processes in which fuel is burned at high temperatures, principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers. A brownish gas, NO_X is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates. NO_x is an ozone precursor that combines with ROG to form ozone (see the discussion of ozone above).

Health Effects

NO_X is an ozone precursor that combines with ROG to form ozone. See the ozone section above for a discussion of the health effects of ozone.

Direct inhalation of NO_X can also cause a wide range of health effects. NO_X can irritate the lungs, cause lung damage, and lower resistance to respiratory infections such as influenza. Short-term exposures (e.g., less than three hours) to low levels of nitrogen dioxide (NO_2) may lead to changes in airway responsiveness and lung function in individuals with preexisting respiratory illnesses. These exposures may also increase respiratory illnesses in children. Long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause irreversible alterations in lung structure. Other health effects associated with NO_X are an increase in the incidence of chronic bronchitis and lung irritation. Chronic exposure to NO_2 may lead to eye and mucus membrane aggravation, along with pulmonary dysfunction. NO_X can cause fading of textile dyes and additives, deterioration of cotton and nylon, and corrosion of metals due to production of particulate nitrates. Airborne NO_X can also impair visibility.

NO_X contributes to a wide range of environmental effects both directly and indirectly when combined with other precursors in acid rain and ozone. Increased nitrogen inputs to terrestrial and wetland systems can lead to changes in plant species composition and diversity. Similarly, direct nitrogen inputs to aquatic ecosystems such as those found in estuarine and coastal waters can lead to eutrophication (a condition that promotes excessive algae growth, which can lead to a severe depletion of dissolved oxygen and increased levels of toxins that are harmful to aquatic life). Nitrogen, alone or in acid rain, also can acidify soils and surface waters. Acidification of soils causes the loss of essential plant nutrients and increased levels of soluble aluminum, which is toxic to plants. Acidification of surface waters creates low pH conditions and levels of aluminum that are toxic to fish and other aquatic organisms.

Particulate Matter

Particulate matter pollution consists of very small liquid and solid particles floating in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. Particulate matter is a mixture of materials that can include smoke, soot, dust, salt, acids, and metals. Particulate matter also forms when gases emitted from motor vehicles and industrial sources undergo chemical reactions in the atmosphere. PM_{10} refers to particles less than or equal to 10 microns in aerodynamic diameter. $PM_{2.5}$ refers to particles less than or equal to 2.5 microns in aerodynamic diameter and are a subset of PM_{10}.

In the western United States, there are sources of PM_{10} in both urban and rural areas. PM_{10} and $PM_{2.5}$ are emitted from stationary and mobile sources, including diesel trucks and other motor vehicles; power plants; industrial processes; wood-burning stoves and fireplaces; wildfires; dust from roads, construction, landfills, and agriculture; and fugitive windblown dust. Because particles originate from a variety of sources, their chemical and physical compositions vary widely.

Health Effects

PM_{10} and $PM_{2.5}$ particles are small enough to be inhaled and lodged in the deepest parts of the lung where they evade the respiratory system's natural defenses. Health problems begin as the body reacts to these foreign particles. Acute and chronic health effects associated with high particulate levels include the aggravation of chronic respiratory diseases; heart and lung disease; and coughing, bronchitis, and respiratory illnesses in children. Recent mortality studies have shown a statistically significant direct association between mortality and daily concentrations of particulate matter in the air. PM_{10} and $PM_{2.5}$ can aggravate respiratory disease and cause lung damage, cancer, and premature death. Sensitive populations, including children, the elderly, exercising adults, and those suffering from chronic lung disease such as asthma or bronchitis are especially vulnerable to the effect of PM_{10}. Non-health-related effects include reduced visibility and soiling of buildings.

Attaining the California particulate matter standards would annually prevent about 6,500 premature deaths, or 3 percent of all deaths. These premature deaths shorten lives by an average of 14 years. This is roughly equivalent to the same number of deaths (4,200 to 7,400) linked to secondhand smoke in 2000. In comparison, motor vehicle crashes caused 3,200 deaths, and 2,000 deaths resulted from homicide. Attaining the California particulate matter and O_3 standards would annually prevent 4,000 hospital admissions for respiratory disease, 3,000 hospital admissions for cardiovascular disease, and 2,000 asthma-related emergency room visits. Exposure to diesel particulate matter causes about 250 excess cancer cases per year in California (CARB and American Lung Association of California, 2007).

A recent study provides evidence that exposure to particulate air pollution is associated with lung cancer. This study found that residents who live in an area that is severely affected by particulate air pollution are at risk of lung cancer at a rate comparable to nonsmokers exposed to secondhand smoke. This study also found an approximately 16 percent excess risk of dying from lung cancer due to fine-particulate air pollution (Pope et al., 2002). Another study shows that individuals with existing cardiac disease can be in a potentially life-threatening situation when exposed to high levels of ultrafine air pollution. Fine particles can penetrate the lungs, cause the heart to beat irregularly, or cause inflammation, which could lead to a heart attack (Peters et al., 2001). Currently, 57 percent of California's population lives in areas that exceed the National $PM_{2.5}$ air standard, while 90 percent lives in areas that exceed California's $PM_{2.5}$ air standard (CARB and American Lung Association of California, 2007).

Sulfur Dioxide (SO_2)

SO_2 is a colorless, irritating gas with a "rotten egg" smell formed primarily by the combustion of sulfur-containing fossil fuels. Historically, SO_2 was a pollutant of concern in Kern County, but with the successful application of regulations, the levels have been reduced significantly.

Health Effects

High concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels during moderate activity may result in breathing difficulties that can be accompanied by symptoms such as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer term exposures to high concentrations of SO_2 in conjunction with high levels of particulate matter include aggravation of existing cardiovascular disease, respiratory illness, and alterations in the lungs' defenses. SO_2 also is a major precursor to $PM_{2.5}$, which is a significant health concern and a main contributor to poor visibility. (See also the discussion of the health effects of particulate matter above.)

SO_2 not only has a bad odor, it can irritate the respiratory system. Exposure to high concentrations for short periods of time can constrict the bronchi and increase mucous flow, making breathing difficult. SO_2 can also irritate the lung and throat at concentrations greater than 6 ppm in many people, impair the respiratory system's defenses against foreign particles and bacteria when exposed to concentrations less than 6 ppm for longer time periods, and enhance the harmful effects of O_3 (combinations of the two gases at concentrations occasionally found in the ambient air appear to increase airway resistance to breathing).

SO_2 tends to have more toxic effects when acidic pollutants, liquid or solid aerosols, and particulates are also present. Effects are more pronounced among "mouth breathers" (e.g., people who are exercising or who have head colds). SO_2 easily injures many plant species and varieties, both native and cultivated. Some of the most sensitive plants include various commercially valuable pines, legumes, red and black oaks, white ash, alfalfa, and blackberry. Increases in SO_2 concentrations accelerate the corrosion of metals, probably through the formation of acids. SO_2 is a major precursor to acidic deposition. Sulfur oxides may also damage stone and masonry, paint, various fibers, paper, leather, and electrical components. Increased SO_2 also contributes to impaired visibility. Particulate sulfate, much of which is derived from SO_2 emissions, is a major component of the complex total suspended particulate mixture.

Other Pollutants

Sulfates

Sulfates (SO_x) are particulate products from combustion of sulfur-containing fossil fuels. When sulfur monoxide or SO_2 is exposed to oxygen, it precipitates out into sulfates (SO_3 or SO_4). Data collected in Kern County identify levels of sulfates that are significantly less than the applicable health standards.

Sulfates are the fully oxidized ionic form of sulfur. Sulfates occur in combination with metal and/or hydrogen ions. In California, emissions of sulfur compounds occur primarily from the combustion of petroleum-derived fuels (e.g., gasoline and diesel fuel) that contain sulfur. This sulfur is oxidized to SO_2 during the combustion process and subsequently converted to sulfate compounds in the atmosphere. The conversion of SO_2 to sulfates takes place comparatively rapidly and completely in urban areas of California because of regional meteorological features.

Health Effects

CARB's sulfates standard is designed to prevent aggravation of respiratory symptoms. Effects of sulfate exposure at levels above the standard include a decrease in oxygen intake, aggravation of asthmatic symptoms, and an increased risk of cardio-pulmonary disease. Sulfates are particularly effective in degrading visibility and, because they are usually acidic, can harm ecosystems, and damage materials and property (CARB 2009).

Lead (Pb)

Lead is a metal that is a natural constituent of air, water, and the biosphere. Lead is neither created nor destroyed in the environment, so it essentially persists forever. Historically, lead was used to increase the octane rating in automobile fuel. However, because gasoline-powered automobile engines were a major source of airborne lead through the use of leaded fuels and that use has been mostly phased out, the ambient concentrations of lead have dropped dramatically. Kern County no longer monitors lead in the ambient air of the SJVAB.

Health Effects

Exposure to lead occurs mainly through inhalation of air and ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues and can adversely affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause neurological impairments such as seizures, mental retardation, and behavioral disorders. Even at low doses, lead exposure is associated with damage to the nervous systems of fetuses and young children, resulting in learning deficits and lowered IQ. Recent studies also show that lead may be a factor in high blood pressure and subsequent heart disease. Lead can also be deposited on the leaves of plants, presenting a hazard to grazing animals and humans through ingestion (USEPA 2011).

Hydrogen Sulfide (H_2S)

Hydrogen sulfide (H_2S) emissions are associated with geothermal activity, oil and gas production, refining, sewage treatment plants, and confined animal feeding operations.

Health Effects

Exposure to low concentrations of H_2S may cause irritation to the eyes, nose, or throat. It may also cause difficulty in breathing for some asthmatics. Exposure to higher concentrations (above 100 ppm) can cause olfactory fatigue, respiratory paralysis, and death. Brief exposures to high concentrations of H_2S (greater than 500 ppm) can cause a loss of consciousness. In most cases, the person appears to regain consciousness without any other effects. However, in many individuals, there may be permanent or long-term effects such as headaches, poor attention span, poor memory, and poor motor function. No health effects have been found in humans exposed to typical environmental concentrations of H_2S (0.00011–0.00033 ppm). Deaths due to breathing in large amounts of H_2S have been reported in a variety of different work settings, including sewers, animal processing plants, waste dumps, sludge plants, oil and gas well drilling sites, and tanks and cesspools.

Visibility-Reducing Particles

The CAAQS for visibility-reducing particles (VRPs), as shown in Table 4.3-1, is a measure or visibility. CARB does not have a measuring method with enough accuracy or precision to designate areas in the state as attainment or nonattainmnent areas with respect to visibility. The entire state is labeled as unclassified.

Vinyl Chloride

Vinyl chloride monomer is a sweet-smelling, colorless gas at ambient temperature. Landfills, publicly owned treatment works, and polyvinyl chloride (PVC) production are the major identified sources of vinyl chloride emissions in California. PVC can be fabricated into several products, such as PVC pipes, pipe fittings, and plastics. In humans, epidemiological studies of occupationally exposed workers have linked vinyl chloride exposure to development of a rare cancer, liver angiosarcoma, and have suggested a relationship between exposure and lung and brain cancers. There are currently no adopted ambient air standards for vinyl chloride.

Health Effects

Short-term exposure to vinyl chloride has been linked with the following acute health effects (Agency for Toxic Substances and Disease Registry 2010; U.S. Department of Health and Human Services 2006):

- Acute exposure of humans to high levels of vinyl chloride via inhalation in humans has resulted in effects on the central nervous system, such as dizziness, drowsiness, headaches, and giddiness.

- Vinyl chloride is reported to be slightly irritating to the eyes and respiratory tract in humans. Acute exposure to extremely high levels of vinyl chloride has caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans, and cardiac arrhythmias in animals.

- Tests involving acute exposure of mice have shown vinyl chloride to have high acute toxicity from inhalation exposure.

Long-term exposure to vinyl chloride concentrations has been linked with the following chronic health effects (Agency for Toxic Substances and Disease Registry 2010; U.S. Department of Health and Human Services 2006; U.S. Environmental Protection Agency [USEPA] 2000a):

- Liver damage may result in humans from chronic exposure to vinyl chloride, through both inhalation and oral exposure.

- A small percentage of individuals occupationally exposed to high levels of vinyl chloride in air have developed a set of symptoms termed “vinyl chloride disease,” which is characterized by Raynaud’s phenomenon (fingers blanch and numbness and discomfort are experienced upon exposure to the cold), changes in the bones at the end of the fingers, joint and muscle pain, and scleroderma-like skin changes (thickening of the skin, decreased elasticity, and slight edema).

- Central nervous system effects (including dizziness, drowsiness, fatigue, headache, visual and/or hearing disturbances, memory loss, and sleep disturbances) as well as peripheral nervous system symptoms (peripheral neuropathy, tingling, numbness, weakness, and pain in fingers) have also been reported in workers exposed to vinyl chloride.

Several reproductive/developmental health effects from vinyl chloride exposure have been identified (Agency for Toxic Substances and Disease Registry 2010; U.S. Department of Health and Human Services 2006):

- Several case reports suggest that male sexual performance may be affected by vinyl chloride. However, these studies are limited by lack of quantitative exposure information and possible co-occurring exposure to other chemicals.

- Several epidemiological studies have reported an association between vinyl chloride exposure in pregnant women and an increased incidence of birth defects, while other studies have not reported similar findings.

- Epidemiological studies have suggested an association between men occupationally exposed to vinyl chloride and miscarriages during their wives' pregnancies, although other studies have not supported these findings.

Long-term exposure to vinyl chloride has also been identified as a cancer risk (Agency for Toxic Substances and Disease Registry 2010; U.S. Department of Health and Human Services 2006; U.S. EPA 2000a)

- Inhaled vinyl chloride has been shown to increase the risk of a rare form of liver cancer (angiosarcoma of the liver) in humans.

- Animal studies have shown that vinyl chloride, via inhalation, increases the incidence of angiosarcoma of the liver and cancer of the liver.

Toxic Air Contaminants (TACs)

Hazardous air pollutants (HAPs) is a term used by the federal Clean Air Act (CAA) that includes a variety of pollutants generated or emitted by industrial production activities. Called TACs under the California Clean Air Act of 1988 (CCAA), ten have been identified through ambient air quality data as being the most substantial health risk in California. Direct exposure to these pollutants has been shown to cause cancer, birth defects, damage to the brain and nervous system, and respiratory disorders.

TACs do not have ambient air quality standards. Since no safe levels of TACs can be determined, there are no air quality standards for TACs. Instead, TAC impacts are evaluated by calculating the health risks associated with a given exposure. The requirements of the Air Toxic "Hot Spots" Information and Assessment Act apply to facilities that use, produce, or emit toxic chemicals. Facilities that are subject to the toxic emission inventory requirements of the act must prepare and submit toxic emission inventory plans and reports and periodically update those reports.

Acetaldehyde

Acetaldehyde is both directly emitted into the atmosphere and formed in the atmosphere from photochemical oxidation. Sources include combustion processes such as exhaust from mobile sources and fuel combustion from stationary internal combustion engines, boilers, and process heaters. Approximately 76 percent of acetaldehyde emissions are from mobile sources, with area sources such as residential wood combustion accounting for approximately 17 percent of total emissions.

Health Effects

Acetaldehyde is classified as a Federal HAP and as a California TAC. Acetaldehyde is a carcinogen that also causes chronic non-cancer toxicity in the respiratory system. The primary acute effect of inhalation exposure to acetaldehyde is irritation of the eyes, skin, and respiratory tract in humans. At higher exposure levels, erythema, coughing, pulmonary edema, and necrosis may also occur (USEPA 2017a).

Benzene

Benzene is highly carcinogenic and occurs throughout California. Approximately 84 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust; currently, the benzene content of gasoline is less than one percent.

Health Effects

Benzene also has non-cancer health effects. Brief inhalation exposure to high concentrations can cause central nervous system depression. Acute effects include central nervous system symptoms of nausea, tremors, drowsiness, dizziness, headache, intoxication, and unconsciousness (USEPA 20017b). Exposure to liquid and vapor may irritate the skin, eyes, and upper respiratory tract in humans. Redness and blisters may result from dermal exposure.

1,3–Butadiene

The majority of 1,3-butadiene emissions comes from incomplete combustion of gasoline and diesel fuels. Mobile sources account for 83 percent of total statewide emissions. Area-wide sources such as agricultural waste burning and open burning contribute to approximately 13 percent of statewide emissions. Approximately 67 percent of 1,3-butadiene emissions are from mobile sources.

Health Effects

In California, 1,3-butadiene has been identified as a carcinogen. Butadiene vapors cause neurological effects at very high levels such as blurred vision, fatigue, headache, and vertigo. Dermal exposure of humans to 1,3-butadiene causes a sensation of cold, followed by a burning sensation, which may lead to frostbite (USEPA 2017c).

Carbon Tetrachloride

The primary sources of carbon tetrachloride in California include chemical and allied product manufacturers and petroleum refineries.

Health Effects

In California, carbon tetrachloride has been identified as a carcinogen. Carbon tetrachloride is also a central nervous system depressant and mild eye and respiratory tract irritant. EPA has classified carbon tetrachloride as a Group B2 probable human carcinogen (USEPA 2017d).

Chromium, Hexavalent

Chromium plating and other metal finishing processes are the primary sources of hexavalent chromium emissions in California. Approximately 65 percent of hexavalent chromium emissions are from stationary sources, such as electrical generation facilities, aircraft and parts manufacturing plants, and fabricated-metal manufacturing facilities.

Health Effects

In California, hexavalent chromium has been identified as a carcinogen. There is epidemiological evidence that exposure to inhaled hexavalent chromium may result in lung cancer. The principal acute effects are renal toxicity, gastrointestinal hemorrhage, and intravascular hemolysis (USEPA 2017e).

Para-Dichlorobenzene

The primary sources of para-dichlorobenzene include consumer products such as non-aerosol insect repellents and solid/gel air fresheners. These sources contribute 99 percent of the statewide para-dichlorobenzene emissions.

Health Effects

In California, para-dichlorobenzene has been identified as a carcinogen. Acute exposure to 1,4-dichlorobenzene via inhalation results in irritation to the eyes, skin, and throat in humans. In addition, long-term inhalation exposure may affect the liver, skin, and central nervous system in humans (e.g., cerebellar ataxia, dysarthria, weakness in limbs, and hyporeflexia) (USEPA 2017f).

Formaldehyde

Formaldehyde is both emitted into the atmosphere directly and formed in the atmosphere as a result of photochemical oxidation. Formaldehyde is a product of incomplete combustion. One of the primary sources of formaldehyde is vehicular exhaust. Formaldehyde is also used in resins, many consumer products (as an antimicrobial agent), and fumigants and soil disinfectants. Approximately 68 percent of formaldehyde emissions in the SJVAB are from mobile sources.

Health Effects

The major toxic effects caused by acute formaldehyde exposure via inhalation are eye, nose, and throat irritation and effects on the nasal cavity. Other effects seen from exposure to high levels of formaldehyde in humans are coughing, wheezing, chest pains, and bronchitis. In California, formaldehyde has been identified as a carcinogen (USEPA, 2017g).

Methylene Chloride

Methylene chloride is used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic, and a solvent in paint-stripping operations. Paint removers account for the largest use of methylene chloride in California (approximately 82 percent).

Health Effects

Case studies of methylene chloride poisoning during paint-stripping operations have demonstrated that inhalation exposure to extremely high levels can be fatal to humans. Acute inhalation exposure to high levels has resulted in effects on the central nervous system, including decreased visual, auditory, and psychomotor functions, but these effects are reversible once exposure ceases. The major effects from chronic inhalation exposure are effects on the central nervous system, such as headaches, dizziness, nausea, and memory loss. California considers methylene chloride to be carcinogenic (USEPA, 2017h).

Perchloroethylene

Perchloroethylene is used as a solvent, primarily in dry cleaning operations; it is also used in degreasing operations, paints and coatings, adhesives, aerosols, specialty chemical production, printing inks, silicones, rug shampoos, and laboratory solvents.

Health Effects

In California, perchloroethylene has been identified as a carcinogen. Perchloroethylene vapors are irritating to the eyes and respiratory tract. Following chronic exposure, workers have shown signs of liver toxicity as well as kidney dysfunction and neurological disorders.

Diesel Particulate Matter

Diesel particulate matter is emitted from both mobile and stationary sources. In California, onroad diesel-fueled engines contribute approximately 24 percent of the statewide total, with an additional 71 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources contribute about 5 percent of total diesel particulate matter.

Health Effects

Diesel exhaust and many individual substances contained in it (including arsenic, benzene, formaldehyde, and nickel) have the potential to contribute to mutations in cells that can lead to cancer. Long-term exposure to diesel exhaust particles poses the highest cancer risk of any TAC evaluated by the California Office of Environmental Health Hazard Assessment (OEHHA). CARB estimates that about 70 percent of the cancer risk that the average Californian faces from breathing toxic air pollutants stems from diesel exhaust particles.

Diesel engines are a major source of fine-particle pollution. The elderly and people with emphysema, asthma, and chronic heart and lung disease are especially sensitive to fine-particle pollution. Numerous studies have linked elevated particle levels in the air to increased hospital admissions, emergency room visits, asthma attacks, and premature deaths among those suffering from respiratory problems. Because children's lungs and respiratory systems are still developing, they are also more susceptible than healthy adults to fine particles. Exposure to fine particles is associated with increased frequency of childhood illnesses and can also reduce lung function in children. In California, diesel exhaust particles have been identified as a carcinogen (California OEHHA and the American Lung Association, 2005; CARB, 2008).

Airborne Fungus (Valley Fever)

Valley Fever, or coccidioidomycosis, is caused by the microscopic fungus coccidioides immitis (*C. immitis*), which grows in arid soil in parts of Kern County and other parts of America. Infection occurs when the spores of the fungus become airborne and are inhaled. The fungal spores become airborne when contaminated soil is disturbed by human activities, such as construction and agricultural activities, and by natural phenomenon, such as wind storms, dust storms, and earthquakes.

Health Effects

Approximately 60 percent of infected persons have no symptoms. The remainder develop flu-like symptoms that can last for a month and tiredness that can sometimes last for several weeks. A small percentage of infected persons (less than one percent) can develop disseminated disease that spreads outside the lungs to the brain, bone, and skin. Without proper treatment, Valley Fever can lead to severe pneumonia, meningitis, and even death. Symptoms may appear between one and four weeks after exposure (County of Los Angeles 2004).

A diagnosis of Valley Fever is made through a sample of blood or other body fluid or biopsy of the affected tissue. It is treatable with anti-fungal medicines and is not contagious. Once recovered from the disease, the individual is protected against further infection. Persons at highest risk from exposure are those with compromised immune systems, such as those with HIV, and those with chronic pulmonary disease. Farmers, construction workers, and others who engage in activities that disturb the soil are at highest risk for Valley Fever. Infants, pregnant women, diabetics, people of African, Asian, Latino, or Filipino descent, and the elderly may be at increased risk for disseminated disease. Historically, people at risk for infection are individuals not already immune to the disease and whose jobs involve extensive contact with soil dust, such as construction or agricultural workers and

archeologists (County of Los Angeles 2004). The disease also has been known to infect animals. Infections occur most often in summer.

It is thought that during drought years the number of organisms competing with *C. immitis* decreases, and the *C. immitis* remains alive but dormant. When rain finally occurs, the arthrocondia germinate and multiply more than usual because of a decreased number of other competing organisms. Later, the soil dries out in the summer and fall, and the fungi can become airborne and potentially infectious (Kirkland and Fierer 1996).

Persons at risk for Valley Fever should avoid exposure to dust and dry soil in areas where Valley Fever is common. Areas with high Valley Fever rates are called hyper-endemic. Approximately 10–50 percent of people living in endemic disease regions are seropositive and considered immune. In any given year, about 3 percent of people who live in an area where coccidiodomycosis is common will develop an infection (County of Los Angeles 2004). The areas of Kern County that have the most incidents of Valley Fever exposure are northeast Bakersfield, Lamont-Arvin, Taft, and Edwards Air Force Base. The Valley Fever fungus has been identified in soil samples taken near the California State University, Bakersfield campus.

Asbestos

Ultramafic serpentinized rock is closely associated with asbestos and composed of the following minerals:

- Antigorite: (Mg, Fe)3Si2O5(OH)4;
- Clinochrysotile: Mg3Si2O5(OH)4;
- Lizardite: Mg3Si2O5(OH)4;
- Orthrochrysotile: Mg3Si2O5(OH)4; and
- Parachrysotile: (Mg, Fe)3Si2O5(OH)4.

Chrysotile minerals are more likely to form serpentinite asbestos; however, serpentinite is uncommon to sedimentary soil found in the project area. Asbestos occurs in certain geologic environments, none of which are common in the project area.

Health Effects

Asbestos can adversely affect humans only in its fibrous form, and these fibers must be broken and dispersed into the air and then inhaled. During geological processes, the asbestos mineral can be crushed, causing it to become airborne. It also enters the air or water from the breakdown of natural deposits. Constant exposure to asbestos at high levels on a regular basis may cause cancer in humans. The two most common forms of cancer are lung cancer and mesothelioma, a rare cancer of the lining that covers the lungs and stomach.

4.3.3 Regulatory Setting

In California, air quality is regulated by several agencies, including USEPA, CARB, and local air districts such as the SJVAPCD. Each of these agencies develops rules and/or regulations to attain the goals or directives imposed upon them through legislation. Although USEPA regulations may not be superseded, some state and local regulations may be more stringent than Federal regulations. The project site is located in the SJVAB and is under the jurisdiction of the SJVAPCD.

Federal

U.S. Environmental Protection Agency (EPA)

The 1977 Federal CAA and 1990 revisions required EPA to identify National Ambient Air Quality Standards (NAAQS) to protect the public health and welfare (see Table 4.3-1). In June of 1997, EPA adopted new PM_{10} National standards and an additional standard for suspended particulate matter at or below PM_{10} to $PM_{2.5}$.

On March 12, 2008, EPA implemented an 8-hour standard for O_3. On October 1, 2015, the EPA Administrator signed the notice for the final rule to revise the primary and secondary NAAQS for O_3 of both primary and secondary standards from 0.075 ppm to 0.070 ppm, and retaining their indicators (O_3), forms (fourth-highest daily maximum, averaged across three consecutive years) and averaging times (eight hours). On April 12, 2010, EPA implemented a 1-hour standard for NO_2 of 100 parts per billion (ppb).

Pursuant to the 1990 CAA Amendments (CAAA), EPA classified air basins (or portions thereof) as either attainment or nonattainment areas for each criteria air pollutant based on whether or not the NAAQS have been achieved. The CAA also required each state to prepare an air quality control plan (State Implementation Plan [SIP]). The 1990 amendments additionally required states containing areas that violate NAAQS to revise their SIPs to incorporate additional control measures to reduce air pollution. EPA has the responsibility to review all SIPs to determine if they conform to the mandates of the CAAA and will achieve air quality goals when implemented.

Regulation of TACs (HAPs under Federal regulations) is achieved through Federal and state controls on individual sources. Federal law defines HAPs as non-criteria air pollutants with short-term (acute) and/or long-term (chronic or carcinogenic) adverse human health effects. The 1977 CAA required EPA to identify National Emission Standards for Hazardous Air Pollutants (NESHAPs) to protect public health and welfare.

The 1990 CAAA offer a technology-based approach to reducing air toxics. Since the CAAA were approved, 188 chemicals have been designated as HAPs and are regulated under a two-phase strategy. The first phase involves requiring facilities to install Maximum Achievable Control Technology (MACT), which includes measures, methods, and techniques—such as material substitutions, work practices, and operational improvements—aimed at reducing toxic air emissions. MACT is the lowest emission rate, or highest level of control demonstrated, on average by the top performing companies (top 12 percent) in the source category. MACT standards already exist for the 174 source categories: 166 major sources and eight area sources. Under the air toxics program, facilities having similar

operating processes are grouped into categories. These MACTs were promulgated in four "bins" of years: 1992, 1994 (39 categories), 1997 (62 categories), and 2000 (67 categories). MACT standards for municipal solid waste landfills were promulgated on May 23, 2002. As of August 2003, MACT standards have been made for 174 source categories and their subcategories.

State

California Air Resources Board (CARB)

CARB, a department of the California Environmental Protection Agency (CalEPA), oversees air quality planning and control throughout California by administering the SIP. Its primary responsibility lies in ensuring implementation of the 1989 amendments to the California Clean Air Act (CCAA), as well as responding to the Federal CAA requirements and regulating emissions from motor vehicles sold in California. It also sets fuel specifications to further reduce vehicular emissions.

The amendments to the CCAA establish the CAAQS and a legal mandate to achieve these standards by the earliest practical date. These standards apply to the same criteria pollutants as the Federal CAA, and also include sulfate, VRPs, hydrogen sulfide and vinyl chloride (refer to Table 4.3-1). They are also more stringent than the Federal standards. The SJVAB is designated as nonattainment for the State ozone and PM_{10} standards. Concentrations of all other pollutants meet state standards.

CARB is also responsible for regulations pertaining to TACs. The Air Toxics "Hot Spots" Information and Assessment Act (Assembly Bill [AB] 2588, 1987, Connelly) was enacted in 1987 as a means to establish a formal air toxics emission inventory risk quantification program. AB 2588, as amended, establishes a process that requires stationary sources to report information regarding the type and quantities of certain substances their facilities routinely release into the SJVAB. Each air pollution control district ranks the data into high, intermediate and low priority categories. When considering the ranking, the potency, toxicity, quantity, volume and proximity of the facility to receptors are given consideration by an air district.

CARB also has on- and off-road engine emission-reduction programs that would indirectly affect the project's emissions through the phasing in of cleaner on- and off-road engines. In addition, CARB has a Portable Equipment Registration Program that allows owners or operators of portable engines and associated equipment to register their units under a statewide program, with specified emission requirements, without having to obtain individual permits from local air districts.

The state recently enacted a new regulation for the reduction of diesel particulate matter and criteria pollutant emissions from in-use off-road diesel-fueled vehicles (13 CCR Article 4.8, Chapter 9, Section 2449). This regulation provides target emission rates for particulate matter and NO_X emissions for owners of fleets of diesel-fueled off-road vehicles. It applies to equipment fleets of three specific sizes, and the target emission rates are reduced over time.

Title V and Extreme Designation

Title V of the CAA, as amended in 1990, creates an operating permits program for certain defined sources. In general, owner/operators of defined stationary sources that emit more than 25 tons per

year of NO_X and ROG must possess a Title V permit. Title V is a federally enforceable state operating permit that is required under 40 CFR, Part 70. The Title V programs are developed at the state or local level, as outlined in 40 CFR 70.

Under the extreme definition, the definition of a major source subject to Title V permitting changes from 25 to 10 tons per year, which results in more businesses having to comply with Title V permitting requirements under the extreme nonattainment designation.

Title V does not impose any new air pollution standards, require installation of any new controls on the affected facilities, or require reductions in emissions. Title V does enhance public and EPA participation in the permitting process and requires additional recordkeeping and reporting by businesses, which results in significant administrative requirements.

Within the entire SJVAB, which includes eight counties, the SJVAPCD estimated that the reclassification to extreme nonattainment, added 150 businesses (excluding agricultural facilities) for a total of 420 facilities currently subject to Title V. These numbers compare to a total of approximately 7,000 facilities that are under permit with the SJVAPCD basin-wide.

Local

Metropolitan Bakersfield General Plan (MBGP)

The Metropolitan Bakersfield General Plan (MBGP) cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the MBGP provide goals, policies, and implementation measures in order to reduce impacts of projects on air quality. Applicable goals relative to the proposed Project site within these elements are listed in Table 4.3-4, *Metropolitan Bakersfield General Plan Goals and Policies for Air Quality*.

Table 4.3-4. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality

Goals and Policies: Conservation/Air Quality Element
Conservation/Air Quality Goal #1: "Promote air quality that is compatible with health, well being, and enjoyment of life by controlling point sources and minimizing vehicular trips to reduce air pollutants."
Conservation/Air Quality Goal #2: Continue working toward attainment of Federal, State and Local standards as enforced by the San Joaquin Valley Air Pollution Control District."
Conservation/Air Quality Goal #3: "Reduce the amount of vehicular emissions in the planning area."
Conservation/Air Quality Element Policies
Conservation/Air Quality Policy #1: "Comply with and promote San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) control measures regarding Reactive Organic Gases (ROG). Such measures are focused on: (a) steam driven well vents, (b) Pseudo-cyclic wells, (c) natural gas processing plant fugitives, (d) heavy oil test stations, (e) light oil production fugitives, (f) refinery pumps and compressors, and (g) vehicle inspection and maintenance."
Conservation/Air Quality Policy #2: "Encourage land uses and land use practices which do not contribute significantly to air quality degradation."

Table 4.3-4. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality

Goals and Policies: Conservation/Air Quality Element
Conservation/Air Quality Policy #3: "Require dust abatement measures during significant grading and construction operations."
Conservation/Air Quality Policy #4: Consider air pollution impacts when evaluating discretionary permits for land use proposals. Considerations should include: a) Alternative access routes to reduce traffic congestion, b) Development phasing to match road capacities, c) Buffers including increase vegetation to increase emission dispersion and reduce impacts of gaseous or particulate matter on sensitive uses."
Conservation/Air Quality Policy #11: "Improve the capacity of the existing road system through improved signalization and traffic control systems."
Conservation/Air Quality Policy #12: "Encourage the use of mass transit, carpooling and other transportation options to reduce vehicle miles traveled."
Conservation/Air Quality Policy #13: "Consider establishing priority parking areas for carpoolers in projects with relatively large numbers of employees to reduce vehicle miles traveled and improve air quality."
Conservation/Air Quality Policy #14: "Establish park and ride facilities to encourage car pooling and the use of mass transit."
Conservation/Air Quality Policy #16: "Cooperate with Golden Empire Transit [GET] and Kern Regional Transit to provide a comprehensive mass transit system for Bakersfield; require large-scale new development to provide related improvements, such as bus stop shelters and turnouts."
Conservation/Air Quality Policy #18: "Encourage walking for short distance trips through the creation of pedestrian friendly sidewalks and street crossings."
Conservation/Air Quality Policy #19: "Promote a pattern of land uses which locates residential uses in close proximity to employment and commercial services to minimize vehicular travel."

San Joaquin Valley Air Pollution Control District (SJVAPCD)

The Guidance for Assessing and Mitigating Air Quality Impacts (GAMAQI) is an advisory document that provides lead agencies, consultants, and project applicants with analysis guidance and uniform procedures for addressing air quality in environmental documents. Local jurisdictions are not required to use the methodology outlined therein. The GAMAQI describes the criteria that the SJVAPCD uses when reviewing and commenting on the adequacy of environmental documents. It recommends thresholds for determining whether projects would have significant adverse environmental impacts, identifies methods for predicting project emissions and impacts, and identifies measures that can be used to avoid or reduce air quality impacts. The GAMAQI includes guidance for analysis for criteria pollutants, particulates, HAPs, and odors for both construction and operations of a project. An update to the GAMAQI was approved on March 19, 2015, and was used as a guidance document for this analysis (SJVAPCD 2015).

There are currently multiple different attainment plans for the SJVAB. These are described in the sections that follow.

1-HOUR EXTREME OZONE ATTAINMENT DEMONSTRATION PLAN

In 2013, the SJVAB had zero violations of the 1-hour O_3 standard established by EPA under the CAA. The SJVAB now meets the 1-hour O_3 standard based on the most recent three-year period air monitoring data (2011-2013). On May 6, 2014, the SJVAPCD submitted a formal request that the EPA determine that the SJVAB has attained the federal 1-hour O_3 standard. In accordance with federal requirements, the SJVAPCD's submittal includes a clean data finding and a finding that attainment is due to permanent and enforceable emissions reductions.

The SJVAPCD developed a 2013 Plan for the Revoked 1-Hour O_3 Standard, which it adopted in September 2013. The modeling confirms that the SJVAB will attain the revoked 1-hour O_3 standard by 2017.

8-HOUR OZONE ATTAINMENT DEMONSTRATION PLAN

The SJVAB is designated as an extreme O3 nonattainment area for the EPA 2008 8-hour O3 standard of 75 parts per billion (ppb). The SJVAPCD is currently in the process of developing an O3 plan to address EPA's 2008 8-hour O3 standard, with attainment required by 2032. Because the SJVAB naturally has high background O3 levels and O3 transport, SJVAPVD faces a regulatory challenge to meet the 2008 8-hour O3 standard.

SJVAPCD adopted the 2007 8-Hour Ozone Plan in April 2007. This plan addresses EPA's 8-hour O3 standard of 84 ppb, which was established by EPA in 1997.

2009 RACT SIP

On April 16, 2009, the Governing Board adopted the Reasonably Available Control Technology Demonstration for Ozone State Implementation Plans (2009 RACT SIP) (SJVAPCD 2009a). In part, the 2009 RACT SIP satisfied the commitment by the SJVAPCD for a new RACT analysis for the 1-hour O3 plan (see discussion of the EPA withdrawal of approval in the Extreme 1-Hour Ozone Attainment Demonstration Plan summary above) and was intended to prevent all sanctions that could be imposed by EPA for failure to submit a required SIP revision for the 1-hour O3 standard. With respect to the 8-hour standard, the plan also assesses the SJVAPCD's rules based on the adjusted major source definition of 10 tons per year (due to the SJVAB's designation as an extreme O3 nonattainment area), evaluates SJVAPCD rules against new Control Techniques Guidelines promulgated since August 2006, and reviews additional rules and rule amendments that had been adopted by the Governing Board since August 17, 2006, for RACT consistency.

2013 PLAN FOR THE REVOKED 1-HOUR OZONE STANDARD

The SJVAPCD developed a plan for EPA's revoked 1-hour O3 standard after the EPA withdrew its approval of the 2004 Extreme 1-Hour Ozone Attainment Demonstration Plan as a result of litigation. As a result of the litigation, the EPA reinstated previously revoked requirements for 1 hour O3 attainment plans. The 2013 plan addresses those requirements, including a demonstration of implementation of Reasonably Available Control Measures and a demonstration of a rate of progress averaging 3 percent annual reductions of ROG or NOX emissions every 3 years. The 2013 Plan for the Revoked 1-Hour Ozone Standard was approved by the Governing Board on September 19, 2013 (SJVAPCD 2013a). Based on implementation of the ongoing control measures, preliminary modeling indicates that the SJVAB will attain the 1-hour O3 standard by 2017, before the final attainment year of 2022 and without relying on long-term measures under CAA Section 182(e)(5) ("black box reductions").

2014 RACT SIP

On June 19, 2014, the SJVAPCD adopted the 2014 Reasonably Available Control Technology Demonstration for the 8-Hour Ozone State Implementation Plan (2014 RACT SIP) (SJVAPCD 2014b). This RACT SIP includes a demonstration that the SJVAPCD rules implement RACT. The plan reviews each of the NOx reduction rules and concludes that they satisfy requirements for stringency, applicability, and enforceability and meet or exceed RACT. The plan's analysis of further ROG reductions through modeling and technical analyses demonstrates that added ROG reductions will not advance SJVAB's O3 attainment. Each ROG rule evaluated in the 2009 RACT SIP, however, has been subsequently approved by the EPA as meeting RACT within the last 2 years. The O3 attainment strategy, therefore, focuses on further NOx reductions.

PM_{10} ATTAINMENT DEMONSTRATION PLAN

A PM10 plan has been adopted and submitted to EPA for review. The 2006 PM10 Plan is a continuation of the SJVAPCD's strategy for achieving the NAAQS for PM10. It is the SIP revision required as a condition of EPA approval of the 2003 PM10 Plan, which became effective June 25, 2004. The SJVAB was recently designated as an attainment area for PM10 under the NAAQS.

On May 19, 2005, the SJVAPCD adopted amendments to the plan to update schedules and emission reductions and align the contingency measure discussion with National requirements. In addition to meeting the requirements of the CAA and containing measures needed to attain the NAAQS at the earliest possible date, this SIP revision is to include an evaluation of the modeling from the California Regional Particulate Air Quality Study and the latest technical information, including inventory and monitoring data.

In September 2007, the SJVAPCD approved a request to redesignate the SJVAB to attainment of the PM10 NAAQS and approve the 2007 PM10 Maintenance Plan. The

maintenance plan and request for redesignation was approved by CARB on October 27, 2007, and submitted to EPA for approval. EPA redesignated the SJVAB to attainment of the PM10 NAAQS and approved the 2007 PM10 Maintenance Plan on September 19, 2008.

$PM_{2.5}$ ATTAINMENT PLANNING

Based on the health studies conducted, PM2.5 is considered to be more adverse to human health than other pollutants. In July 1997, EPA set two PM2.5 standards: a 24-hour standard set at 65 µg/m3 to protect against short-term health impacts and a 12-month (annual) standard set at 15 µg/m3 to protect against longer term impacts. The SJVAB has been designated a nonattainment area for the PM2.5 standards.

The SJVAPCD Governing Board adopted the 2008 PM2.5 Plan on April 30, 2008. This plan is designed to assist the SJVAB in attaining all PM2.5 standards, including the 1997 federal standards, the 2006 federal standards, and the state standard, as soon as possible. On July 13, 2011, the EPA issued a rule partially approving and disapproving the 2008 PM2.5 Plan. Subsequently, on November 9, 2011, the EPA issued a final rule approving most of the plan with an effective date of January 9, 2012. However, the EPA disapproved the plan's contingency measures because they would not provide sufficient emission reductions.

Approved by the Governing Board on December 20, 2012, the 2012 PM2.5 Plan addresses attainment of EPA's 24-hour PM2.5 standard of 35 micrograms per cubic meter (µg/m³) established in 2006. In addition to reducing direct emissions of PM2.5, this plan focuses on reducing emissions of NOX, which is a predominant pollutant in the formation of PM2.5 in the SJVAB. The plan relies on a multilevel approach to reducing emissions through SJVAPCD efforts (industry, the general public, employers, and small businesses) and state/federal efforts (passenger vehicles, heavy-duty trucks, and off-road sources), as well as SJVAPCD and state/federal incentive programs to accelerate replacement of on- and off-road vehicles and equipment. Through compliance with this attainment plan, the SJVAB would achieve attainment of the federal PM2.5 standard by the attainment deadline of 2019, with the majority of the SJVAB actually experiencing attainment well before the deadline. The EPA lowered the PM2.5 standard again in 2012 and is in the process of completing attainment designations.

The Governing Board adopted the 2015 Plan for the 1997 PM2.5 Standard on April 16, 2015. This plan addresses the EPA's annual PM2.5 standard of 15 micrograms per cubic meter (µg/m3) and 24-hour PM2.5 standard of 65 µg/m3 established in 1997. While nearly achieving the 1997 standards, the SJVAB experienced higher $PM_{2.5}$ levels in winter 2013–2014 due to the extreme drought, stagnation, strong inversions, and historically dry conditions; thus, the SJVAPCD was unable to meet the attainment date of December 31, 2015. Accordingly, this plan also contains a request for a one-time extension of the attainment deadline for the 24-hour standard to 2018 and the annual standard to 2020. The plan builds on past development and implementation of effective control strategies. Consistent with EPA regulations for $PM_{2.5}$ plans to achieve the 1997 standards, the plan

contains Most Stringent Measures, Best Available Control Measures, additional enforceable commitments for further reductions in emissions, and ensures expeditious attainment of the 1997 standard.

APPLICABLE NON-STATIONARY SOURCE REGULATIONS

The SJVAPCD's primary means of implementing air quality plans are by adopting and enforcing rules and regulations. Stationary sources within the jurisdiction are regulated by the SJVAPCD's permit authority over such sources and through its review and planning activities. Unlike stationary source projects, which encompass very specific types of equipment, process parameters, throughputs, and controls, air emissions sources from land use development projects such as Grapevine are mainly mobile sources (traffic) and area sources (small dispersed stationary and other non-mobile sources), including exempt (i.e., no permit required) sources such as consumer products, landscaping equipment, furnaces, and water heaters. Mixed-use land development projects may include nonexempt sources including devices such as charbroilers, small to large boilers, stationary internal combustion engines, gas stations, or asphalt batch plants.

Notwithstanding nonexempt stationary sources, which would be permitted on a case-by-case basis, SJVAPCD Regulations VIII and IX generally apply to land use development projects and are described below:

SJVAPCD REGULATION VIII—FUGITIVE PM10 PROHIBITIONS.

Rules 8011–8081 are designed to reduce PM10 emissions (predominantly dust/dirt) generated by human activity, including construction and demolition, road construction, bulk materials storage, use of paved and unpaved roads, and carryout and trackout. Among the Regulation VIII rules applicable to the project are the following:

Rule 8011—General Requirements;

Rule 8021—Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities;

Rule 8031—Bulk Materials;

Rule 8041—Carryout and Trackout;

Rule 8051—Open Areas;

Rule 8061—Paved and Unpaved Roads; and

Rule 8071—Unpaved Vehicle/Equipment Traffic Areas.

REGULATION IX – MOBILE AND INDIRECT SOURCES

Rule 9110 General Conformity

Rule 9120 Transportation Conformity

Rule 9410 Employer Based Trip Reduction

Rule 9510 Indirect Source Review (ISR)

RULE 9510 (INDIRECT SOURCE REVIEW, ADOPTED DECEMBER 15, 2005)

The purpose of the Indirect Source Review (ISR) is to reduce emissions of NOX and PM10 from new development projects. Rule 9510 places application and emission-reduction requirements on certain development projects to reduce emissions through on-site mitigation, off-site SJVAPCD-administered projects, or a combination of the two. Each project proponent is required to submit an air impact assessment application concurrent with the last discretionary approval by the County pursuant to Rule 9510's requirements.

Although compliance with Rule 9510 is separate from the CEQA process, control measures used to comply with the Rule 9510 are considered mitigation to a less-than-significant impact under CEQA.

INDIRECT SOURCE MITIGATION FEE

Indirect sources are land uses that attract or generate motor vehicles trips. Indirect source emissions contain many pollutants, principally PM10, ROG, and NOX. The SJVAPCD included a requirement in the adopted 2003 PM10 Plan to develop and implement an ISR rule by July 2004, with implementation to begin in 2005. The ISR rule went into effect in March 2006. SB 709 required the SJVAPCD to adopt by regulation a schedule of fees to be assessed on area-wide and indirect sources of emissions. After public hearings, the district adopted Rule 9510 on December 15, 2005.

The purpose of Rule 9510 is to reduce emissions of NOX and PM10 from new development projects. The rule applies to development projects that, upon full buildout, seek to gain discretionary approval for any one of the following: 50 residential units, 2,000 square feet of commercial space, 25,000 square feet of light industrial space, 20,000 square feet of medical or recreational space, 39,000 square feet of general office space, 100,000 square feet of heavy industrial space, 9,000 square feet of educational space, 10,000 square feet of government space, or 9,000 square feet of any land use not identified above. Several sources are exempt from the rule, including transportation projects and transit projects (exempt only from Rule 9510 Section 6.2 and Section 7.1.2), reconstruction projects that result from a natural disaster, and development projects whose primary sources of emissions are subject to SJVAPCD Rules 2201 and 2010, which address stationary sources. Any development project that has a mitigated baseline of less than 2 tons per year for NOX

and PM10 is also exempted from the mitigation requirements of the rule. Developers are encouraged to reduce as much air pollution as possible through on-site mitigation or the incorporation of air-friendly designs and practices into the project. Some examples include bike paths and sidewalks; traditional street design; medium- to high-density residential developments; locating near bus stops and bike paths; locating near different land use zones, such as commercial; and increasing energy efficiency. If these practices do not completely meet the required reductions (under the rule), new development projects are required to mitigate the remainder of their emissions by contributing to a mitigation fund that would be used to pay for the most cost-effective projects to reduce emissions. Examples include projects to retire or crush polluting cars, replace older diesel engines, and replace gas-powered lawnmowers with electric lawnmowers.

The ISR requires developers to reduce 20 percent of construction-exhaust NOX, 45 percent of construction-exhaust PM10; 33 percent of operational NOX over 10 years; and 50 percent of operational PM10 over 10 years. The SJVAPCD estimates that the potential reductions from this program in 2010 will be 11.5 tons per day (4,197.5 tons per year) of PM10 and 4.1 tons per day (1,496.5 tons per year) of NOX.

DEVELOPMENT MITIGATION CONTRACT (DMC) AGREEMENTS

A development mitigation contract (DMC) is an air quality mitigation measure by which a developer enters into a contractual agreement with the district to reduce a development project's impact on air quality beyond that achieved by compliance with District Rule 9510. Implementation of the DMC is comparable to implementation of the ISR; project emissions are characterized, funds are paid to the district, and the district administers the funds to secure the required emission-reduction projects. For projects subject to Rule 9510, the DMC must exceed the air quality benefits from compliance with the ISR. Therefore, applicants that enter into a DMC are considered in compliance with District Rule 9510. Examples of emission-reduction projects include projects to retire or crush polluting cars, replace older diesel engines, and replace gas-powered lawnmowers with electric lawnmowers. The SJVAPCD's 2008 annual report on the district's ISR program (June 19, 2008) includes the projects and reductions attributable to Rule 9510, including DMC agreements for combined on- and off-site emission reductions, totaling 2,078 tons of NOX and 1,087 tons of PM10.

LOCAL CONTROL MEASURES

The SJVAPCD requires all local governments within its eight-county jurisdiction to adopt resolutions as part of the Extreme OADP that must be approved by EPA. The resolutions describe the reasonably available control measures that each jurisdiction will implement to reduce O3-causing emissions into the air from transportation sources. Local jurisdictions are also required to adopt best available control technology (BACT) measures to reduce particle emissions as part of the PM10 Area Attainment Demonstration Plan. This process is coordinated and assisted by regional transportation planning agencies, such as the Kern Council of Governments (Kern COG).

The Kern County Board of Supervisors adopted a resolution on March 12, 2002, that committed the County to implementing several measures to reduce O3-causing emissions. Among the measures are cost incentives for road contractors to minimize land closures, transit-oriented land use planning, and measures to encourage County employees and other motorists to restrict driving on days with high O3 levels as well as continuing efforts to convert County vehicles to low-emission compressed natural gas and gasoline/electric hybrid engines. Many of these measures have been incorporated as general plan update policies.

The Kern County Board of Supervisors adopted a resolution on January 7, 2003, that committed the County to implementing several measures aimed at reducing PM10 emissions from County roadways. Among the measures are plans to determine the feasibility of paving the County's unpaved roads, which are lightly traveled, paving the shoulders of the most heavily traveled paved County roads as funding allows, and purchasing two PM10-compliant street sweepers as funding allows. The resolution also committed the County to imposing tougher rules for cancelling road improvements on large rural parcels; requiring public and private access roads for new commercial and industrial development to be paved; evaluating the adverse air quality impacts of new development and, where appropriate, requiring mitigation measures; implementing policies that require developers to control and abate dust during grading and construction operations; and, to receive a permit for expansion or a significantly altered use, requiring unpaved parking and storage areas of commercial and agricultural operations in County areas to be paved.

APPLICABLE STATIONARY SOURCE REGULATIONS

The SJVAPCD has primary responsibility for regulating stationary sources of air pollution situated within its jurisdictional boundaries. To this end, the SJVAPCD implements air quality programs required by state and Federal mandates, enforces rules and regulations based on air pollution laws, and educates businesses and residents about its role in protecting air quality. The SJVAPCD is also responsible for managing and permitting existing, new, and modified sources of air emissions within the SJVAB and establishing the following rules and regulations to ensure compliance with local, state, and National air quality regulations.

RULE 2010 (PERMITS REQUIRED)

Rule 2010 requires that an Authority to Construct permit (a new source review permit) and a Permit to Operate be obtained prior to constructing, altering, replacing, or operating any device that emits or may emit air contaminants.

RULE 2020 (EXEMPTIONS)

Rule 2020 specifies criteria that emission units must meet to be exempt from SJVAPCD permit requirements. The rule also specifies the recordkeeping requirements to verify the

exemption and outlines the compliance schedule for emission units that lose the exemption after installation. Rule 2020 applies to any source that emits or may emit air contaminants.

RULE 2070 (EXEMPTIONS)

Rule 2070 sets forth the standards that must be met for a permit to be issued by the SJVAPCD. The rule applies to any activity required to obtain a permit according to Rule 2010 (Permits Required).

RULE 2201 (NEW AND MODIFIED STATIONARY SOURCE REVIEW RULE)

The stated purpose of Rule 2201 is to provide for the review of new and modified stationary sources of air pollution and to provide mechanisms, including emission trade-offs, by which authority to construct such sources may be granted without interfering with the attainment or maintenance of ambient air quality standards. The SJVAPCD new source review rule applies to all new stationary sources and all modifications to existing stationary sources that are subject to SJVAPCD permit requirements. The rule generally requires that new or modified equipment include BACT and that emission increases above specified thresholds be offset.

RULE 2520 (TITLE V FEDERALLY MANDATED OPERATING PERMITS)

Rule 2520 serves as the SJVAPCD's mechanism for issuing, renewing, revising, revoking, and terminating operating permits for sources of air contaminants in accordance with the requirements of Title 40, Part 70, of the Code of Federal Regulations (CFR). This rule defines the sources that require federally mandated operating permits, as well as the content of these permits. Federally mandated operating permits are required for all major sources of air pollutants, as well as other sources listed in Section 2.0 of the rule. Generally, the federally mandated operating permits include emission limitations and standards for federal criteria pollutants (ROG, NOx, CO, SOx, PM10, PM2.5, and lead), new source performance standards, and recordkeeping and reporting requirements. This rule requires that the SJVAPCD combine all federal and state applicable standards into one permit for each facility, and that the permit indicate where state standards exceed federal standards.

SJVAPCD Rule 2520 applies to major stationary sources of air contaminants and to major sources of HAPs. Major sources of air contaminants are generally considered to be sources that emit 100 tons per year of a regulated air pollutant, without considering fugitive emissions. To be considered major for HAPs, a source must emit 10 tons per year or more of a single HAP or 25 tons per year or more of HAPs in aggregate.

RULE 2530 (FEDERALLY ENFORCEABLE POTENTIAL TO EMIT)

The purpose of Rule 2530 is to restrict a stationary source's potential to emit so that a source may be exempt from the requirements of Rule 2520 (Federally Mandated Operating Permits). This rule applies to any stationary source that is a major source of regulated air pollutants or of hazardous air pollutants but with limitations would be exempt from Rule 2520. This exemption provides stationary sources in the SJVAPCD with a separate option to comply with air quality restrictions. Rule 2530 also includes recordkeeping and reporting requirements. Rule 2530 allows facilities to be excluded from the Title V program (see Rule 2520) by taking limits or keeping records to demonstrate that their emissions are below the applicable thresholds. This process is also referred to as a "synthetic minor."

RULE 2550 (FEDERALLY MANDATED PRECONSTRUCTION REVIEW FOR MAJOR SOURCES OF AIR TOXICS)

Rule 2550 provides an administrative mechanism for applying the requirements of 40 CFR 63.40–63.44 at major sources of hazardous air pollutants that have Authority to Construct permits for new construction or reconstruction. Rule 2550 requires that new or reconstructed sources use Toxic Best Available Control Technology, with some exceptions.

RULE 4001 (NEW SOURCE PERFORMANCE STANDARDS)

Rule 4001 codifies the SJVAPCD's adoption and incorporation of the New Source Performance Standards as set forth in 40 CFR 60. New Source Performance Standards apply to a variety of different types of stationary sources, including asphalt plants. The regulation imposes emissions standards for certain pollutants and requires that specified emission control equipment and monitoring devices be installed at all new, modified, or reconstructed facilities to limit emissions. The regulation also includes test methods and procedures, as well as monitoring, notification, and recordkeeping requirements.

RULE 4002 (NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS)

Rule 4002 incorporates the National Emission Standards for Hazardous Air Pollutants (NESHAPs) as set forth in 40 CFR 61, and the NESHAPs for source categories as set forth in 40 CFR 63. 40 CFR 61 includes emission standards for several known toxic air pollutants, such as beryllium, mercury, and vinyl chloride. 40 CFR 63 regulates the NESHAP by source categories. Both regulations also include test methods and procedures, as well as monitoring, notification, and recordkeeping requirements.

RULE 4101 (VISIBLE EMISSIONS)

Rule 4101 prohibits the emissions of visible air contaminants to the atmosphere. The rule applies to any source operation that emits or may emit air contaminants.

RULE 4102 (PUBLIC NUISANCE)

The purpose of Rule 4102 is to protect the health and safety of the public. The rule applies to any source operation that emits or may emit air contaminants or other materials and prohibits from any source whatsoever the discharge emissions of air contaminants or other materials that cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public or that endanger the comfort, repose, health, or safety of any such person or the public or that cause or have a natural tendency to cause injury or damage to business or property.

RULE 4201 (PARTICULATE MATTER CONCENTRATION)

Rule 4201 establishes a particulate matter emission standard and applies to any source operation that emits or may emit dust, fumes, or total suspended particulate matter. The rule prohibits the release or discharge into the atmosphere from any single source operation, dust, fumes, or total suspended particulate matter emissions in excess of 0.1 grain per cubic foot of gas at dry standard conditions.

RULE 4801 (SULFUR COMPOUNDS)

Rule 4801 limits the emission of sulfur compounds and applies to any discharge to the atmosphere of sulfur compounds that would exist as a liquid or a gas at standard conditions. The rule prohibits the discharge of sulfur compounds into the atmosphere in concentrations greater than 2,000 parts per million by volume (ppmv) as SO2 on a dry basis averaged over 15 consecutive minutes.

Air Quality Conformity Determination for Transportation Plans and Programs

The federal CAA amendments of 1990 require a finding be made that any project, program, or plan subject to approval by a metropolitan planning organization conforms to air plans for attainment of air quality standards. Kern COG is designated the Regional Transportation Planning Agency and a Metropolitan Planning Organization for Kern County. In that capacity, Kern COG models air quality projections based on population projections in conjunction with current general plan designations and estimated vehicle miles in conjunction with the current Regional Transportation Plan (RTP) and the Federal Transportation Plan (FTP) for Kern County. These results are compared to pollutant budgets for each basin approved by EPA in the 1999 base year. Kern County is contained within two air basins: SJVAB and the Mojave Desert Air Basin. Each air basin has its own plans and pollutant budgets. Kern COG makes conformity findings for each air basin.

Kern County recently prepared a draft 8-Hour Ozone Air Quality Conformity Analysis to analyze Kern County's federally approved Federal Transportation Improvement Program (FTIP) and the Destination 2030 RTP. Changes to the NAAQS for ozone from a one-hour measurement to an eight-hour measurement have triggered the need for this analysis. The FTIP for the Kern County region is a six-year schedule of multimodal transportation improvements, and the RTP is a long-range, 26-year transportation plan. The conformity findings conclude that the FTIP and RTP result in emissions that are less than the emission budgets of baseline emissions for CO, VOC, NO_x, and PM_{10} (Kern Council of Governments [Kern COG] 2005).

4.3.4 Impacts and Mitigation Measures

This section describes the air quality significance thresholds, the air quality methodology used to evaluate whether the proposed Project would exceed the thresholds, and an evaluation of the proposed Project's impacts.

Methodology

The Air Quality Impact Analysis was prepared pursuant to the GAMAQI (SJVAPCD 2015) and the Kern County Air Quality Assessment Preparation Guidelines of the Kern County CEQA Implementation Document (December 2006). The County guidance was developed by the Kern County Planning and Natural Resources Department to assist with the preparation of the air quality assessments for use as a technical document in EIRs. This County guidance, called the "Guidelines for Preparing Air Quality Assessments for Use in EIRs" is intended to ensure that the assumptions and methodology used in the County's environmental documents are uniform from one project to the next to facilitate the comparison of air quality environmental effects. The County guidance states that the most recent air quality guidance documents from the SJVAPCD, such as the GAMAQI, must be used and referenced in the preparation of an air quality assessment and that the latest version of all models must be used for the appropriate application. It also notes that where the Kern County Planning and Natural Resources Department guidelines require quantification and the SJVAPCD does not; therefore, for purposes of CEQA, the Kern County Planning and Natural Resources Department guidelines must be followed.

Kern County guidance states that an air quality assessment should include estimates of short-term construction emissions in tons per year. The estimates must include site grading and building construction emissions, with comparison to the adopted County CEQA thresholds and the applicable air district (SJVAPCD for western Kern County) thresholds. Per the County's guidance, all assumptions should be clearly presented, including length of each construction phase, equipment that will be used during each phase, and the amount of soil disturbance, including any import or export of soil. The emission factors used to estimate emissions should be clearly documented, and the model output should be included in the report.

The SJVAPCD guidance, GAMAQI, states that the latest SJVAPCD-approved models should be used to conduct an air quality analysis. The current recommended model to estimate potential project-generated criteria air pollutant emissions from construction is the California Emissions Estimator Model (CalEEMod), Version 2013.2.2 (available on-line at www.caleemod.com). CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for government

agencies, land use planners, and environmental professionals to quantify potential criteria air pollutant emissions from a variety of land use projects.

The GAMAQI identifies thresholds that separate a project's short-term and long-term emissions. The CalEEMod standard defaults were applied for the emissions estimates except for the following (Insight Environmental Consultants 2016):

- Land use size and lot acreage was adjusted to match the project description;
- Construction schedule was estimated for each construction phase;
- Average daily traffic numbers were adjusted based on data from the Traffic Study (July 2017); and
- Demolition construction phase was removed.

Short-term, emissions are primarily from the construction phase a project and are recognized to be short in duration and without lasting impacts on air quality.

The Air Quality Impact Assessment applied the default CalEEMod equipment list, many variables are factored into the calculation of construction emissions such as length of the construction period, number of each type of equipment, site characteristics, area climate, and construction personnel activities. All equipment was assumed to be in use for the proposed Project specified hours per day and load SJVAPCD's required measures for all project include: (1) water exposed area three times per day; and (2) reduce vehicle speed to less than 15 miles per hour.

Thresholds of Significance

The Kern County California Environmental Quality Act (CEQA) Implementation Document and Kern County Environmental Checklist state that a project could potentially have a significant effect if it would:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard as adopted in (c) i or (c) ii, or as established by EPA or an air district, or contribute substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in nonattainment under an applicable National or State ambient air quality standard (including emissions that exceed quantitative thresholds for ozone precursors). Specifically, would implementation of the project exceed any of the thresholds outlined in Table 4.3-5, *Proposed Project Air Quality Thresholds of Significance by Air Basin*?

Table 4.3-5. Proposed Project Air Quality Thresholds of Significance by Air Basin

Air Basin	Criteria Pollutant					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$

SJVAB[1]						
Construction Sources (tons/year)	10	10	100	27	15	15
Operations Sources (tons/year)	10	10	100	27	15	15
MDAB[2]						
Operations Daily Mobile Sources (lbs/day)	137	137	--	--	--	--
Operations Sources (tons/year)	25	25	NA	27	15	15

NA = not applicable.
Sources: 1) SJVAPCD, 2015a.
2) EKAPCD, 1999.

- Expose sensitive receptors to substantial pollutant concentrations.
- Cause the creation of objectionable odors, affecting a substantial number of people.

Kern County has adopted the SJVAPCD's quantitative emission thresholds for NO_X and ROG to determine whether the potential air quality impacts of a project may produce a significant impact. The air quality threshold for ROG and NO_X is 10 tpy. For PM_{10}, the County has adopted a threshold of significance that is consistent with the SJVAPCD's fugitive dust control rules (Regulation VIII). For CO, no regional emission thresholds have been established.

Project Impacts

Impact 4.3-1: The Project Would Not Be Consistent with the Air Quality Attainment Plan.

Air quality impacts from proposed projects within Kern County are controlled through policies and provisions of the SJVAPCD, KCGP, and MBGP (Insight Environmental Consultants 2017). Each project should also demonstrate consistency with the SJVAPCD's adopted Air Quality Attainment Plans (AQAP) for ozone and PM_{10}. The SJVAPCD is required to submit a "Rate of Progress" document to the CARB that demonstrates past and planned progress toward reaching attainment for all criteria pollutants. The CCAA requires air pollution control districts with severe or extreme air quality problems to provide for a five percent reduction in nonattainment emissions per year. The AQAP prepared for the San Joaquin Valley by the SJVAPCD complies with this requirement. The CARB reviews, approves, or amends the document and forwards the plan to the EPA for final review and approval within the State Implementation Plan (SIP).

Air pollution sources associated with stationary sources are regulated through the permitting authority of the SJVAPCD under the "New and Modified Stationary Source" rule (SJVAPCD Rule 2201). Owners of any new or modified equipment that emits, reduces, or controls air contaminants, except those specifically exempted by the SJVAPCD, are required to apply for an Authority to Construct and Permit to Operate (SJVAPCD Rule 2010). Additionally, best available control technology (BACT) is required on specific types of stationary equipment and are required to offset both stationary source emission increases along with increases in cargo carrier emissions if the specified threshold levels are exceeded (SJVAPCD Rule 2201, 4.7.1). Through this mechanism, the SJVAPCD ensures that all stationary sources within the proposed Project area would be subject to the standards of the SJVAPCD and that new developments do not result in net increases in stationary sources of criteria air pollutants.

Required Evaluation Guidelines

CEQA Guidelines and the Federal CAA (Sections 176 and 316) contain specific references on the need to evaluate consistencies between the proposed Project and the applicable AQAP for the proposed Project site. To accomplish this, the CARB has developed a three-step approach to determine proposed Project conformity with the applicable AQAP:

1. Determination that an AQAP is being implemented in the area where the project is being proposed. The SJVAPCD has implemented the current, modified, AQAP as approved by the CARB. The current AQAP is under review by the EPA.

2. The proposed Project must be consistent with the growth assumptions of the applicable AQAP. The proposed Project is included within the employment increases projected in the KCGP and MBGP.

3. The proposed Project must contain in its design all reasonably available and feasible air quality control measures. The proposed Project incorporates various policy and rule-required implementation measures that will reduce related emissions.

The CCAA and AQAP identify transportation control measures as methods to further reduce emissions from mobile sources. Strategies identified to reduce vehicular emissions, such as reductions in vehicle trips, vehicle use, vehicle miles traveled, vehicle idling, and traffic congestion in order to reduce vehicular emissions, can be implemented as control measures under the CCAA as well. Additional measures may also be implemented through the building process, such as providing electrical outlets on exterior walls of structures to encourage use of electrical landscape maintenance equipment or measures such as electrical outlets for electrical systems on diesel trucks to reduce or eliminate idling time.

Since the growth represented by the proposed Project was anticipated by the KCGP and MBGP and incorporated into the AQAP, conclusions may be drawn from the following criteria:

- The findings of the analysis conducted using Traffic Analysis Zones show that sufficient employment increases are planned for the proposed Project area;

- That, by definition, the emissions from the proposed Project are below the SJVAPCD's established emissions impact thresholds; and

- That the primary source of emissions from the proposed Project would be on-road trucks that are licensed through the State of California and whose emissions are already incorporated into the CARB's San Joaquin Valley Emissions Inventory.

Based on these factors, the proposed Project is consistent with the AQAP.

Consistency with Kern Council of Government's Regional Conformity Analysis

The Kern COG Regional Conformity Analysis Determination demonstrates that the regional transportation expenditure plans (Destination 2030 Regional Transportation Plan and Federal

Transportation Improvement Program) in the Kern County portion of the San Joaquin Valley air quality attainment areas would not hinder the efforts set out in the CARB's SIP for each area's nonattainment pollutants (CO, ozone, and PM_{10}). The analysis uses an adopted regional growth forecast governed by both the adopted Kern COG Policy and Procedure Manual and a Memorandum of Understanding between Kern County and Kern COG (representing itself and outlying municipal member agencies).

The Kern COG Regional Conformity Analysis considers general plan amendments (GPAs) and zone changes (ZCCs) that were enacted at the time of the analysis as projected growth within the area based on land use designations incorporated within the KCGP and MBGP. Land use designations that are altered based on subsequent GPAs that were not included in the regional conformity analysis were not incorporated into the Kern COG analysis. Consequently, if a proposed project is not included in the regional growth forecast using the latest planning assumptions, it may not be said to conform to the regional growth forecast. Under the current Kern County zoning, the proposed Project site is designated as A (Exclusive Agriculture) and would be included in the regional growth forecast.

> Item 2 under Section 3 of the Model Maintenance Procedure of the Kern COG Regional Transportation Modeling Policy and Procedure Manual, states:
>
> Land Use Data - General Plan land capacity data or "Build-out capacity" is used to distribute the forecasted County totals, and may be updated as new information becomes available, and is revised in regular consultation with local planning departments.

Under current policies, only after a GPA is approved can housing and employment assumptions be updated to reflect capacity changes. Since the proposed Project requires a GPA from R-IA (Resource-Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), GC (General Commercial), and HC (Highway Commercial). The existing growth forecast would eventually be modified to reflect these changes.

In addition, a review of the Kern COG regional forecast was prepared to evaluate if the proposed Project area growth forecast would be sufficient for the proposed Project's projected employment increase. The adopted growth forecasts are assigned to Traffic Analysis Zones (TAZs). A review of the growth forecast for a six-mile radius from the proposed Project was conducted (Insight Environmental Consultants 2017). Table 4.3-6, *TAZ Analysis Area Projected Growth Analysis*, shows the TAZ growth forecast data for the proposed Project's six-mile radius. Table 4.3-7 *Percent Increase/Decrease on TAZ Analysis Area* shows the percent increase or decrease for the six-mile radius regarding population, households and employment.

Table 4.3-6. TAZ Analysis Area Projected Growth Analysis

	Years		
	2015	2020	2030
Population	128,388	136,471	164,550
Households	37,429	40,811	49,703

Table 4.3-6. TAZ Analysis Area Projected Growth Analysis			
	Years		
	2015	2020	2030
Employment	27,895	29,744	33,690
Source: Insight Environmental Consultants 2017.			

Table 4.3-7. Percent Increase/Decrease on TAZ Analysis Area			
Years	Percent Increase / Decrease		
	Population	Households	Employment
2015*	0	0	0
2020	6	9	7
2030	28	33	21
Source: Insight Environmental Consultants 2017.			

The proposed Project is consistent with the existing land use designation and is currently located within an existing TAZ. There is sufficient employment growth forecast to account for employment growth by 2030. The proposed Project would be considered consistent with the adopted growth forecast and, therefore, consistent with the regional air quality conformity.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.3-2: The Project Would Violate Any Air Quality Standard as Adopted or Established by EPA or Air District or Contribute Substantially to an Existing or Projected Air Quality Violation.

Short-Term (Construction) Emissions

Generally short-term impacts refer to those impacts that occur during the construction phase of the proposed Project are temporary in nature without lasting impacts on air quality. Primarily this phase results in particulate emissions from the construction related activities including fugitive dust and other particulate matter, as well as exhaust emissions generated by earthmoving activities and operation of grading equipment during site preparation. Construction emissions are caused by on-site or off-site activities. On-site emissions principally consist of exhaust emissions (NO_x, SO_x, CO, ROG, PM_{10}, and $PM_{2.5}$) from heavy-duty construction equipment, motor vehicle operation, and fugitive dust

(mainly PM_{10}) from disturbed soil. Off-site emissions are caused by motor vehicle exhaust from delivery vehicles, as well as worker traffic, but also include road dust (PM_{10}). Major construction-related activities include the following:

- Grading/clearing, including the excavation;
- Excavation and earth moving for infrastructure construction of the utilities, both on and off-site, and dwelling unit foundations and footings;
- Building construction;
- Asphalt paving of access roads throughout the development; and
- Application of architectural coatings on surfaces such as dwelling stucco and interior painting.

Construction equipment such as scrapers, bulldozers, forklifts, backhoes, water trucks, and industrial saws are expected to be used on the proposed Project site and would result in exhaust emissions consisting of CO, NO_x, ROG, SO_x, PM_{10}, and $PM_{2.5}$. During the finishing phase, paving operations and application of architectural coatings would release ROG emissions. Construction emission can vary substantially from day to day, depending on the level of activity, the specific type of operation, and prevailing weather conditions.

Kern County requires that PM_{10} emissions from construction activities be included with the operational impacts of the proposed Project.

Regulation VIII Control Measures (From Table 6-2 of the SJVAPCD GAMAQI):

- All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/ suppressant, covered with a tarp or other suitable cover or vegetative ground cover.
- All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant.
- All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking.
- With the demolition of buildings up to six stories in height, all exterior surfaces of the building shall be wetted during demolition.
- When materials are transported off-site, all material shall be covered, or effectively wetted to limit visible dust emissions, and at least six inches of freeboard space from the top of the container shall be maintained.

- All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at the end of each workday. (The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions.) (Use of blower devices is expressly forbidden.)

- Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant.

- Within urban areas, an owner/operator shall prevent carryout and trackout, or immediately remove carryout and trackout when it extends 50 feet or more from the nearest unpaved surface exit point of the site.

- Any construction site with 150 or more vehicle trips per day shall prevent carryout and track-out.

Enhanced and Additional Control Measures for Construction Emissions of PM_{10}:

Enhanced Control Measures - Measures to be implemented at construction sites when required to mitigate significant PM_{10} impacts:

- Limit traffic speeds on unpaved roads to 15 miles per hour;

- Shut down equipment when not in use for extended periods;

- Construction equipment shall operate no longer than eight (8) cumulative hours per day; and

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than one percent.

Additional Control Measures - Measures that are encouraged at large construction sites located near sensitive receptors, or for projects requiring additional emissions reductions:

- Track out will be prevented by one of the following:

    - A Grizzly with rails, pipes or grates to dislodge debris off exiting vehicles;

    - A layer of washed gravel at one inch or larger in diameter, three inches deep;

    - Extension of paved road at least 100 feet from publicly maintained road; or

    - Installation of a wheel washer.

- Install wind breaks at windward side(s) of construction areas;

- Suspend excavation and grading activity when winds exceed 20 mph (Regardless of wind speed, an owner/operator must comply with Regulation VIII's 20 percent opacity limitation); and

- Limit area subject to excavation, grading, and other construction activity at any one time.

The precise construction details for the proposed Project were unknown at the time of the Air Quality Impact Analysis (Insight Environmental Consultants 2016; refer to Appendix C). The Air Quality Impact Analysis assumed default construction equipment list. All equipment was assumed to be in use for the proposed Project specified hours per day and load factors. SJVAPCD's required measures for all projects include: (1) water exposed area three-times per day; and (2) reduce vehicle speed to less than 15 miles per hour. Refer Appendix C for CalEEMod results.

Table 4.3-8, *Construction Emissions*, presents the proposed Project's unmitigated and mitigated short-term emissions based on the expected full buildout period for the proposed Project.

Table 4.3-8. Construction Emissions

Emissions Source	Pollutant (tons/year)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
Unmitigated						
Year 2016	0.20	1.84	1.50	0.002	0.30	0.18
Year 2017	3.71	3.35	3.56	0.006	0.39	0.23
Year 2018	3.82	4.47	4.72	0.009	0.64	0.36
Year 2019	0.26	2.26	2.37	0.004	0.39	0.21
Year 2020	3.47	1.61	2.06	0.004	0.22	0.11
Year 2021	3.67	3.25	4.19	0.009	0.56	0.29
Year 2022	0.20	1.61	2.12	0.004	0.35	0.18
Year 2023	3.43	1.17	1.90	0.004	0.19	0.09
Year 2024	3.60	2.49	3.90	0.009	0.51	0.24
Mitigated						
Year 2016	0.20	1.84	1.50	0.002	0.20	0.13
Year 2017	3.71	3.35	3.56	0.006	0.39	0.23
Year 2018	3.82	4.47	4.72	0.009	0.54	0.32
Year 2019	0.26	2.26	2.37	0.004	0.29	0.17
Year 2020	3.47	1.61	2.06	0.004	0.22	0.11
Year 2021	3.67	3.25	4.19	0.009	0.46	0.24
Year 2022	0.20	1.61	2.12	0.004	0.25	0.13
Year 2023	3.43	1.17	1.90	0.004	0.19	0.09
Year 2024	3.60	2.49	3.90	0.009	0.41	0.19
SJVAPCD Threshold	10	10	100	27	15	15
Is Threshold Exceeded After Mitigation?	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Source: Insight Environmental Consultants, 2017.

As calculated by CalEEMod using the default equipment list (refer to Appendix C), the short-term emissions for each year of construction are predicted to be below the SJVAPCD threshold levels and less than significant. Even though emissions would be below the threshold of significance, the Air Quality Impact Assessment also analyzed the emission levels with the incorporation of mitigation measures. The mitigated short-term emissions from the proposed Project (as calculated by CalEEMod) using the default equipment listing, would not exceed the SJVAPCD significance levels and the levels would be the same except for PM_{10} and $PM_{2.5}$; however, mitigation would further

reduce emission levels for PM_{10} and $PM_{2.5}$. With the implementation of mitigation measures, impacts would be less than significant in this regard.

Long-Term (Operational) Impacts

Long-term (operational) emissions are caused by operational mobile, area and energy sources. Table 4.3-9 *Operational Emissions* presents operational emissions for post-project conditions, approximately year 2025. The table depicts operational emissions with and without mitigation.

Table 4.3-9. Operational Emissions

Emissions Source	Pollutant (tons per year)*					
	ROG	**NO_X**	**CO**	**SO_X**	**PM_{10}**	**$PM_{2.5}$**
Unmitigated Emissions						
Area Source Emissions	12.96	0.0002	0.03	0.00	0.0001	0.0001
Energy Source Emissions	0.30	2.74	2.30	0.002	0.21	0.21
Mobile Source Emissions	22.40	70.27	288.17	0.67	33.51	10.02
Total Unmitigated Long-Term Emissions	**35.65**	**73.01**	**290.50**	**0.69**	**33.72**	**10.23**
SJVAPCD and Kern County Annual Threshold	**10**	**10**	**100**	**27**	**15**	**15**
Is the Threshold Exceeded Before Mitigation?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**
Mitigated Emissions						
Area Source Emissions	11.79	0.0002	0.03	0.00	0.0001	0.0001
Energy Sources Emissions	0.30	2.74	2.30	0.02	0.21	0.21
Mobile Source Emissions	21.46	63.92	275.48	0.59	29.15	8.72
Rule 9510 – ISR Compliance Reduction	-	(17.96)	-	-	(12.50)	-
Total Mitigated Long-Term Emissions	**33.55**	**48.70**	**277.80**	**0.61**	**16.86**	**8.93**
SJVAPCD and Kern County Annual Threshold	**10**	**10**	**100**	**27**	**15**	**15**
Is the Threshold Exceeded After Mitigation?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**

Notes:
* 0.00 may represent zero or emissions less than 0.005.

Source: Insight Environmental Consultants 2017.

As calculated by the CalEEMod, operational emissions would exceed the SJVAPCD threshold levels for ROG, NO_x, CO, and PM_{10}. Even with the incorporation of Mitigation Measures, long-term air quality operational impacts would be significant and unavoidable.

Fugitive Dust Emissions

Operations of the Project site at full buildout is not expected to present a significant source of fugitive dust (PM_{10}) emissions. The main source of PM_{10} emissions would be from project-related vehicular traffic from employees and consumers driving to and from the proposed Project site. PM_{10} on its own as well as in combination with other pollutants creates a health hazard. The SJVAPCD's Regulation VIII establishes required controls to reduce and minimize fugitive dust emissions. The following SJVAPCD Rules and Regulations apply to the proposed Project (as discussed above in Section 4.3.3, *Regulatory Setting*).

- Rule 4102 – Nuisance

- Regulation VIII – Fugitive PM_{10} Prohibitions
- Rule 8011 – General Requirements
- Rule 8021 – Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities
- Rule 8041 – Carryout and Trackout
- Rule 8051 – Open Areas

The proposed Project would comply with applicable SJVAPCD Rules and Regulations, the Kern County Zoning Ordinance. In addition, Mitigation Measures MM 4.3-1 through MM 4.3-3 would reduce operational fugitive dust emissions; however, as shown in Table 4.3-9 above, impacts would be significant and unavoidable.

Ambient Air Quality

An ambient air quality analyses were performed to determine if the project's construction and operations have the potential to impact ambient air quality through a violation of the ambient air quality standards or a substantial contribution to an existing or projected air quality standard. The basis for the analysis is dispersion modeling applied to the project as described. Maximum daily emissions were used as the basis for determining the proposed Project's potential impact on ambient air quality. Additional information on the ambient air quality modeling methods and assumptions are presented in Appendix C (Insight Environmental Consultants 2017).

The maximum off-site ground level concentration of each pollutant for the 1-hour, 3-hour, 8-hour, 24-hour and annual periods was predicted using the most recent version of EPA's AMS/EPA Regulatory Model (AERMOD) dispersion software under the Lakes Environmental ISC-AERMOD View interface. SJVAPCD-approved, AERMET-processed U Star meteorological datasets for calendar years 2010 through 2014 was input to AERMOD (Insight Environmental Consultants 2017). This was the most recent available dataset available at the time the modeling runs were conducted. All of the regulatory default AERMOD model keyword parameters were employed. Rural dispersion parameters were used for this project, which differs from the urban setting used in the CalEEMod model. The CalEEMod selection criteria is based on trip distances to the project site while the AERMOD selection criteria is based on the majority of the land use surrounding the facility. The majority of the land surrounding the project site is considered "rural" under the Auer land use classification method (Insight Environmental Consultants 2017).

Emissions were evaluated for each pollutant on a short-term (correlating to pollutant averaging period) and long-term (annual) basis, with the exception of CO that was evaluated only for short-term exposures since there are no long-term significance thresholds for CO. Emissions were modeled as an area source with a release height of 1.0 meters.

The majority of mobile emissions predicted by CalEEMod will occur beyond the project boundary because of vehicle trips. In order to determine the on-site vehicle emissions, the following

methodology was discussed and approved by the SJVAPCD (Insight Environmental Consultants 2016). An estimated on-site trip distance was determined by calculating the diagonal distance from the center of the project to the furthest corner. The on-site estimated trip distance was determined to be 0.75 miles. The on-site estimated trip distance was then divided by the average trip length used by CalEEMod, 8.09 miles, in order to determine the on-site to off-site mobile emissions ratio, 9.27 percent. The total mobile emissions calculated by CalEEMod were then reduced by 90.73 percent to estimate the mobile on-site emissions used for ambient air quality modeling.

A fenceline coordinate grid of receptor points was constructed. The grid consisted of a 25-meter fenceline spacing and 25-meter tier spacing extending a distance of 100 meters with initial receptors starting 25 meters from the facility boundary. Elevated terrain options were employed even though there is not a complex terrain in the proposed Project area.

For each pollutant and averaging period modeled, a "total" concentration was estimated by adding the maximum measured background air concentration to the maximum predicted Project impacts. The maximum measured background air concentrations used in this analysis were calculated from measured concentrations at the nearest monitoring stations.

The results of the air dispersion modeling are presented in Table 4.3-10 *Predicted Ambient Air Quality Impacts* and demonstrate that the maximum impacts attributable to the proposed Project, when considered in addition to the existing background concentrations, are below the applicable ambient air quality standard for NO_x, SO_x, and CO. Refer to Appendix C for details regarding the model outputs.

Table 4.3-10. Predicted Ambient Air Quality Impacts

Pollutants	Averaging Period	Background	Project	Project + Background	NAAQS	CAAQS
NO_2	1-hour	59.76	44.04	103.80	188.68	338
	Annual	24.57	3.08	27.65	100	56
SO_2	1-hour	30.50	0.36	30.86	196	655
	3-hour	27.450	0.15	27.60	1,300	---
	24-hour	6.770	0.08	6.85	365	105
	Annual	1.440	0.03	1.47	---	---
CO	1-hour	1480.00	141.70	1621.70	40,000	23,000
	8-hour	617.00	51.64	668.64	10,000	10,000
PM_{10}	24-hour	104.00	3.26	107.26	150	50
	Annual	56.42	1.04	57.45	---	20
$PM_{2.5}$	24-hour	83.20	1.14	84.34	35	---
	Annual	17.90	0.36	18.26	12	12

Source: Insight Environmental Consultants 2017.

Pre-Project concentrations of PM_{10} and $PM_{2.5}$ exceed their respective ambient air quality standards. PM_{10} and $PM_{2.5}$ are evaluated in accordance with the SJVAPCD recommended significant impact level for fugitive PM_{10} and $PM_{2.5}$ emissions. It is the SJVAPCD's policy to use significant impact levels to determine whether a proposed new or modified source will cause or contribute significantly

to an AAQS violation. If a project's maximum impacts are below the SJVAPCD's significance thresholds, the project is judged to not cause or contribute significantly to an AAQS or PSD increment violation. A comparison of the proposed impact from the Project to the District SIL values is provided in Table 4.3-11 *Modeled Project Levels Compared to Significance Threshold*.

Table 4.3-11. Modeled Project Levels Compared to Significance Thresholds

Pollutant	Averaging Period	Predicted Concentration	Significance Level
PM_{10}	24-hour	3.26	10.4
	Annual	1.04	2.08
$PM_{2.5}$	24-Hour	1.14	2.5
	Annual	0.36	0.63

Source: Insight Environmental Consultants 2017.

Because the Project's modelled PM_{10} and $PM_{2.5}$ are below the SJVAPCD's significance levels for 24-hour and annual concentrations, the Project's contribution to potential violations of ambient air quality standards would be less-than-significant.

Mitigation Measures

MM 4.3-1: **Air Quality**. To minimize personnel and public exposure to potential Valley Fever–containing dust both on- and off-site, the following additional control measures shall be included in the DCP to be prepared for this project:

a. Equipment, vehicles, and other items shall be thoroughly cleaned of dust before they are moved offsite to other work locations.

b. Wherever possible, grading and trenching work shall be phased so that earth-moving equipment is working well ahead or down-wind of workers on the ground.

c. The area immediately behind grading or trenching equipment shall be sprayed with water before ground workers move into the area.

d. In the event that a water truck runs out of water before dust is sufficiently dampened, ground workers being exposed to dust are to leave the area until a full truck resumes water spraying.

e. All heavy-duty earth-moving vehicles shall be closed-cab and equipped with a HEP-filtered air system.

f. Workers shall receive training to recognize the symptoms of Valley Fever, and shall be instructed to promptly report suspected symptoms of work-related Valley Fever to a supervisor. Evidence of training shall be provided to the Kern

County Planning and Natural Resources Department within 24 hours of the training session.

g. Valley Fever informational handout shall be provided to all on-site construction personnel. The handout shall, at a minimum, provide information regarding the symptoms, health effects, preventative measures, and treatment. Additional information and handouts can be obtained by contacting the Kern County Public Health Services Department.

MM 4.3-2: **Valley Fever Training**. Onsite personnel shall be trained on the proper use of personal protective equipment, including respiratory equipment. National Institute for Occupational Safety and Health (NIOSH)-approved respirators shall be provided to onsite personal, upon request. Evidence of training shall be provided to the Kern County Planning and Natural Resources Department within 24 hours of the training session.

MM 4.3-3: **Valley Fever Education Fees.** One-time payment of $3,200.00 shall be made to the Kern County Public Works: Public Health Department for the specific purposes of continued Valley Fever education and outreach.

MM 4.3-4: All required landscaping along major and arterial roadways will be designed with native drought-resistant species (plants, trees, and bushes) to reduce demand for gas-powered landscape maintenance equipment.

MM 4.3-5: Prior to issuance of building permit, the applicant shall submit evidence, verified by the Air District, that the development has total Project construction and operations mitigated baseline below 2 tons per year for NO_x (total Project construction and operations) and mitigated baseline below 2 tons per year for PM_{10} emissions (total Project constructions and operations). Required reductions can be achieved from any combination of Project design, compliance with the Indirect Source Review (ISR) and/or a Development Mitigation Contract. If a Development Mitigation Contract is utilized a copy of the executed agreement and implementing reports will be provided to the Planning Department to substantiate compliance. As there still would be unmitigated emissions of ROG participation in any air mitigation program adopted by Kern County that provides equal or more effective mitigation than this mitigation measure can be utilized as a replacement for the requirements of this mitigation measure.

Level of Significance after Mitigation

Less than significant for construction related impacts and operational SO_x PM_{10}, and $PM_{2.5}$. Significant and Unavoidable Impact of ROG, NO_x, and CO operational emissions.

Impact 4.3-3: The Project Would Violate Standards for CO Concentrations.

CO Hot Spots Analysis

Localized high concentrations of CO along a congested roadway or intersection may expose nearby sensitive receptors, e.g. children, the elderly, hospital patients, etc., even when it is not being recorded high at the monitoring sites. These areas of high CO concentrations are known as CO Hot Spots. The SJVAPCD GAMAQI contains criteria for determining whether an analysis is warranted for a particular project. If the following two criteria are met by the proposed Project then further CO analysis is warranted:

- The traffic study indicates that the Project would cause one or more streets or at one or more intersections within the general Project area would be reduced to a Level of Service (LOS) E or F;

- Signalized and/or channelization is added to an intersection and vicinity, and sensitive receptors such as residences, schools, hospitals, etc. are located in the vicinity of the affected intersection or signalization.

A traffic study was prepared for this proposed Project. The traffic study indicated that potentially impacted intersections and roadway segments would operate at a level of service (LOS) C or better and this is within the GAMAQI significance criteria. Based upon the results of the traffic study, a CO Hot Spot analysis was not prepared for this proposed Project. No concentrated excessive CO emissions are expected to be caused once the proposed Project is completed. The proposed Project would not violate CO standards and would therefore have a less than significant impact on air quality.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.3-4: The Project Would Result In A Cumulatively Considerable Net Increase of Any Criteria Pollutant For Which The Project Region Is Nonattainment Under an Applicable Federal Or State Ambient Air Quality Standard.

As noted in Table 4.3-2, the SJVAB is a nonattainment area for the State 1-hour ozone, 8-hour ozone, PM_{10}, and $PM_{2.5}$ standards and is a nonattainment area for National 8-hour ozone and $PM_{2.5}$ standards. As shown above in Table 4.3-8, project construction emissions of these pollutants would be below SJVAPCD annual thresholds. The proposed Project would create ozone, NO_X, PM_{10}, and $PM_{2.5}$ emissions during construction, which would contribute to the current nonattainment status of these pollutants within the SJVAB. As noted in Impact 4.3-2, the proposed Project's emissions during temporary construction activities would not exceed thresholds and would have a less than significant impact. Operation of the proposed Project would also create additional criteria pollutants, particularly

as a result of increased mobile emissions in the project area. As shown in Table 4.3-9, above, project operation emissions of these pollutants would exceed the SJVAPCD thresholds and result in a significant and unavoidable impact. (Refer to Impact 4.3-2, above, for further discussion.)

CEQA and SJVAPCD's Rule 9510 require that all feasible and reasonable mitigation be applied to the proposed Project to reduce air quality impacts from construction and operations, whether the emissions would exceed the thresholds or not.

Rule 9510 states that development projects with emissions above 2.0 tons per year of NO_X and/or PM_{10} are subject to the mitigation requirements of the rule. Rule 9510 allows these reductions to be accomplished through project design changes such as using a higher insulation value in construction that could result in no additional costs for fees to the SJVAPCD. The proposed Project would be required to adhere to any determination of this rule by SJVAPCD. In addition, the proposed Project would implement Mitigation Measures MM 4.3-1 through MM 4.3-5, which would further reduce construction and operation emissions. Even with implementation of these mitigation measures, however, the proposed Project would still contribute the non-attainment status in the SJVAB regarding these pollutants.

Based on these considerations, the proposed Project's potential to result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard would be potentially significant.

Mitigation Measures

Implement Mitigation Measures MM 4.3-1 through MM 4.3-5.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

Impact 4.3-5: The Project Would Expose Sensitive Receptors to Substantial Pollutant Concentrations.

Sensitive receptors are defined as facilities or land uses that include members of the population that are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of these sensitive receptors are residences, schools, hospitals and daycare centers. CARB has identified the following groups of individuals as the most likely to be affected by air pollution: persons over 65 years of age, children under the age 14, athletes and persons with cardiovascular and chronic respiratory disease such as asthma, emphysema, and bronchitis.

There were four schools identified that are within a two-mile radius of the Project site. As identified in Table 4.3-8, above, construction emissions would be below SJVAPCD thresholds and would be less than significant. However, as shown in Table 4.3-9, above, operation Project emissions would exceed SJVAPCD thresholds for ROG, NO_x, CO, and PM_{10}. Thus, surrounding sensitive receptors could potentially be exposed to substantial pollutant concentrations from the proposed Project. Implementation of Mitigation Measure MM 4.3-1 through MM 4.3-5 would help to reduce impacts

to sensitive receptors; however, impacts to ROG, NO_x, and CO from operation of the proposed Project cannot be reduced to less than significant impacts. Therefore, sensitive receptors would potentially be exposed to adverse quantities of long-term emissions. The proposed Project would result in significant and unavoidable impacts to sensitive receptors.

Mitigation Measures

Implement mitigation measures MM 4.3-1 through MM 4.3-5.

Level of Significance After Mitigation

Significant and Unavoidable impact of ROG, NO_x, and CO operation emissions. Less than significant after mitigation for Project contribution of all other emissions. Less than significant for construction emissions.

Impact 4.3-6: The Project Would Create Odor Impacts.

Because offensive odors rarely cause any physical harm and no requirements for their control are included in State or federal air quality regulations, the SJVAPCD has no rules or standards related to odor emissions, other than its Nuisance Rule 22. According to the GAMAQI, analysis of potential odor impacts should be conducted for the following two situations:

- Generators – projects that would potentially generate odorous emissions proposed to locate near existing sensitive receptors or other land uses where people may congregate, and

- Receivers – residential or other sensitive receptor projects or other projects built for the intent of attracting people locating near existing odor sources.

The purpose of the proposed M-1 PD (Light Industrial, Precise Development Combining) Zone District it to designate areas for wholesale commercial, storage, trucking, assembly-type manufacturing, other similar industrial uses. According to the Kern County Zoning Ordinance Chapter 19.36, uses within the M-1 Zone District may not exceed six (6) stories or seventy-five (75) feet and may not produce fumes, odor, dust, smoke, gas, or vibrations extending beyond zoning district boundaries. The purpose of the proposed M-2 PD (Medium Industrial Precise Development Combining) Zone District is to designate areas for general manufacturing, processing, and assembly activities. According to the Kern County Zoning Ordinance Chapter 19.38, uses within the M-2 Zone District may not produce fumes, odor, dust, smoke, gas, or vibrations extending beyond zoning district boundaries. In addition to the proposed M-1 and M-2 Zone Districts, the proposed Project includes the Precise Development (PD) Combining Districts. Implementation of the proposed PD Combining Districts would ensure that although a specific use of the site is not proposed at this time any future proposed development would be required to prepare a PD Plan, which would ensure that any specific use would not produce any objectionable odors offsite.

The purpose of the proposed CH PD (Highway Commercial, Precise Development Combining) Zone District is to designate areas for gas stations, restaurants, and motels uses while the purpose of the proposed C-2 PD (General Commercial, Precise Development Combining) Zone District is to

designate areas for shopping centers and heavy commercial uses. According to the Kern County Zoning Ordinance Chapters 19.34 and 19.32, respectively, there is no specific odor restriction; however, according to Kern County Health and Safety Ordinance Chapter 8.2, any person in possess, charge or control of any structure, property or other premises shall keep it free and clear of all accumulations of solid waste which may produce odor, attract or harbor insects or rodents or provide a breeding place for them, be offensive to the senses, or become a hazard to health, safety and welfare of the public.

Because the proposed Project is a mixed use industrial and commercial project, any industrial activities triggering air permits would be under the regulation of the SJVAPCD and commercial activities do not typically allow tenants that create objectionable odors, the proposed Project is not considered a source of objectionable odors or odorous compounds. In addition, the proposed Project would not exceed any screening trigger levels to be considered a source of objectionable odors or odorous compounds based on the SJVAPCD's GAMAQI provisions (Insight Environmental Consultants 2017). Therefore, the proposed Project is not expected to be a source of any odorous compounds nor would it likely be impacted by any odorous source. Impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

This cumulative impact analysis uses a tiered approach to provide the reader with a thorough understanding of local, regional, and valley-wide air quality conditions and the proposed Project's contribution to cumulative air quality impacts. The cumulative project list is provided in Table 3-5, *Cumulative Projects List for Kern County*, in Section 3.0, *Cumulative Projects*. This geographic scope of analysis is appropriate because of influence of the area with wildfires, as well as the localized nature of hazardous materials impacts and other hazards discussed in this section.

The Kern County Planning and Natural Resources Department's Guide for Preparing an Air Quality Assessment for Use in Environmental Impact Reports has determined that a cumulative analysis must be prepared for a proposed development when the project is required to prepare an EIR. The cumulative analysis is used to consider localized impacts, determine consistency with existing air quality plans, and provide a comparison of the project's impacts to the SJVAB emissions.

The air quality analysis conducted for this Project, which is included as Appendix C to this Recirculated Draft EIR, indicates that, with mitigation, Project impacts would be individually significant. The air quality impact analysis, however, also considered impacts of the proposed Project in conjunction with the impacts of other past, present, and reasonably foreseeable projects in the air basin. The following cumulative impacts were considered.

- Cumulative Ozone Impacts (ROG and NOx) from numerous sources within the region, including transport from outside the region. Ozone is in chemical reactions produced by ROG, NOx, and sunlight.

- Cumulative CO Impacts produced primarily by vehicular emissions.

- Cumulative PM_{10} Impacts within the region and locally from the various projects. Such projects may cumulatively produce a significant amount of PM_{10} if several projects conduct grading or earthmoving activities at the same time.

- HAP Impacts on sensitive receptors within the SJVAPCD-recommended screening radius of one mile.

Total Cumulative Project Emissions

A cumulative impact analysis considers the proposed Project along with the anticipated growth of the area. According to CEQA (§15355) cumulative impacts are defined "as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts."

There are 104 planned development projects within a six-mile radius of the proposed Project. These projects are identified in Table 3-5, *Cumulative Projects List for Kern County*, as well as provided in Appendix C. Projects that are planned but have not been submitted for review or approved by the County or City were not included because there is no way to determine what the projects may entail.

Table 4.3-12, *Cumulative Projects Emissions,* provides the cumulative projects emissions for construction and operation phases of the cumulative environment. The emissions estimated presented in the Air Quality Impact Analysis were modeled using the CalEEMod computer model to predict cumulative impacts. Emissions for the construction and operational phase of each project were based on total number of lots or square footage for maximum project buildout. No mitigation measures were applied to any of the projects as it is not known which, if any, would be required by the City of Bakersfield or Kern County, or which may be voluntarily proposed by the individual developer or required by code or regulation. Additionally, no cumulative significance thresholds are shown because no cumulative thresholds have been established by SJVAPCD, CARB, or other regulatory authority. These projects represent all known and reasonably foreseeable projects in the area at this time. As these projects are either currently under construction or approved by the City of Bakersfield or Kern County for consistency with applicable regulations, it is assumed that they are in conformance with the regional AQAP. The model outputs for the cumulative impacts analysis have been included in Appendix C.

Table 4.3-12. Cumulative Projects Emissions

Six-Mile Radius Project Types	Pollutant (tons/year)							
	ROG	NO_x	CO	SO_x	Fugitive PM_{10}	Exhaust PM_{10}	PM_{10}	$PM_{2.5}$
Construction[1]								
Tentative Tracts Subtotal	204.88	114.95	345.67	1.23	131.95	3.77	135.73	36.91
Tentative Parcel Maps Subtotal	3.43	13.51	11.21	0.02	0.77	0.77	1.54	1.05
Site Plan Review Subtotal	8.17	9.41	11.09	0.02	0.95	0.45	1.41	0.73
Total Cumulative Six-Mile Projects	216.48	137.87	367.97	1.27	133.67	4.99	138.68	38.69
This Project	*22.36*	*22.05*	*26.32*	*0.051*	*1.85*	*1.10*	*2.95*	*1.61*
Total Cumulative Projects	**238.84**	**159.92**	**394.29**	**1.32**	**135.52**	**6.09**	**141.63**	**40.30**
Operations								
City of Bakersfield and Kern County (Combined)								
Tentative Tracts Subtotal	162.77	272.39	941.99	3.22	152.26	8.83	161.09	49.3
Tentative Parcel Maps Subtotal	1.68	2.42	9.19	0.03	1.25	0.08	1.32	0.41
Site Plan Review Subtotal	22.9	53.82	243.12	0.55	24.67	2.33	27.00	8.89
Total Cumulative Six-Mile Projects	**187.35**	**328.63**	**1,194.30**	**3.80**	**178.18**	**11.24**	**189.41**	**58.60**
This Project	*33.55*	*66.66*	*277.80*	*0.61*	*27.82*	*1.54*	*29.36*	*8.93*
Total Cumulative Projects	**220.9**	**395.29**	**1,472.10**	**4.41**	**206.00**	**12.78**	**218.77**	**67.53**

Source: Insight Environmental Consultants 2017.

[1] These emissions are overestimated and include all years of construction not just a single year, as they are discretionary projects that are subject to various mitigation measures that have not yet been determined nor their impacts reduced herein.

The most recent certified SJVAB Emission Inventory data available from the CARB is based on data gathered for the 2012 annual inventory. This data will be used to assist the SJVAPCD in demonstrating attainment of Federal eight-hour ozone standards and contained 218,964 tons/year VOC (ROG) and 119,282 tons/year NO_x from all sources (Insight Environmental Consultants 2016). On a regional basis, the proposed Project represents approximately 0.016 percent of the ROG and 0.038 percent NO_x emissions in the SJVAB. The SJVAB emissions would essentially stay the same regardless of whether or not the proposed Project is built (Insight Environmental Consultants 2017). However, the proposed Project by itself is considered significant. The proposed Project in conjunction with other past, present and foreseeable future projects would result in cumulative long-term impacts to air quality. The SJVAB's cumulative air quality impacts would remain significant without this project since the air basin is currently considered to be in nonattainment for certain criteria pollutants. The proposed Project's incremental contribution to these impacts is significant and unavoidable.

Mitigation Measures

Implement Mitigation Measures MM 4.3-1 through MM 4.3-5.

Level of Significance after Mitigation

Cumulative Impacts are considered significant and unavoidable.

Hazardous Air Pollutants

The GAMAQI states that, when evaluating potential impacts related to HAPs, "impacts of local pollutants (CO, HAPs) are cumulatively significant when modeling shows that the combined emissions from the proposed Project and other existing and planned projects will exceed air quality standards." Dispersion modeling showed that the proposed Project would not exceed any NAAQS, CAAQS, or other health risk standards (Insight Environmental Consultants 2017 refer to Appendix C); thus, the proposed Project would not be a significant source of HAPs. Therefore, the proposed Project would not pose a significant cumulative CO or HAPs impact.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.4

Biological Resources

Section 4.4
Biological Resources

4.4.1 Introduction

The purpose of this section is to identify existing biological resources on-site and in the vicinity of the proposed Project, analyze potential Project-related impacts on these resources (including special-status species and habitats), and recommend mitigation measures to reduce the significance of impacts. The analysis provided in this section is based on the findings of the Biota Report. A Biota report was prepared by McIntosh and Associates in June 2009. Due to the time between the technical study and this Recirculated Draft Environmental Impact Report (RDEIR), a second Biota Report was prepared by McCormick Biological, Inc. in July 2017. See Appendix D, Biota Report, and Appendix N, Original Technical Studies.

This section describes the biological character of the proposed Project site in terms of vegetation, flora, wildlife, and wildlife habitats, and analyzes the biological significance of the site in accordance with Federal, State and local laws and policies. General plant and wildlife surveys of the proposed Project site were conducted on October 31, November 1, and December 5, 2006, and again on March 10, 2016 (McIntosh & Associates 2009; McCormick Biological 2017). These surveys were conducted to evaluate the biological character of the proposed Project and to determine if special-status species have the potential to occur within the proposed Project site. Survey methodology in 2006 included meandering pedestrian transects through all present habitat types. In 2016, all perimeter and interior roads were slowly driven, stopping to inspect and evaluate representative habitat features and noting observations of identified plant and wildlife species observed. Supporting documentation regarding species findings included direct observations and/or significant species signs (e.g., scat, tracks, feather/fur, prey remains, nests/burrows or any other indication of wildlife presence) and literature reviews from the California Natural Diversity Database (CNBB), United States Fish and Wildlife Service (USFWS), California Fish and Wildlife Service (CDFW), the California Native Plant Society (CNPS), and Western Bat Working Group (WBWG). Botanical survey techniques followed the CNPS recommended guidelines. Photographs taken during field surveys are included in Appendix D, *Biota Report*, and Appendix N, *Original Technical Studies*.

4.4.2 Environmental Setting

The proposed Project is situated in the southern San Joaquin Valley in Kern County, California. The Project site consists of approximately 314.30 acres, generally located north of Houghton Road, east of State Route (SR) 99, west of South Union Avenue (SR-204), and south of DiGiorgio Road, approximately 1.10 miles southeast of the City of Bakersfield, and within the unincorporated area of Kern County, California.

The 314.30-acre Project site is mostly vacant; however, the site does contain a steel storage building associated with agricultural activities, one plugged and abandoned oil well, two active, diesel-powered irrigation wells, and one domestic well. Between the various fields are dirt roads, irrigation ditches, and an equipment/materials storage area. No undisturbed native habitat exists on the Project

site or adjacent properties. The surrounding land includes vacant land and agricultural lands, with a cluster of single-family residential to the east and an automobile wrecking yard to the south. Photographs record conditions that were observed on the project site (Appendix D and Appendix N).

The proposed Project site is located along the southwestern edge of the San Joaquin Valley; a broad, treeless plain in the rain shadow of the Inner Coast Ranges. The San Joaquin Valley is characterized by relatively low rainfall, averaging less than 10 inches per year, mostly between January and March. The west side of the Valley, near the coastal range receives an average of around 4 inches (10 centimeters) per year and the east side averages about 6 inches (15 centimeters) per year. Approximately 90 percent of the rainfall in the region occurs between November 1 and April 1. Drought cycles occur periodically, becoming severe enough that plant and animal populations can experience large fluctuations.

The Valley Region's climate can be characterized as Mediterranean; with hot, dry summers and cool, moist winters. Summer high temperatures typically exceed 100 °Fahrenheit (°F); with an average of 110 days per year over 90 °F. Winter temperatures in the San Joaquin Valley are mild, with an average of only 16 days per year with frost. The vegetation communities in the San Joaquin Valley are distinguishable due to tule fog, higher humidity, and isolation from continental climatic influences by mountain ranges.

The Kern County General Plan (KCGP) describes the Valley Region as "the southern San Joaquin Valley below an elevation of 1,000 feet [mean sea level] msl" within Kern County. The proposed Project area is located at elevations between 330 and 340 feet above msl.

Vegetation and General Botanical Surveys

Surveys of the Project site were conducted on October 31, November 1, and December 5, 2006 and again on March 10, 2016 (McIntosh & Associates 2009; McCormick Biological 2017). The Project site has been under agricultural production and currently consists entirely of land either currently under row crop agriculture or between crops.

At the time of the 2009 Biota Report, sheep were actively grazing on the areas that were fallow or previously alfalfa fields and the eastern portion of the site was active grain crops which had been recently tilled (McIntosh and Associates 2009). Ruderal habitats were identified along the paved perimeter roadways, dirt access roads, the fallowed and old alfalfa fields, and the banks of the irrigation ditches. No sensitive habitat types were identified within the Project site during the 2006 or the 2017 surveys. No federally-listed, or proposed, or state-listed plant species were identified within the proposed Project site during the 2006 or the 2017 surveys.

One agricultural sump at the southern boundary contained a few wetland-indicative plant species; however, due to regular maintenance activities and clearing, it is not considered a wetland-riparian habitat. A second agricultural sump, located in the eastern portion of the property, appeared to no longer function as an agricultural sump and was filled with non-native grasses and forbs, and discarded debris. It did not contain wetland plant species and is not considered a sensitive vegetative community. Lined and unlined irrigation ditches occur at various locations throughout the Project site; however, they do not provide sensitive habitat because of regular maintenance and clearing.

Other than these sites, potential wetland, riparian, or other aquatic habitat was not identified within the Project site. Table 4.4-1 *Special Status Plants Known to Occur in the Vicinity of the Project* lists sensitive plants, below.

Table 4.4-1. Special Status Plants Known to Occur in Vicinity of Project Site

Scientific Name Common Name	Status Fed/State/ CNPS	Survey Results/Regional or Nearest Occurrence*
Astragalus hornii var. *hornii* Horn's milk vetch	S/-/1B.1	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Atriplex cordulata var. cordulata Heartscale	S/-/1B.2	No suitable soil or habitat is present on the project site. No impacts are anticipated
Atriplex coronate var. vallicola *Lost Hills crownscale*	S/-/1B.2	No suitable soil or habitat is present on the project site. No impacts are anticipated
Atriplex tularensis Bakersfield smallscale	-/E/1A	No suitable soil or habitat is present on the project site. No impacts are anticipated.
California macrophylla Round-leaved filaree	S/-/1B.1	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Calochortus striatus Alkali mariposa lily	S/-/1B.2	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Caulanthus californicus California jewelflower	E/E/1B.1	This species is believed extirpated from Kern County. This species is highly sensitive to disturbance. Although suitable soil is present of the project, the species is highly unlikely to occur given previous site disturbance and proximity to isolated, known occurrences. No impacts are anticipated.
Caulanthus lemmonii Lemmon's jewelflower	S/-/1B.2	No suitable soil or habitat is present on the project site. No impacts are anticipated
Chloropyron molle ssp. *hispidum* Hispid bird's-beak	S/-/1B.1	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Delphinium recurvatum Recurved larkspur	S/-/1B.2	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Eremalche parryi ssp. *kernensis* Kern mallow	E/-/1B.1	Suitable soils are present on the project site. Historic disturbance from row crop farming and subsequent discing for vegetation control would greatly reduce the potential for presence. No impacts are anticipated.
Eriastrum hooveri Hoover's woolly star	D/-/4.2	No suitable habitat is present on the project site. No impacts are anticipated.
Eschscholzia lemmonii ssp. *kernensis* Tejon poppy	-/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated
Imperata brevifolia California satintail	-/-/2.1	No suitable soil or habitat is present on the project site. No impacts are anticipated.
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	S/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated
Layia leucopappa Comanche Point layia	S/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated.
Monolopia congdonii San Joaquin woolly-threads	E/-/1B.2	No suitable habitat is present on the project site. No impacts are anticipated.
Navarretia setiloba Piute Mountains navarretia	S/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated.
Opuntia basilaris var. *treleasei* Bakersfield cactus	E/E/1B.1	No suitable habitat is present on the project site. No impacts are anticipated.

Table 4.4-1. Special Status Plants Known to Occur in Vicinity of Project Site

Scientific Name Common Name	Status Fed/State/ CNPS	Survey Results/Regional or Nearest Occurrence*
Puccinellia simplex California alkali grass	-/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated
Stylocline masonii Mason's neststraw	S/-/1B.1	No suitable habitat is present on the project site. No impacts are anticipated.

STATUS:
Federal and State Listing Code:
C = Candidate for Listing; D = Delisted; E = Federally or State-listed Endangered; S = BLM Sensitive Species;
T = Federally or State-listed Threatened

Additional State Listing Code:
CSC = California Species of Concern; SFP = State Fully Protected; WL = Watch List

CNPS Listing Codes
1A Plants presumed extirpated in California, and either rare or extinct elsewhere
1B.1 Plants considered rare, threatened, or endangered in California and elsewhere; seriously threatened in California
1B.2 Plants considered rare, threatened, or endangered in California and elsewhere; fairly threatened in California
1B.3 Plants considered rare, threatened, or endangered in California and elsewhere, not very threatened in California
2A Plants presumed extirpated in California, but more common elsewhere
2B.1 Plants considered rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California
2B.2 Plants considered rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California
2B.3 Plants considered rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California
3 Plants about which more information is needed
3.1 Plants about which more information is needed; seriously threatened in California
3.2 Plants about which more information is needed; fairly threatened in California
3.3 Plants about which more information is needed; not very threatened in California
4.1 Plants of limited distribution in California; seriously threatened in California
4.2 Plants of limited distribution in California; fairly threatened in California
4.3 Plants of limited distribution in California; not very threatened in California
Source: McIntosh & Associates 2009; McCormick Biological 2017.

Wildlife Surveys

During the 2017 biological survey, small mammal burrows were noted during the surveys along the periphery of the Project site and dirt roads (McCormick Biological 2017). Direct and indirect evidence of several special-status wildlife species was noted during the surveys conducted on the Project site and buffer. Three special-status wildlife species (birds) were observed within the Project site during the 2006 biological surveys.

Amphibians

No special status amphibian species or signs of their inhabitance were observed on the proposed Project site. In addition, because of the sequential disturbance created by continued agricultural activities, special status species would not be expected to occur, particularly as no habitat is present. Bullfrogs were observed, and California toad scat was observed within the study area in 2006. No amphibians or signs of amphibians were observed during the 2017 survey.

Reptiles

The common side-blotched lizard was observed within the proposed Project boundaries, but this species is not a listed special status species. No special status species were observed within the proposed Project site and suitable on-site habitat for most of these species is absent. One special-status reptile, the silvery legless lizard has the potential to occur within the Project site.

Silvery legless lizard

Habitat for this species includes lightly vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. They prefer warm, loose soil that is somewhat moist, and can often be found under leaf litter, rocks, boards, driftwood, and logs.

The silvery legless lizard is considered a California species of special concern and its range extends from Antioch in Contra Costa County, south through the Coastal, Transverse, and Peninsular Ranges, along the western edge of the Sierra Nevada Mountains, and parts of the San Joaquin Valley and Mojave Desert to El Consuelo in Baja California. Its elevation range extends from near sea level on the Monterey Peninsula to approximately 5,900 feet above sea level in the Sierra Nevada foothills.

Silvery legless lizard has been divided into five species, with four new species being described. The four new species have no status; however, each has a very restricted known range. The majority of the soils on the Project site are suitable for this species. Legless lizards are extremely difficult to detect and may be present in low numbers in the limited habitat on the project site.

Birds

Migratory bird special status species, such as the Grasshopper sparrow, Golden Eagle, Burrowing owl, and Loggerhead shrike, may occur in the proposed Project areas. The sharp-shinned hawk, burrowing owl, and northern harrier were observed during the 2006 surveys but were not identified during the 2017 surveys. Other raptors and birds of prey (barn owls, great horned owls and red-tailed hawks) may forage over agriculture fields. There are no trees suitable for nesting raptors within the Project boundary.

Grasshopper Sparrow

The grasshopper sparrow is a California species of special concern that is also protected under the Migratory Bird Treaty Act (MBTA) and California Fish and Game Code. The grasshopper sparrow is considered a rare summer resident of California from March to September, and little is known of its wintering status. The species is found in a variety of habitats within its known range, but its preference within California seems to include moderately open grasslands with short to moderate vegetation height and scattered shrubs such as California sagebrush (*Artemisia californica*). The bird's typical diet consists of grasshoppers and seeds. Seeds the grasshopper sparrow is known to eat come from knotweed (*Polygonum* spp.), campion (*Lychnis* spp.), oats (*Avena* spp.), and pigweed. The grasshopper sparrow's naturally patchy range in California has become even more fragmented due to agricultural and urban development

The grasshopper sparrow was not observed during any of the surveys. No potential nesting habitat is present on the Project site; however, the site does present potential foraging habitat and is within the range of the species.

Sharp-shinned Hawk

The sharp-shinned hawk prefers to nest on a horizontal branch against the main trunk of the tree in dense forest or riparian areas, typically on north facing slopes. They normally return to the same nesting area every year, but do not use the same nest. Sharp-shinned hawks hunt from perches or by rapid flapping flight. Approximately 90 percent of their diet consists of birds, specifically song birds. They are also known to occasionally take large insects, frogs, lizards, and small mammals.

The sharp-shinned hawk is a California species of special concern. The breeding population in California has experienced a decline, which the migrating populations appear to have rebounded from declines of the 1950s and early 1960s. Threats to the species include the falconry trade and logging.

An adult male sharp-shinned hawk was observed foraging after small passerine flocks throughout the Project site during all days of the biological surveys. The make sharp-shinned hawk was also observed perching in the trees lining South Union Avenue (SR-204) on the eastern boundary of the proposed Project.

Burrowing Owl

The burrowing owl is a California species of special concern, and documented population declines have occurred in the state since at least the 1970s. It has no federal listing but is protected by the MBTA.

Burrowing owls are diurnal, and during active periods of the year may be observed above ground in the vicinity of their burrows, roosting on the ground or nearby high spots such as berms, fence posts, or shrubs. They have a varied diet that includes insects, small rodents, birds, amphibians, reptiles, and carrion, and there is some evidence that population sizes of California vole (*Microtus californicus*) influence their survival and reproductive success. In California, the species is typically found in close association with California ground squirrels (*Otospermophilus beecheyi*). The squirrels create burrows that are used by burrowing owls as year-round shelter and seasonal nesting habitat; however, burrowing owls may also use human-made structures such as culverts, corrugated metal pipes, debris piles, or openings beneath pavement as shelter and nesting habitat.

Within California, it is found throughout the Central Valley, in the San Francisco Bay Area, Carrizo Plain, and Imperial Valley. The Central Valley population is a year-round resident in annual and perennial grasslands or other vegetation communities that support little to no tree or shrub cover. California is considered an important wintering ground for migrants, whose burrowing owl population is augmented during the winter season.

Burrowing owl primarily occur in open grasslands and desert habitats throughout California. Burrowing owl prey varies with availability, season, and location. Primary prey includes insects, small mammals and birds, reptiles and amphibians, and carrion. They utilize burrows abandoned by

mammals such as ground squirrels or badgers. In soft soil, they have been known to excavate their own burrows.

The burrowing owl is a federal and state species of concern. Burrowing owl populations have been declining over the past 60 years, with a rapid decline in the last five years. The initial reduction in numbers has been attributed to the conversion of grasslands to agriculture. The recent accelerated loss is believed to be due to increased habitat loss from residential and commercial development.

Three adult burrowing owls and one active burrow were identified in the central and eastern portion of the proposed Project site during the 2006 biological surveys. The burrow was located on the bank of an unlined irrigation ditch in association with a ground squirrel colony. The owls occurred in a recently tilled area used for row crops and the adjacent unlined irrigation ditch.

No burrowing owls were observed during the 2017 survey. No evidence of burrowing owl presence, such as feathers, tracks or pellets, was observed. The habitat observed along the road edges and other lightly disturbed areas including ground squirrel burrows on the project site, has potential for this species. Both nesting and foraging habitat was present and the species could occupy in the future.

Golden Eagle

In the western U.S., this species occurs primarily in open mountainous areas, rolling foothills, canyons, and plains. Nesting occurs in trees and on cliff faces, and their diet consists primarily of small mammals, birds, snakes, and carrion. The golden eagle is an uncommon permanent resident and migrant throughout California, except for the center of the Central Valley, and range from sea level up to 11,500 feet (3,505 meters). The species is fully protected in the state of California.

The golden eagle was not observed during any of the biological surveys. Golden eagles are expected to forage in the western foothills and occasionally on the Valley floor in the vicinity of the proposed Project site. No nesting habitat is present for this species within the Project site.

Northern Harrier

The northern harrier occurs from annual grassland to lodgepole pine forests and alpine meadows. The species frequents meadows, open rangelands, grasslands, desert sinks, prairies, fresh and saltwater emergent wetlands, and some types of croplands. They occur throughout the year within the Central Valley in suitable habitat but are more abundant during the winter months. Northern harriers fly low over open habitats in search of prey consisting primarily of voles, but including mice, birds, frogs, small reptiles, and invertebrates. Nests are built on the ground in shrubby vegetation.

The northern harrier is a California species of special concern. Habitat degradation appears to be a major reason for decline of the species in California. Destruction or disturbance of wetlands and mashes, as well as the burning, disking and plowing of grasslands during the breeding season has had a negative affect on the species.

One male northern harrier was observed on all days of the 2006 biological surveys. The northern harrier was foraging throughout the proposed Project boundaries. No northern harrier were observed

on-site during the 2017 survey. No nesting habitat was identified on-site during any of the biological surveys.

Loggerhead Shrike

The loggerhead shrike is considered a species of special concern in California. It is a robin-sized bird about nine inches in length with a raptor-like, hooked bill. Lacking talons, the shrike impales its prey to facilitate feeding, or to store it for future consumption. Its diet includes a variety of insects and spiders, small reptiles, rodents, and small birds. Nests are built on stable branches in densely-foliaged shrubs or trees, usually well-concealed.

This species prefers open habitats such as savannas and deserts, with scattered shrubs, trees, posts, fences, utility lines, or other perches. In California, the loggerhead shrike occurs as a resident over most of the state, being absent from high mountain regions.

Loggerhead shrike were not observed during any of the biological surveys. No suitable nesting substrate for this species occurs on the Project site; however, the species is known to occur across Kern County and the Project site and vicinity provide suitable foraging habitat.

Swainson's Hawk

Swainson's hawks prefer open areas including grasslands with scattered trees or shrubs for perching, irrigated meadows, and ecotones. Agricultural areas, particularly alfalfa fields, riparian areas, juniper-sage flats, and oak savannas are desired by the Swainson's hawk in California. During winter months and migration, the hawks primarily eat insects, but are known to consume birds, small mammals, reptiles, and amphibians during summer months. They are found to take advantage of certain agricultural practices, such as tilling, by following behind the tractor and capturing prey as it is disturbed by equipment. They are known to nest in trees, shrubs, and utility poles between four feet and 100 feet in height. In the Central Valley, they nest in riparian habitats as well.

The Swainson's hawk is a California threatened and a federal species of concern. Swainson's hawk population has declined by 90 percent since the 1940s due to the loss of nesting habitat.

Swainson's hawks were not observed during any of the biological surveys; however, perching locations and foraging habitat was identified. The large trees and utility poles adjacent to the proposed Project provide suitable perching locations. The Project site also contains suitable foraging habitat for the species. No nesting habitat occurs on-site.

Ground and Low Shrub Nesting Birds

Several common and special-status ground and low shrub bird species may forage in the vicinity of the proposed Project site. Some have a potential to nest on the site. In addition, many of the common species of birds protected by the MBTA could nest on the proposed project site during the next breeding/nesting season. No bird nests were observed during any of the biological survey on the Project site.

Mammals

The proposed Project site contains denning and foraging habitat for some mammal species. According to the Biota Report no special status animal species were observed on the proposed Project site. Five species, the Pallid bat, Tipton kangaroo rat, Western mastiff bat, Tulare grasshopper mouse, and San Joaquin kit fox, have the potential to occur in the Project area.

Tulare Grasshopper Mouse

The Tulare grasshopper mouse is considered a California species of special concern. Though the Tulare grasshopper mouse prefers to feed on small mammals and insects, its diet also includes other invertebrates and seeds.

Historically, the species ranged from western Merced and eastern San Benito Counties east to Madera County and south to the Tehachapi Mountains. Currently, they are known to occur along the western margin of the Tulare Basin including western Kern County; within the Carrizo Plain Natural Area; along the Cuyama Valley side of the Caliente Mountains in San Luis Obispo County; and the Ciervo-Panoche Region in Fresno and San Benito Counties.

Small mammal burrows suitable for use by Tulare grasshopper mouse were observed on the Project site during the 2017 survey. In addition, this species could be present along the project periphery.

Western Mastiff-Bat

Western mastiff bats are primarily cliff dwelling bats which roost under exfoliating rock slabs but have been found in tall buildings as well. Roosts are typically found more than 10 feet above the ground, allowing for a clear vertical drop below the entrance for flight. Though acoustic records in California document foraging or commuting at up to 10,000 feet in the southern Sierra Nevada, the species regularly forage at 100 to 200 feet and may forage in flocks. Bats may travel relatively far from roosting sites to forage, in one case being heard in open desert 15 miles from the nearest possible roosting site. The foraging habitat of the western mastiff bat includes dry desert washes, flood plains, chaparral, oak woodland, open Ponderosa pine forest, grassland, and agricultural areas. In California, it is most frequently encountered in broad open areas, with a diet primarily consisting of moths, beetles, crickets, and katydids.

Unlike most bats in this area, western mastiffs do not mate in the fall. This species breeds in late winter and births around July. Migrations are limited to small changes in roost locations and hibernation only occurs in short periods resulting in year-round activity.

The western mastiff bat is considered threatened by broad, excessive pesticide use which is thought to lower their prey base, loss of clean water sources, and public hysteria resulting in colony eradications. They are considered a California species of species concern.

No potential day roost habitat is present on or near the proposed Project site for this species. This species may forage in the vicinity of the Project site.

Pallid Bat

The pallid bat is currently considered a California species of special concern. They forage over open shrub-steppe grasslands, oak savannah grasslands, open Ponderosa pine forests, talus slopes, gravel roads, lava flows, fruit orchards, and vineyards, but diet and forage area preference is known to vary with population. This species breeds from October through February and birth from April through July. These bats are not migratory but may move around seasonally.

Pallid bats roost in a variety of natural and man-made structures such as rock outcrops or buildings, as well as under concrete slabs or other semi-solid to solid materials on the ground. The species may roost alone, in small groups of 2 to 20 bats, or in a group with hundreds of individuals. This species is susceptible to losses from disturbance of roosts, especially hibernation sites or where hundreds roost together, and pesticide use which lowers their prey base.

Minimal potential roosting habitat is present; however, the project site represents potential foraging habitat for the species.

San Joaquin Kit Fox

The San Joaquin kit fox (SJKF) is currently a federally-listed endangered and state-listed threatened species and is the largest subspecies of kit fox. SJKF occur in a variety of open grassland, oak savannah, and shrub vegetation types/habitats as well as agricultural and urban areas in Kern County. In the southern San Joaquin Valley portion of the range, SJKF are generally found in sparse, annual grassland and scrub communities (e.g., valley sink scrub, saltbush scrub). San Joaquin kit fox historically inhabited such native San Joaquin Valley plant communities as valley saltbush scrub, annual grassland, and valley sink scrub. The species occupied much of the San Joaquin Valley, from Contra Costa County to southern Kern County. Home ranges for the taxon have been reported by several authors to range from 1 to 12 square miles. Numerous anthropogenic factors, such as habitat loss, fragmentation and degradation, predation, road kills, suffocation, trapping, and electrocution, have contributed to the decline of the species within its historical range.

As these communities have diminished, the species have been found to occupy grasslands and scrublands of varying degrees of modification or disturbance. Kit fox have been observed within areas modified by oil extraction equipment, agricultural crop production, and cattle grazing. Kit fox utilize one to several underground dens throughout the year, which they require for temperature regulation and protection from predators and weather.

SJKF do not typically excavate their own dens, but rather enlarge the burrows of other species, such as California ground squirrels, and change dens on a regular basis. California ground squirrel, black-tailed jackrabbits, and white-footed mice are common prey species. They are also known to consume kangaroo rats, pocket mice, cottontails, San Joaquin antelope squirrels, ground-nesting birds, insects, and grasses.

Although, no SJKF dens were observed on the Project site during the biological surveys (2006 and 2017), the entire Project site represents potential denning and foraging habitat for this species along the periphery and margins of the Project. SJKF are known to occur throughout Kern County in similar habitat. During the 2006 survey San Joaquin kit fox tracks were identified in several locations

throughout the Project site and scat was observed in the southern portion of the site. During the 2017 survey, dens were identified during the biological survey. Several partially collapsed culverts within the proposed Project site provide suitable kit fox denning habitat, although none of the collapsed culverts showed signs of past or present occupation. The Project site also provides suitable kit fox foraging habitat. A culvert near the north boundary of the proposed Project passes under SR-99, connecting the proposed Project site with suitable habitat west of SR-99. In addition, the proposed Project is within the current mapped distribution of the San Joaquin kit fox. There are several known documented occurrences of the species approximately three miles north of the proposed Project. Table 4.4-2 *Special Status Wildlife That May Occur in the Vicinity of the Project Site* lists sensitive animals, below.

Table 4.4-2. Special Status Wildlife That May Occur in Vicinity of Project Site

Scientific Name Common Name	Status Federal/State	Survey Results/Regional or Nearest Occurrence*
Invertebrates		
Branchinecta lynchi Vernal pool fairy shrimp	T/-	No vernal pools are present on the project site. No impacts are anticipated.
Desmocerus californicus dimorphus Valley elderberry longhorn beetle	T/-	No host plant species are present on the project site or vicinity. No impacts are anticipated.
Fish		
Hypomesus transpacificus Delta smelt	T/T	The project site is beyond the range of the species. No suitable habitat is present and no downstream effects
Amphibians		
Lithobates pipiens *Northern leopard frog*	-/CSC	No suitable habitat is present on the project site. No impacts are anticipated
Rana draytonii California red-legged frog	T/-	The project site is beyond the published range of the species. No suitable habitat is present on the project site. No impacts are anticipated.
Spea hammondii Western spadefoot toad	-/ CSC	No suitable habitat is present on the project site. No impacts are anticipated
Reptiles		
Anniella pulchra pulchra Silvery legless lizard	-/CSC	Suitable soils for this species exist on the project site. Although individual silvery legless lizards may be impacted, the number is likely to be extremely limited based on discing conducted over four consecutive years and no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.
Emys marmorata *Western pond turtle*	-/CSC	No suitable habitat is present on the project site. No impacts are anticipated
Gambelia sila Blunt-nosed leopard lizard (BNLL)	E/E,SFP	The undisturbed habitat of the site is appropriate and the project is within the range of the species. As communicated by SJRC personnel, the site has been disced annually for at least four years prior to 2015. No impacts are anticipated.
Masticophis flagellum ruddocki San Joaquin coachwhip	-/CSC	Project site does not represent suitable habitat for this species due to discing, and isolated location relative to suitable habitat. No impacts are anticipated.

Table 4.4-2. Special Status Wildlife That May Occur in Vicinity of Project Site

Scientific Name Common Name	Status Federal/State	Survey Results/Regional or Nearest Occurrence*
Phrynosoma blainvillii Coast horned lizard	-/CSC	Suitable soils are present on the project site. Although individual Coast horned lizards may be impacted, the number is likely to be extremely limited based on discing conducted over four consecutive years and no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.
Thamnophis gigas Giant garter snake	T/-	This species is likely extirpated from Kern County. Project site does not represent suitable habitat for this species. No impacts are anticipated
Birds		
Agelaius tricolor Tricolored blackbird	S/CSC	No suitable nesting or foraging habitat is present on the project site. No impacts are anticipated.
Aquila chrysaetos Golden eagle	-/SFP	No suitable nesting habitat is present on the project site. No impacts are anticipated.
Athene cunicularia Burrowing owl	-/CSC	Species not observed during fieldwork. No owl burrows identified. The project site represents suitable foraging and nesting habitat for the species based on the presence of California ground squirrel burrows.
Buteo swainsoni Swainson's hawk	-/T	No trees suitable for raptor nesting exist in the vicinity of the project. No stick nests observed. No impacts are anticipated.
Circus cyaneus Northern harrier	-/CSC	No trees suitable for raptor nesting exist in the vicinity of the project. No stick nests observed. No impacts are anticipated.
Elanus leucurus *White tailed kite*	-/SFP	No trees suitable for nesting exist on the project. The site represents marginal foraging habitat. No impacts are anticipated.
Eremophila alpestris actia California horned lark	-/WL	The site is within the range of the species and represents suitable nesting and foraging habitat. None were observed.
Falco mexicanus Prairie falcon	-/WL	A prairie falcon was observed soaring during the field survey. No suitable nesting sites exits on the project. The site represents marginal foraging habitat for the species. No impacts anticipated given the project size relative to surrounding, similar habitat suitable for foraging.
Gymnogyps californianus California condor	E/E, SFP	No suitable nesting or foraging habitat exists on the project site. No impacts are anticipated.
Lanius ludovicianus Loggerhead shrike	-/CSC	No loggerhead shrike was observed during the field survey. No suitable nesting sites exits on the project. The site represents marginal foraging habitat for the species. No impacts anticipated given the project size relative to surrounding, similar habitat suitable for foraging.
Mammals		
Ammospermophilus nelsoni San Joaquin antelope squirrel	-/T	The project site is beyond the current published range of the species. The survey was conducted under suitable conditions for observation of the species and no individuals were recorded. No impacts are anticipated

Table 4.4-2. Special Status Wildlife That May Occur in Vicinity of Project Site

Scientific Name Common Name	Status Federal/State	Survey Results/Regional or Nearest Occurrence*
Antrozous pallidus Pallid bat	-/CSC	No suitable roosting habitat exists on the project site. The site represents marginal foraging habitat for the species. No impacts anticipated given the project size relative to surrounding, similar habitat suitable for foraging
Dipodomys ingens Giant kangaroo rat	E/E	Historic row-crop farming precludes occupation although individuals have been known to persist on the periphery of agriculture. No burrows typical of Dipodomys sp. were observed during the field survey. No impacts are anticipated.
Dipodomys nitratoides nitratoides Tipton kangaroo rat	E/E	The project site is within the range of the species. Historic row-crop farming and subsequent discing would generally preclude occupation although individuals have been known to persist on the periphery of agriculture. No burrows typical of *Dipodomys* sp. were observed during the field survey. No impacts are anticipated.
Eumops perotis californicus Greater western mastiff bat	-/CSC	No suitable roosting habitat exists on the project site. The site represents marginal foraging habitat for the species. No impacts anticipated given the project size relative to surrounding, similar habitat suitable for foraging.
Onychomys torridus tularensis Tulare grasshopper mouse	-/CSC	Suitable habitat is present on the project site. Although individual Tulare grasshopper mice may be impacted, the number is likely to be extremely limited based on discing conducted over four consecutive years and no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.
Perognathus inornatus inornatus	S/-	Suitable habitat is present on the project site. Although individual San Joaquin pocket mice may be impacted, the number is likely to be extremely limited based on discing conducted over four consecutive years and no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.
Sorex ornatus relictus Buena Vista Lake shrew	E/-	No suitable habitat is present on the project site. No impacts are anticipated.
Taxidea taxus American badger	-/CSC	No suitable habitat is present on the project site. No impacts are anticipated. See additional discussion
Vulpes macrotis mutica San Joaquin kit fox (SJKF)	E/T	The site represents suitable habitat for the species. SJKF dens were identified during fieldwork.

Federal		State	
S	Listed as BLM Sensitive Species	CSC	California Department of Fish and Wildlife Designated Species of Special Concern
D	Delisted	D	Delisted
E	Listed as Endangered	E	Listed as Endangered
PT	Proposed as Threatened	SFP	California Department of Fish and Wildlife Designated Fully Protected
T	Listed as Threatened	T	Listed as Threatened

Wetlands and Jurisdictional Waters of the United States

No riparian habitat is present on the Project site. A search of the USFWS National Wetlands Inventory resulted in no wetlands mapped within the project site vicinity (McIntosh & Associates 2009; McCormick Biological 2017). These results are consistent with the observed conditions within the survey area.

4.4.3 Regulatory Setting

The CDFG and USFWS lists Threatened and Endangered taxa (e.g., species, subspecies or variety) in the proposed Project area. The electronic Inventory of Rare and Endangered Vascular Plants of California of the California Native Plant Society's (CNPS 2006) and the California Natural Diversity Database (CNDDB) (McIntosh & Associates 2009; McCormick Biological 2017) identify special-status plants, wildlife, and habitats known to occur in the vicinity of the Project site.

Federal

The Federal Endangered Species Act (FESA)

The FESA of 1973 (50 SFR 17) provides legislation to protect plant and animal taxa considered at risk of extinction and classified as either threatened or endangered. Section 9 of the FESA prohibits any person or entity from the "taking" of any endangered fish or wildlife species. Impacts to listed species resulting from project implementation would require the responsible agency or individual to consult the USFWS. Formal consultations must take place with the USFWS pursuant to Sections 7 and 10 of the FESA, with the USFWS then making a determination as to the extent of impact to a particular species. If the USFWS determines that impacts to a species would likely occur, then alternatives and measures to avoid or reduce impacts must be identified.

Section 4 requires Federal agencies to, among other things, prepare recovery plans for newly listed species unless USFWS determines such a plan would not promote the conservation of the species.

Section 7 requires Federal agencies, in consultation with, and with the assistance of the Secretary of the Interior or the Secretary of Commerce, as appropriate, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species. The USFWS and National Marine Fisheries Service (NMFS) share responsibilities for administering FESA. Regulations governing interagency cooperation under Section 7 are found at 50 CFR Part 402. The opinion issued at the conclusion of consultation will include a statement authorizing a take that may occur incidental to an otherwise legal activity.

Section 9 lists those actions that are prohibited under FESA. Take of a species listed in accordance with FESA is prohibited. Section 9 of FESA prohibits take (i.e., to harass, harm, pursue, hunt, wound, kill, etc.) of listed species of fish, wildlife, and plants without special exemption. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or shelter. "Harass" is further defined as actions that create the likelihood of injury to listed species to an extent

as significantly disrupt normal behavior patterns which include, but not limited to, breeding, feeding, and shelter.

Section 10 provides a means whereby a non-Federal action with a potential to result in the take of a listed species could be allowed under an incidental take permit. Application procedures are found at 50 CFR Parts 13 and 17 for species under the jurisdiction of USFWS and 50 CFR Parts 217, 220, and 222 for species under the jurisdiction of NMFS.

San Joaquin Valley Upland Species Recovery Plan

The San Joaquin Valley Upland Species Recovery Plan (Upland Species Recovery Plan) covers 34 species of plants and animals that occur in the San Joaquin Valley. The plan's 11 listed species comprise the following.

Five plant species are listed as endangered under FESA:

- California jewelflower (Caulanthus californicus),
- Palmate-bracted bird's-beak (Cordylanthus palmatus),
- Kern mallow (Eremalche parryi ssp. kernensis),
- San Joaquin woolly-threads (Lembertia congdonii), and
- Bakersfield cactus (Opuntia basilaris var. treleasei);

Five animal species are listed as endangered:

- Giant kangaroo rat (*Dipodomys ingens*),
- Fresno kangaroo rat (*Dipodomys nitratoides exilis*),
- Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*),
- Blunt-nosed leopard lizard (*Gambelia silus*), and
- San Joaquin kit fox (*Vulpes macrotis mutica*).

One plant species is listed as threatened:

- Hoover's wooly-star (*Eriastrum hooveri*); and

Twenty-three plant and animal species are listed as candidates or species of concern are as follows:

- Lesser saltscale (*Atriplex minuscula*),
- Bakersfield smallscale (*Atriplex tularensis*),

- Lost Hills saltbush (*Atriplex vallicola*),
- Vasek's clarkia (*Clarkia tembloriensis Vasek* ssp. *calientensis*),
- Temblor buckwheat (*Eriogonum temblorense*),
- Tejon poppy (*Eschscholzia lemmonii* ssp. *kernensis*),
- Diamond-petaled California poppy (*Eschscholzia rhombipetala*),
- Comanche Point layia (*Layia leucopappa*),
- Munz's tidy-tips (*Layia munzii*),
- Jared's peppergrass (*Lepidium jaredii*),
- Merced monardella (*Monardella leucocephala*),
- Merced phacelia (*Phacelia ciliata* var. *opaca*), and
- Oil neststraw (*Stylocline citroleum*).
- Ciervo aegialian scarab beetle (*Aegialia concinna*),
- San Joaquin dune beetle (*Coelus gracilis*),
- Doyen's dune weevil (*Trigonoscuta* sp.),
- San Joaquin antelope squirrel (*Ammospermophilus nelsoni*),
- Short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*),
- Riparian woodrat (*Neotoma fuscipes riparia*),
- Tulare grasshopper mouse (*Onychomys torridus tularensis*),
- Buena Vista Lake shrew (*Sorex ornatus relictus*),
- Riparian brush rabbit (*Sylvilagus bachmani riparius*), and
- San Joaquin Le Conte's thrasher (*Toxostoma lecontei lecontei*).

The ultimate goal of this recovery plan is to delist the 11 endangered and threatened species and ensure the long-term conservation of the 23 candidates and species of concern. An interim goal is to reclassify the endangered species to threatened status. USFWS is responsible for implementation of the Upland Species Recovery Plan.

Migratory Bird Treaty Act

With the presence of certain habitats present within, and adjacent to, the proposed Project site, the potential exists for migratory birds, including raptors to utilize the vegetation for nesting. The Migratory Bird Treaty Act (MBTA) is a law that fully protects all migratory birds and their respective parts (i.e., eggs, nests and feathers). The MBTA protects migratory birds through conventions that are common to Canada, Japan, Mexico, Russia, and the United States.

Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. 668, enacted by 54 Stat. 250)

The Bald and Golden Eagle Protection Act (BGEPA) of 1940 protects bald and golden eagles by prohibiting the taking, possession, and commerce of such birds and establishes civil penalties for violation of this Act. Take of bald and golden eagles is defined as follows: "disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or, (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior'' (72 FR 31132; 50 CFR 22.3).

On November 10, 2009, USFWS implemented new rules (74 FR 46835) governing the "take" of golden and bald eagles. The rules were released under the existing BGEPA which has been the primary regulatory protection for unlisted eagle populations since 1940. All activities that may disturb or incidentally take an eagle or its nest as a result of an otherwise legal activity must be permitted by the USFWS under this act.

A programmatic permit would be available to industries or agencies undertaking activities that may disturb or otherwise take eagles on an ongoing operational basis. The USFWS has defined programmatic take as "take that (1) is recurring, but not caused solely by indirect effects, and (2) occurs over the long term and/or in a location or locations that cannot be specifically identified." The second criterion is the key factor that distinguishes programmatic take from any other take that has indirect effects that continue to cause take after the initial action.

In April 2012, a proposed rule change was published by the USFWS regarding take permits for golden eagles that would extend the maximum allowable permit life of a programmatic take permit from 5 to 30 years. The rule would also increase the associated fees to cover the actual costs of processing the permit application. The USFWS is studying the proposal pursuant to the National Environmental Policy Act (NEPA).

State

California Environmental Quality Act (CEQA) (Public Resource Code Section 21000 et seq.)

The California Environmental Quality Act (CEQA) was adopted in 1970 and applies to actions directly undertaken, financed, or permitted by State and local lead agencies. CEQA requires that

agencies inform themselves about the environmental effects of their proposed actions, consider all relevant information, provide the public an opportunity to comment on the environmental issues, and avoid or reduce potential environmental harm whenever feasible. CEQA establishes State policy to prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures. Regulations for implementation are found in the CEQA Guidelines published by the Resources Agency. These guidelines establish an overall process for the environmental evaluation of projects.

Section 15380. Although threatened and endangered species are protected by specific federal and State statutes, CEQA Guidelines Section 15380(b) provides that a species not listed on the federal or State list of protected species may be considered rare or endangered if the species can be shown to meet certain specified criteria. These criteria have been modeled after the definition in the FESA and the section of the California Fish and Game Code dealing with rare or endangered plants or animals. This section was included in CEQA primarily to deal with situations in which a public agency is reviewing a project that may have a significant effect on, for example, a candidate species that has not been listed by either USFWS or CDFW. Thus, CEQA provides an agency with the ability to protect a species from the potential impacts of a project until the respective government agencies have an opportunity to designate the species as protected, if warranted. CEQA also calls for the protection of other locally or regionally significant resources, including natural communities. Although natural communities do not at present have legal protection of any kind, CEQA calls for an assessment of whether any such resources would be affected and requires findings of significance if there would be substantial losses. Natural communities listed by CNDDB as sensitive are considered by CDFW to be significant resources and fall under the CEQA Guidelines for addressing impacts. Local planning documents such as general plans often identify these resources as well.

California Endangered Species Act (CESA)

California has a parallel mandate to the FESA, which is the CESA of 1984 and the California Native Plant Protection Act of 1977. These laws regulate the listing and take of plant and animal species designated as endangered, threatened or rare. The State of California also lists Species of Special Concern based on limited distribution, declining populations, diminishing habitat or unusual scientific, recreational or educational value. Under state law, the CDFG is empowered to review projects for their potential to impact listed species and their habitats.

Section 2080. Section 2080 of the California State Fish and Game Code states, "No person shall import into this State [California], export out of this State, or take, possess, purchase, or sell within this State, any species, or any part or product thereof, that the Commission [State Fish and Game Commission] determines to be an endangered species or threatened species, or attempt any of those acts, except as otherwise provided in this chapter, or the Native Plant Protection Act, or the California Desert Native Plants Act." Pursuant to Section 2081 of the California State Fish and Game Code, the CDFW may authorize individuals or public agencies to import, export, take, or possess, any State-listed endangered, threatened, or candidate species as long as they do not have State Fully Protected status. These otherwise prohibited acts may be authorized through permits or a memorandum of understanding (MOU) if: (1) the take is incidental to an otherwise lawful activity; (2) impacts of the authorized take are minimized and fully mitigated; (3) the permit is consistent with any regulations adopted pursuant to any recovery plan for the species; and, (4) the project proponent ensures adequate

funding to implement the measures required by the CDFW. The CDFW makes this determination based on available scientific information and considers the ability of the species to survive and reproduce.

Fully Protected Species. The State of California first began to designate species as "Fully Protected" prior to the creation of the CESA. Lists of Fully Protected species were initially developed to provide protection to those animals that were rare or faced possible extinction, and included fish, mammals, amphibians and reptiles, birds, and mammals. Most Fully Protected species have since been listed as threatened or endangered under the CESA and/or ESA. The regulations that implement the Fully Protected Species Statute (Fish and Game Code Sections 3511, 4700, 5050, 5515) provide that Fully Protected species may not be taken or possessed at any time. Furthermore, the statute prohibits any State agency from issuing incidental take permits for Fully Protected species, except for scientific research or relocation of the bird species for the protection of livestock pursuant to Section 670.7 of the California Code of Regulations or Section 2835 of the Fish and Game Code.

Fish and Game Code

The CDFW is responsible for conserving, protecting and managing California's fish, wildlife and native plant resources. Protected species may not be "taken" or possessed without a permit from the Fish and Game Commission and/or the CDFW. Information on these species can be found within Section 3511 (birds), Section 4700 (mammals), Section 5050 (reptiles and amphibians) and Section 5515 (fish) of the Fish and Game Code. It is unlawful to take the nest or eggs of any bird, or to take any bird of prey per Section 3503 of the Fish and Game Code.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals, policies, and implementation measures in order to reduce impacts to biological resources. Applicable goals relative to the proposed Project within the Biological Resources Element are listed in Table 4.4-3, *Metropolitan Bakersfield General Plan Goals and Policies for Biological Resources*, below.

Table 4.4-3. Metropolitan Bakersfield General Plan Goals and Policies for Biological Resources

Goals and Policies: Conservation/Biological Resources Element
Conservation/Biological Resources Goal #1: "Conserve and enhance Bakersfield's biological resources in a manner which facilitates orderly development and reflects the sensitivities and constraints of these resources."
Conservation/Biological Resources Goal #2: "To conserve and enhance habitat areas for designated 'sensitive' animal and plant species."
Conservation/Biological Resources Policy #1: "Direct development away from 'sensitive biological resource' areas, unless effective mitigation measures can be implemented."

Table 4.4-3. Metropolitan Bakersfield General Plan Goals and Policies for Biological Resources

Goals and Policies: Conservation/Biological Resources Element
Conservation/Biological Resources Policy #2: "Preserve areas of riparian vegetation and wildlife habitat within floodways along rivers and streams, in accordance with the Kern River Plan Element and channel maintenance programs designed to maintain flood flow discharge capacity."
Conservation/Biological Resources Policy #3: "Discourage, where appropriate, the use of off-road vehicles to protect designated sensitive biological and natural resources."
Conservation/Biological Resources Policy #4: "Determine the feasibility of enhancing sensitive biological habitat and establishing additional wildlife habitat in the study area with State and/or Federal assistance."
Conservation/Biological Resources Policy #5: "Determine the locations and extent of suitable habitat areas required for the effective conservation management of designated "sensitive" plant and animal species."
Conservation/Biological Resources Policy #6: "Investigate the feasibility of including natural areas selected for the habitat conservation plan as a component of the regional park system."

Metropolitan Bakersfield Habitat Conservation Plan (MBHCP)

Kern County and the City of Bakersfield developed the MBHCP to acquire permits that allow take of Federally and State listed species included in the MBHCP area. The permits acquired include a permit under Section 10(a)(1)(B), of the Federal Endangered Species Act (hereafter referred to as a 10(a) permit), and a permit under Section 2081 of the CESA (CESA 9322). The MBHCP is designed to offset impacts resulting from the incidental take of listed species and the loss of habitat incurred through the authorization of otherwise lawful activities. The goal of the MBHCP is to acquire, preserve and enhance native habitats that support special status species while allowing development to proceed as set forth in the Metropolitan Bakersfield General Plan. The study area covered by the MBHCP contains both the City of Bakersfield and Kern County jurisdictions.

The proposed Project is within the boundaries of the adopted MBHCP. The MBHCP meets the requirements of both state and federal endangered species acts and fully complies with state and federal environmental regulations set forth in NEPA and CEQA. Upon payment of the required mitigation fees, currently $2,145 per gross acre, and receipt of project approval, a developer/applicant becomes a subpermittee and is allowed the incidental take of the covered species of the San Joaquin kit fox and Bakersfield cactus in accordance with state and federal endangered species laws. Mitigation fees are used for the acquisition and management of lands for conservation. The lands are held in perpetuity. The MBHCP program has preserved approximately 18,000 acres of endangered species habitat and contributed over six million dollars toward management of preserve areas.

4.4.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative and quantitative basis through a comparison of the anticipated Project effects on biological habitat. The change in the land use is significant if the effects described below occur. The evaluation of proposed Project impacts as based on professional judgment, analysis of the County's biological resources polices and adopted Kern County thresholds in the Kern County CEQA Implementation Document.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, or regulations or by the CDFG or USFWS;
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFG or USFWS;
- Have a substantial adverse effect on Federally protected wetlands, as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; and/or
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional or state habitat conservation plan.

Project Impacts

Impact 4.4-1: The Project Would Have a Substantial Adverse Effect, Either Directly or Through Habitat Modifications, on Any Species Identified as a Candidate, Sensitive or Special Status Species in Local or Regional Plans, Policies or Regulations, or by the CDFW or USFWS.

Special Status Plants

According to the Biota Report, the literature review, and based on general habitat conditions (given the decades of intensive row crop farming of the site and adjacent properties), out of 21 special-status plant species that occur in the region of the Project, no plants were determined to potentially exist on the Project site. Therefore, less than significant impacts to special-status plant species are anticipated.

Special Status Wildlife

Of the 32 wildlife species identified as potentially occurring in the region of the project site, 10 of these were determined to have the potential to be affected by the Project. Direct impacts could occur with the construction and development of the proposed Project, which could result in an "incidental take" of a threatened, endangered, or otherwise protected species. Indirect impacts, in the form of loss of foraging habitat associated with a threatened, endangered, or otherwise protected species, may also occur as a result of the development of the proposed Project.

San Joaquin kit fox. No San Joaquin kit fox were observed during the biological surveys of the proposed Project site; however, the Project site represents suitable habitat. Additionally, dens were identified during the 2017 biological survey. The proposed Project site also provides suitable foraging habitat for the species and is within the mapped distribution for the species. In addition, the CNDDB documents the presence of the species in the vicinity of the proposed Project.

Potential direct adverse impacts to the San Joaquin kit fox include direct mortality from vehicle collision, entrapment in open pipes, trenches or pits and contamination. Habitat loss, degradation, and fragmentation are also potential impacts to the species resulting from the proposed Project. Potential indirect impacts to the San Joaquin kit fox resulting from the implementation of the proposed Project include those associated with human habitation of the agricultural property, such as increased traffic, refuse, domestic pets and pedestrian use of adjacent open lands. Such potential impacts to the species resulting from the proposed Project would result in a "take" of the San Joaquin kit fox and be considered a significant impact.

Tulare Grasshopper. No Tulare grasshopper mice were observed during the biological surveys of the proposed Project site. Suitable habitat is present on the project site. Although individual Tulare grasshopper mice may be impacted, the number is likely to be extremely limited based on discing conducted over four consecutive years and no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.

Pallid Bat. No Pallid bats were observed during the biological surveys of the proposed Project site. Additionally, no suitable roosting habitat exists on the project site and the site represents marginal foraging habitat for the species. Therefore, no impacts are anticipated given the project size relative to surrounding area which contains similar habitat suitable for foraging.

Greater Wester Mastiff Bat. No Greater western mastiff bats were observed during the biological surveys of the proposed Project site. Additionally, no suitable roosting habitat exists on the project site and the site represents marginal foraging habitat for the species. Therefore, no impacts are anticipated given the project size relative to surrounding area which contains similar habitat suitable for foraging.

Silvery Legless Lizard. No Silvery legless lizards were observed during the biological surveys of the proposed Project site. Although suitable soils for this species exist on the project site and individual silvery legless lizards may be impacted, the number is likely to be extremely limited based on past history of agriculture and disking conducted over four consecutive years. Additionally, no previously known occurrences on the site or in the vicinity. Consequently, impacts to this species are considered less than significant.

However, because the proposed Project lies within the MBHCP area, mitigation and compensation requirements of the implemented MBHCP would reduce listed potential impacts to a less than significant level. Several special status birds have potential, or have been observed, to occur within the proposed Project site. Disturbance of the sensitive bird species would be prohibited under CEQA, CDFG Code, CESA and/or the MBTA. Although the site may represent marginal foraging habitat, it is unlikely that any of these species, except the burrowing owl, use the Project site for nesting purposes due to the lack of suitable nesting habitat. The proposed Project would result in adverse impacts to burrowing owl foraging and nesting habitat.

To reduce impacts to special status species that may occur on the Project site, mitigation provided by the MBHCP would mitigate for the loss of foraging habitat. Compliance with the MBHCP is intended to conserve entire communities and ecosystems. Impacts on habitat for special status species, including San Joaquin kit fox, will be mitigated through the payment of a one-time mitigation fee due prior to disturbance and payable to Kern County at the time grading plans are approved or building permits are issued. The MBHCP mitigation fee is currently $2,145 per gross acre, although it may be increased in the future to keep pace with inflation. The mitigation fee will apply to the acres of all vegetation types directly impacted by the proposed Project. In addition to the MBHCP, conformance to other species protection regulations, such as compliance with Section 3503 of the California Fish and Game Code, which prohibits the disturbance of nesting birds, would ensure impacts to these species are less than significant.

Burrowing Owl. Although no burrowing owls were observed, because the site contains ground squirrel burrows, the site does represent suitable nesting habitat for burrowing owl. Therefore, Project implementation would result in adverse impacts to burrowing owl foraging and nesting habitat. Because the burrowing owl is not covered by the MBHCP, additional avoidance and mitigation measures would be required to avoid violations of the MBTA and California Fish and Game Code.

Northern Harrier Hawk, Sharp-Shinned Hawk and other raptors. Although northern harrier and sharp-shinned hawk were observed during the 2009 biological surveys, Project implementation is not expected to result in adverse impacts to these species as nesting habitat does not occur on-site.

The proposed Project would result in adverse impacts to foraging habitat for sensitive bird species and raptors. American kestrels have been observed foraging on-site and owl and red-tailed hawk roosts were identified within the proposed Project boundaries during the surveys. Mitigation provided by the MBHCP for other sensitive species would mitigate for the loss of foraging habitat because of project implementation. Disturbance of nesting birds, sensitive and non-sensitive, is prohibited by Section 3503 of the California Fish and Game Code. An owl nest and a rock pigeon nest were identified in the eastern portion of the site, during the biological surveys. These species are not considered sensitive species; however, the CDFG Code prohibits disturbance of a nest site until the young have fledged.

Therefore, implementation of mitigation measures and compliance with federal, State, and County guidelines would reduce impacts to special-status species potentially occurring in the vicinity of the project to a less than significant level.

Mitigation Measures

MM 4.4-1: **Biological Monitoring.** Prior to initiation of any site preparation and/or construction activities, the project proponent shall retain a Lead Biologist who shall be approved prior to conducting pre-construction surveys by the Kern County Planning and Natural Resources Department with a submitted resume. The Lead Biologist will have oversight over implementation of all necessary avoidance and minimization efforts and will have the authority to stop construction activities, if any of the requirements associated with these measures are not being fulfilled. If the biologist has requested work activities stop due to take of any listed species, the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife will be notified within 1 day via email and telephone. In addition to the Lead Biologist, all other qualified biologists or monitors working on site, conducting evaluations, etc., shall submit resumes for approval to the Kern County Planning and Natural Resources Department.

MM 4.4-2: **Environmental Awareness Training and Education Program.** Prior to the issuance of grading or building permits and for the duration of construction activities, all new construction workers at the project site shall attend an Environmental Awareness Training and Education Program (WEAP), developed and presented by the Lead Biologist. Any employee responsible for the operations and maintenance or decommissioning of the project facilities shall also attend the Environmental Awareness Training and Education Program.

a. The Training Program shall include, but not be limited to, information on the life history of species including the blunt-nosed leopard lizard, San Joaquin whipsnake, coast horned lizard, burrowing owl, Swainson's hawk, prairie falcon, Le Conte's thresher, Nelson's antelope squirrel, giant kangaroo rat, short-nosed kangaroo rat, Tipton kangaroo rat, Tulare grasshopper mouse, San Joaquin pocket mouse, American badger, nesting birds, and San Joaquin kit fox, as well as other wildlife and plant species that may be encountered during construction activities, their legal protections, the definition of "take" under the Endangered Species Act, measures to protect the species, reporting requirements, specific measures that each worker shall employ to avoid take of wildlife species, and penalties for violation of the Act.

b. To ensure employees and contractors understand their roles and responsibilities, training may be conducted in languages other than English.

    1. An acknowledgement form signed by each worker indicating that Environmental Awareness Training and Education Program has been completed would be kept on record;

    2. A sticker shall be placed on hard hats indicating that the worker has completed the Environmental Awareness Training and Education Program. Construction workers shall not be permitted to operate equipment within the construction areas unless they have attended the

Environmental Awareness Training and Education Program and are wearing hard hats with the required sticker;

3. A copy of the training transcript and/or training video, as well as a list of the names of all personnel who attended the Environmental Awareness Training and Education Program and copies of the signed acknowledgement forms shall be submitted to the Kern County Planning and Natural Resources Department; and,

4. The construction crews and contractor(s) shall be responsible for unauthorized impacts from construction activities to sensitive biological resources that are outside the areas defined as subject to impacts by project permits.

5. An Operation and Maintenance-phase version of the WEAP will be maintained within the onsite O&M facility for review as may be necessary during the life of the project.

6. All vehicles will be directed to exercise caution when commuting within the project area. A 15-mile per hour speed limit will be enforced on unpaved roads.

7. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

8. A litter control program shall be instituted at the project site. All workers shall ensure their food scraps, paper wrappers, food containers, cans, bottles, and other trash from the project area are deposited in covered or closed trash containers. The trash containers shall be removed from the project area at the end of each working day.

9. No canine or feline pets or firearms (except for federal, state, or local law enforcement officers and security personnel) shall be permitted on construction sites to avoid harassment, killing, or injuring of listed species.

10. Maintenance and construction excavations greater than 2 feet deep shall be covered, filled in at the end of each working day, or have earthen escape ramps no greater than 200 feet apart provided to prevent entrapment of listed species.

11. All construction activities shall be confined within the project construction area, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. At no time shall equipment or personnel be allowed to adversely affect areas outside the project site.

12. Because dusk and dawn are often the times when listed species are most actively foraging, all construction activities will cease 0.5 hour before sunset and will not begin prior to 0.5 hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of the project site by artificial lighting during nighttime hours is prohibited.

13. Tightly woven fiber netting or similar material shall be used for erosion control or other purposes at the project site to ensure that special-status species do not get trapped. This limitation will be communicated to the contractor through use of Special Provisions included in the bid solicitation package.

14. Use of rodenticides and herbicides at the project site shall be avoided to the maximum extent feasible. If use is unavoidable, rodenticides and/or herbicides shall be utilized in such a manner to prevent primary or secondary poisoning of special-status species and depletion of prey populations on which they depend. All uses of such compounds shall observe labels and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Pesticide Regulation, and other appropriate state and federal regulations as well as additional project-related restrictions deemed necessary by the U.S. Fish and Wildlife Service or California Department of Fish and Wildlife.

MM 4.4-3: **Preconstruction Surveys.** A pre-construction survey by a qualified biologist or monitor shall be conducted no more than 30 days and no less than 14 days prior to the commencement of any site preparation, ground disturbance, and/or construction activities in previously undisturbed areas of the project site. If any evidence of occupation of that portion of the project site by listed or other special-status plant or animal species is observed, a buffer shall be established by a qualified biologist that results in sufficient avoidance to comply with applicable regulations. If sufficient avoidance cannot be established, the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife shall be contacted for further guidance and consultation on additional measures. The project proponent or operator shall obtain any required permits from the appropriate wildlife agency. Copies of the pre-construction survey and results, as well as all permits and evidence of compliance with applicable regulations, shall be submitted to the Kern County Planning and Natural Resources Department.

The following buffer distances shall be established prior to commencement of any site preparation and/or construction activities, if any listed or other special status plant or animal species is observed:

a. San Joaquin kit fox or American badger potential den: 50 feet;

b. San Joaquin kit fox or American badger known den: 100 feet;

c. San Joaquin kit fox or American badger pupping den: contact the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife;

d. Burrowing owl burrow outside of breeding season: as recommended by the California Department of Fish and Wildlife Staff Report 2012;

e. Burrowing owl burrow during breeding season: as recommended by the California Department of Fish and Wildlife Staff Report 2012;

f. Swainson's hawk nest during breeding season: 0.5 mile;

g. Other protected raptor nests during the breeding season: as recommended by a qualified biologist;

h. Other protected nesting migratory bird nests during the breeding season: as recommended by a qualified biologist; and

i. Coast horned lizard, San Joaquin whipsnake, and other special-status wildlife species: as recommended by a qualified biologist.

MM 4.4-4: If construction activities are conducted during the typical nesting bird season (February 15 through September 15), pre-construction surveys shall be conducted by a qualified biologist prior to any site preparation and/or construction activity to identify potential nesting bird activity. The survey area shall include a 500-foot buffer surrounding the property. If no active nests are found within the survey area, no further mitigation is required. If nesting activity is identified during the pre-construction survey process, the following measures will be implemented:

a. If active nest sites of bird species protected under the Migratory Bird Treaty Act and/or California Fish and Game Code are observed within the project site, then the project will be modified and/or delayed as necessary to avoid direct take of the identified nests, eggs, and/or young;

b. If active nest sites of raptors and/or bird species of special concern are observed within the vicinity of the project site, then the appropriate buffer around the nest site (typically 250 feet for passerines and 500 feet for raptors) will be established. Construction activities in the buffer zone will be prohibited until the young have fledged the nest and achieved independence; and,

c. Active nests shall be documented by a qualified biologist, and a letter report shall be submitted to the Kern County Planning and Natural Resources Department documenting project compliance with the Migratory Bird Treaty Act and California Fish and Game Code.

MM 4.4-5: Within 6 months prior to commencement of site preparation and/or construction activities, the project proponent shall ensure that a U.S. Fish and Wildlife Service-approved biologist conducts a protocol survey for blunt-nosed leopard lizard in

accordance with the guidelines published by the California Department of Fish and Wildlife, Region 4, Fresno Office (CDFW 2004). If blunt-nosed leopard lizards are located within the action area, the U.S. Fish and Wildlife Service will be contacted to discuss methods for proceeding with the project in a manner which will avoid take.

MM 4.4-6: **Burrowing Owl.** The project proponent shall implement the following measures, based on the recently updated California Department of Fish and Game (now California Department of Fish and Wildlife) 2012 Staff Report on Burrowing Owl Mitigation, to ensure potential impacts to burrowing owl resulting from project implementation will be avoided and minimized to less-than-significant levels:

a. A qualified wildlife biologist (i.e., a wildlife biologist with previous burrowing owl survey experience) shall conduct pre-construction surveys of the permanent and temporary impacts areas, plus an ISO-meter (approximately 492-foot) buffer, to locate active breeding or wintering burrowing owl burrows no less than 14 days prior to construction. The survey methodology will be consistent with the methods outlined in the Staff Report and will consist of walking parallel transects 7 to 20 meters apart, adjusting for vegetation height and density as needed, and noting any potential burrows with fresh burrowing owl sign or presence of burrowing. As each burrow is investigated, biologists will also look for signs of American badger and kit fox. Copies of the survey results shall be submitted to the California Department of Fish and Wildlife and Kern County Planning and Natural Resources Department.

If burrowing owls are detected, no ground-disturbing activities, such as road construction or ancillary facilities, shall be permitted within the distances listed below in the table titled "Burrowing Owl Burrow Buffers," unless otherwise authorized by California Department of Fish and Wildlife. Burrowing owls shall not be moved or excluded from burrows during the breeding season.

If avoidance of active burrows is infeasible, the owls can be passively displaced from their burrows according to recommendations made in the 2012 Staff Report on Burrowing Owl Mitigation. Burrowing owls should not be excluded from burrows unless or until:

a. Occupied burrows shall not be disturbed during the nesting season unless a qualified biologist meeting the Biologist Qualifications set forth in the May 2012 California Department of Fish and Wildlife Staff Report, verifies through noninvasive methods that either: (1) the owls have not begun egg-laying and incubation; or (2) juveniles from the occupied burrows are foraging independently and are capable of independent survival. Burrowing owls will not be moved or excluded from burrows during the breeding season.

A Burrowing Owl Exclusion Plan is developed and approved by the applicable local California Department of Fish and Wildlife office and submitted to the Kern

County Planning and Natural Resources Department. The plan shall include, at a minimum:

a. Confirm by site surveillance that the burrow(s) is empty of burrowing owls and other species preceding burrow scoping;

b. Type of scope and appropriate timing of scoping to avoid impacts;

c. Occupancy factors to look for and what will guide determination of vacancy and excavation timing (one-way doors should be left in place 48 hours to ensure burrowing owls have left the burrow before excavation, visited twice daily, and monitored for evidence that owls are inside and can't escape, i.e., look for sign immediately inside the door);

d. How the burrow(s) will be excavated. Excavation using hand tools with refilling to prevent reoccupation is preferable whenever possible (may include using piping to stabilize the burrow to prevent collapsing until the entire burrow has been excavated and it can be determined that owls reside the burrow);

e. Removal of other potential owl burrow surrogates or refugia on-site;

f. Photographing the excavation and closure of the burrow to demonstrate success and sufficiency;

g. Monitoring of the site to evaluate success and, if needed, to implement remedial measures to prevent subsequent owl use to avoid take;

h. How the impacted site will continually be made inhospitable to burrowing owls and fossorial mammals (e.g., by allowing vegetation to grow tall, heavy disking, or immediate and continuous grading) until development is complete.

Permanent loss of occupied burrow(s) and habitat is mitigated in accordance with the measures described below.

Temporary exclusion is mitigated in accordance with the measures described below.

Site monitoring is conducted prior to, during, and after exclusion of burrowing owls from their burrows sufficient to ensure take is avoided. Conduct daily monitoring for 1 week to confirm young of the year have fledged if the exclusion will occur immediately after the end of the breeding season.

Excluded burrowing owls are documented using artificial or natural burrows on an adjoining mitigation site (if able to confirm by band re-sight).

In accordance with the Burrowing Owl Exclusion Plan, a qualified wildlife biologist shall excavate burrows using hand tools. Sections of flexible plastic pipe or burlap bag shall be inserted into the tunnels during excavation to maintain an escape route for any animals inside the burrow. One-way doors shall be installed at the entrance to the active burrow and other potentially active burrows within 160 feet of the active burrow. The one-way doors can be removed 48 hours after installation, and ground-disturbing activities can proceed. Alternatively, burrows can be filled to prevent reoccupation.

During construction activities, monthly and final compliance reports shall be provided to the California Department of Fish and Wildlife, Kern County Planning and Natural Resources Department, and other applicable resources agencies documenting the effectiveness of mitigation measures and the level of burrowing owl take associated with the proposed project.

Should burrowing owls be found on-site, compensatory mitigation for lost breeding and/or wintering habitat shall be implemented on-site or off-site in accordance with Burrowing Owl Staff Report guidance and in consultation with the California Department of Fish and Wildlife. At a minimum, the following recommendations shall be implemented:

a. Temporarily disturbed habitat shall be restored, if feasible, to pre-project conditions, including decompacting soil and revegetating. If restoration is not feasible, then the project proponent shall implement (2) below.

Permanent impacts to nesting, occupied, and satellite burrows and/or burrowing owl habitat will be mitigated such that the habitat acreage, number of burrows, and burrowing owls impacted are replaced based on a site-specific analysis and shall include:

a. Permanent conservation of similar vegetation communities (grassland, scrublands, desert, urban, and agriculture) to provide for burrowing owl nesting, foraging, wintering, and dispersal (i.e., during breeding and non-breeding seasons) comparable to or better than that of the impact area, and with sufficiently large acreage, and presence of fossorial mammals. Conversation shall occur in areas that support burrowing owl habitat and can be enhanced to support more burrowing owls.

Permanently protect mitigation land through a conservation easement deeded to a nonprofit conservation organization or public agency with a conservation mission. If the project is located within the service area of a California Department of Fish and Wildlife-approved burrowing owl conservation bank, the project operator may purchase available burrowing owl conservation bank credits.

Develop and implement a mitigation land management plan in accordance with Burrowing Owl Staff Report guidelines to address long-term ecological sustainability and maintenance of the site for burrowing owls.

Fund the maintenance and management of mitigation land through the establishment of a long-term funding mechanism such as an endowment.

Habitat shall not be altered or destroyed, and burrowing owls shall not be excluded from burrows, until mitigation lands have been legally secured, are managed for the benefit of burrowing owls according to California Department of Fish and Wildlife-approved management, monitoring and reporting plans, and the endowment or other long-term funding mechanism is in place or security is provided until these measures are completed.

Mitigation lands should be on, adjacent to, or in proximity to the impact site, where feasible, and where habitat is sufficient to support burrowing owls.

Consult with the California Department of Fish and Wildlife when determining off-site mitigation acreages.

MM 4.4-7: **Burrowing Owl Buffers.** The project proponent shall continuously comply with the following: If any burrowing owl burrows are observed during the pre-construction survey, avoidance measures shall be consistent with those included in the California Department of Fish and Wildlife staff report on burrowing owl mitigation (CDFG, 2012).

If occupied burrowing owl burrows are observed outside of the breeding season, a passive relocation effort may be instituted in accordance with the guidelines established by the California Burrowing Owl Consortium (1993) and the California Department of Fish and Wildlife (CDFG, 2012) (Table 1). During the breeding season, a buffer zone, as noted in Table 1, shall be maintained unless a qualified biologist verifies through noninvasive methods that either the birds have not begun egg laying and incubation or that juveniles from the occupied burrows are foraging independently and are capable of independent survival. Buffer zones may be reduced in size through consultation with appropriate agencies and the project biologist to determine if avoidance would still be achieved. The Kern County Planning and Natural Resources Department shall be kept apprised of meetings and correspondence for any consultation.

Table 4.4-4. Burrowing Owl Burrow Buffers (CDFG Staff Report, 2012)

Location	Time of Year	Level of Disturbance		
		Low	Medium	High
Nesting Sites	April 1-Aug 15	656 ft	1,640 ft	1,640 ft
Nesting Sites	Aug 16-Oct 15	656 ft	656 ft	1,640 ft
Any Occupied Burrow	Oct 16-Mar 31	164 ft	328 ft	1,640 ft

MM 4.4-8: **Trash Abatement.** Prior to issuance of grading or building permits, a long-term trash abatement program shall be established for construction, operations and maintenance. Trash and food items shall be contained in closed containers and removed daily.

MM 4.4-9: **Trash Abatement and Trench Monitoring Requirements.** Prior to and during construction activities, the project proponent shall ensure the project complies with the following:

a. Any pipe, culvert, or similar structure with a diameter of 4 inches or greater, stored onsite for one or more nights shall be inspected to ensure kit foxes or other wildlife have not become entrapped or buried in the pipes. If the pipes, culverts, or similar structures with a diameter of 4 inches or greater are not capped or otherwise covered, they shall be inspected twice daily, in the morning and evening, and prior to burial or closure, to ensure no kit foxes or other wildlife become entrapped or buried in the pipes.

b. All food, garbage, and plastic shall be disposed of in closed containers and regularly removed from the site to minimize attracting ranging kit fox, or other wildlife to the site where they may be harmed. All trash shall be removed and disposed of regularly in accordance with state and local laws and regulations.

MM 4.4-10: **San Joaquin kit fox.** Prior to and during construction activities:

a. If any San Joaquin kit fox dens are found during pre-construction surveys, the status of the dens shall be evaluated no more than 14 days prior to project ground disturbance. Provided that no evidence of kit fox occupation is observed, potential dens shall be marked and a 50-foot avoidance buffer delineated using stakes and flagging or other similar material to prevent inadvertent damage to the potential den. If a potential den cannot be avoided, it may be hand-excavated following United States Fish and Wildlife Service standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance by the lead biologist. If kit fox activity is observed at a den, the den status shall change to "known" per United States Fish and Wildlife Service guidelines (1999), and the buffer distance shall be increased to 100 feet. Absolutely no excavation of San Joaquin kit fox known or pupping dens shall occur without prior authorization from the United States Fish and Wildlife Service and California Department of Fish and Wildlife.

b. To enable kit foxes and other wildlife (e.g., American badger) to pass through the project site during construction, the perimeter security fence shall leave a 5-inch opening between the fence mesh and the ground or the fence shall be raised 5 inches above the ground. The bottom of the fence fabric shall be knuckled (wrapped back to form a smooth edge) to protect wildlife that passes under the fence.

c. All pipes, culverts, or similar structures with a diameter of four inches or more that are stored at a construction site for one or more overnight periods shall be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe shall not be moved until the United States Fish and Wildlife Service has been consulted. If necessary, under the direct supervision

of the biologist, the pipe may be moved once to remove it from the path of construction activity until the fox has escaped.

d. To prevent inadvertent entrapment of San Joaquin kit foxes, badgers, or other animals during construction, all excavated, steep-walled holes or trenches more than two feet deep shall be covered with plywood or similar materials at the close of each working day, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they shall be thoroughly inspected for trapped animals. If trapped animals are observed, escape ramps or structures shall be installed immediately to allow escape. If listed species are trapped, the United States Fish and Wildlife Service and California Department of Fish and Wildlife shall be contacted.

e. All vertical tubes used in project construction, such as chain link fencing poles shall be temporarily or permanently capped at the time they are installed to avoid the entrapment and death of special-status birds.

MM 4.4-11: **Nesting Birds.** A pre-construction protocol-level surveys by a qualified biologist for nesting birds shall be required if construction activities are scheduled to occur during the breeding season for raptors and other migratory birds (February 1–August 31), to reduce potential impacts to nesting birds and raptors. The survey shall be conducted within 30 days of ground disturbance activities.

a. If any nesting birds/raptors are observed, a qualified biologist shall determine buffer distances and/or the timing of project activities so that the proposed project does not cause nest abandonment or destruction of eggs or young. This measure shall be implemented so that the proposed project remains in compliance with the Migratory Bird Treaty Act and applicable State regulations.

MM 4.4-12: Prior to any vegetation removal during site preparation, the areas required for construction shall be surveyed for actively nesting birds. If any wildlife is encountered during the course of construction, the wildlife shall be allowed to leave the construction area unharmed. Should any active bird nests be identified, the vegetation shall not be removed in areas that contain actively nesting birds. A biological monitor shall survey the areas of vegetation slated for removal, a report shall be submitted to the Kern County Planning and Natural Resources Department for review prior to site preparation.

MM 4.4-13: The measures below shall be implemented throughout construction and operation of the project:

a. Project-related vehicles shall observe a 15 mile-per-hour speed limit in all project areas, except on county roads and State and federal highways. Construction after sundown shall be prohibited. Off-road traffic outside of designated project areas shall be prohibited.

b. No pets shall be allowed in project areas, except for trained canine animals related to security and operation of the facility.

c. All uses of such herbicidal and rodenticide compounds shall observe label and other restrictions mandated by the United States Environmental Protection Agency, California Department of Food and Agriculture, and federal and State legislation as well as additional project-related restrictions deemed necessary by the California Department of Fish and Wildlife and/or the United States Fish and Wildlife Service.

d. No plants or wildlife shall be collected, taken, or removed from the construction areas or areas of off-site improvements, except as necessary for project-related vegetation removal or wildlife relocation. Salvage of native vegetation to be removed from construction areas is encouraged but shall only be performed by qualified biologists and with written approval from the California Department of Fish and Wildlife.

e. If San Joaquin kit fox known or pupping dens are observed in project areas, the project proponent shall contact the United States Fish and Wildlife Service and California Department of Fish and Wildlife to discuss appropriate actions.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.4-2: The Project Would Have a Substantial Adverse Effect on any Riparian Habitat or Other Sensitive Natural Community Identified in Local or Regional Plans, Policies, Regulations, or by the CDFG or USFWS.

The proposed Project site does not contain any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFW or USFWS. Two agricultural sumps were identified within the proposed Project boundaries; however, they are not considered a wetland-riparian habitat. Lined and unlined irrigation ditches throughout the Project site; however, they do not provide sensitive habitat because of regular maintenance and clearing. Accordingly, potential wetland, riparian, or other aquatic habitats were not identified on-site during the biological surveys or reviews of regional plans. Consequently, no substantial adverse effect will occur as a result of the development of the project. Impacts would be considered less than significant and additional mitigation is not required

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.4-3: The Project Would Have a Substantial Adverse Effect on Federally Protected Wetlands, as Defined by Section 404 of the CWA (Including, But Not Limited to, Marsh, Vernal Pool, Coastal, etc.) Through Direct Removal, Filling, Hydrological Interruption or Other Means.

The proposed Project does not contain any features identified in wetland categories appear on the USFWS National Wetlands Inventory mapping (McIntosh & Associates 2009; McCormick Biological 2017). Therefore, the proposed Project would not result in the disturbance to any wetland, no impacts would occur, and additional mitigation is not required.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.4-4: The Project Would Interfere Substantially with the Movement of Any Native or Migratory Fish or Wildlife Species or With Established Native Resident or Migratory Wildlife Corridors or Impede the Use of Native Wildlife Nursery Sites.

The entire Project site is highly disturbed in nature due to agricultural activities and the proposed Project site does not contain any wildlife movement corridors. Wildlife corridors can be defined as connections between wildlife blocks that meet specific habitat needs for species movement generally during migratory periods but seasonally as well. While wildlife corridor width requirements can vary based on the needs of the species utilizing them, wildlife corridors generally contain habitat dissimilar to the surrounding vicinity and include examples such as riparian areas along rivers and streams, washes, canyons, or otherwise undisturbed areas within urbanization. The Project site does not contain any of these types of habitats and contains no water bodies that would be used by any fish species. Land uses on properties surrounding the proposed Project consist of residential or other agricultural uses. Overall, the proposed Project is not anticipated to significantly impair or impact movement or migration of wildlife species. However, the proposed Project contains open areas (vacant land) that is adjacent to properties that contain open areas. Therefore, there is the potential for wildlife species to traverse the Project site. Mitigation Measures MM 4.4-1 through MM 4.4-12 would be implemented as part of the proposed Project and ensure impacts remain less than significant.

Mitigation Measures

Implement Mitigation Measures MM 4.4-1 through MM 4.4-12, above.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.4-5: The Project Would Conflict With Any Local Policies or Ordinances Protecting Biological Resources, Such as a Tree Preservation Policy or Ordinance.

The proposed Project is required to comply with the MBHCP and all requirements in the Kern County Ordinance Codes and the Metropolitan Bakersfield General Plan. There are no biological resources on the Project site that are protected by local policies. Therefore, the proposed Project would not conflict with any local policies or ordinances that protect biological resources.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.4-6: The Project Would Conflict with the Provisions of an Adopted Habitat Conservation Plan, Natural Community Conservation Plan or Other Approved Local, Regional or State Habitat Conservation Plan.

As discussed above, the proposed Project is located within the MBHCP. The proposed Project would implement the policies required by the MBHCP, which provides mitigation sufficient to reduce potential impacts to a less than significant level. Conformance to the requirements, including payment of fees, would ensure that no conflict with any HCP, NCCP, or other approved local, regional, or state habitat conservation plan occurs. Additionally, consultation with USFWS and CDFW regarding special-status species is not required due to the implementation of the MBHCP. Therefore, the Project will not conflict with the provisions of the MBHCP. Impacts would be less than significant, and no additional mitigation is required included.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Ecological Communities Previously Occurring within the Metropolitan Bakersfield General Plan Area

The proposed Project would not result in cumulative impacts to wetlands or other sensitive habitats, special status plants, violation of local or ordinances protecting biological resources, or conflict with an adopted HCPs, NCCPs, or other approved local, regional, or State HCPs. The Metropolitan Bakersfield General Plan lists 21 sensitive natural communities know to occur or potentially occur in

the Bakersfield area. Of these 21 sensitive ecological communities, no sensitive natural communities occur within the proposed Project boundaries. The proposed Project boundaries include agricultural and ruderal habitat types.

Because no sensitive natural communities are present within the proposed Project boundaries, impacts would be less than significant. However, as a byproduct of the applicant paying mitigation fees to acquire habitat to support San Joaquin kit fox, some grasslands are anticipated to be acquired, leading to a potential for a net benefit to this resource.

Mitigation Measures

Implement Mitigation Measures MM 4.4-1 through MM 4.4-12, above.

Level of Significance after Mitigation

Impacts would be less than significant.

Species of Concern Occurring within the Metropolitan Bakersfield General Plan Area

Plants

Ten special-status plant species were identified within the boundaries of the Metropolitan Bakersfield General Plan area:

- Bakersfield cactus (*Opuntia treleasei*),
- Bakersfield saltbush (*Atriplex tularensis*),
- Hoover's wooly-star (*Eriastrum hooveri*),
- California jewel flower (*Caulanthus californicus*),
- Kern mallow (*Ermalche kernensis*),
- Tulare pseudobahia (*Pseudobahai peirsonii*),
- Striped adobe lily (*Fritillaria straita*),
- Slough thistle (*Cirsium crassicule*),
- Recurved larkspur (*Delphinium recuvatum*), and
- San Joaquin wooly-threads (*Lembertia congdonii*).

Of the above listed plants, no species were identified as occurring on the proposed Project site. The Applicant's contribution to purchase mitigation habitat that supports San Joaquin kit fox (per requirements of the MBHCP) would, as a beneficial side-effect of acquiring undeveloped property to protect that species, acquire property that could support one or more of the seven special-status plant species listed above.

Wildlife

Seven special-status wildlife species were identified within the boundaries of the Metropolitan Bakersfield General Plan area:

- San Joaquin kit fox,
- Blunt-nosed leopard lizard,
- Tipton kangaroo rat,
- Short-nosed kangaroo rat,
- Giant kangaroo rat,
- San Joaquin antelope ground squirrel, and
- San Joaquin pocket mouse.

Of the above lists wildlife species, only evidence of San Joaquin kit fox was identified on the Project site. The San Joaquin kit fox is known to occur in the vicinity of the proposed Project site and although none were observed, dens were identified within the proposed Project boundaries. The Applicant will be required to pay a fee pursuant to the MBHCP to purchase habitat to support the lifecycle needs of this species. The Applicant's contribution to purchase mitigation habitat that supports San Joaquin kit fox will, as a beneficial side effect, acquire property that could support one or more of the other six special-status wildlife species listed above. No significant cumulative impacts are anticipated.

Mitigation Measures

Implement Mitigation Measures MM 4.4-1 through MM 4.4-12, above.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.5

Cultural Resources

Section 4.5
Cultural Resources

4.5.1 Introduction

This section of the RDEIR addresses the potential cultural resources impacts associated with construction and operation of the proposed Project. It describes the cultural background and setting of the Project area, discusses the regulatory setting, and provides the results of cultural resources surveys and analyses conducted for the proposed Project. Potential impacts on cultural resources that could result from the proposed Project, including prehistorical and historical archaeological sites and paleontological discoveries, are also discussed and feasible mitigation measures are provided.

The purpose of this section is to identify the potential for cultural resources to occur on the property and to assess the significance of such resources. A Phase I Cultural Resource Survey was prepared by Hudlow Cultural Resource Associates in October of 2008 and revised in May 2009. Included in the original report is information from two records searches and complete site survey of the Project area completed between February and March 2006. A subsequent Field Check and Record Search was prepared by Hudlow Cultural Resource Associates in March 2016 and revised in July 2017. See Appendix E, *Cultural Resources*. And Appendix N, *Original Technical Studies.*

The analysis in this section has been prepared in accordance with Section 15064.5 of the California Quality Act (CEQA) Guidelines, which considers potential impacts on prehistoric, historic, and paleontological resources.

4.5.2 Environmental Setting

The proposed Project is situated in the southern San Joaquin Valley in Kern County, California. The Project site consists of approximately 314.30 acres, generally located north of Houghton Road, east of State Route (SR) 99, west of South Union Avenue, and south of DiGiorgio Road, within the unincorporated area of Kern County, California.

The approximately 314.30-acre Project site consists of vacant, disked land that has been utilized for row-crop agriculture. The proposed Project site is mostly vacant; however, the site does contain a steel storage building associated with agricultural activities, one plugged and abandoned oil well, two active, diesel-powered irrigation wells, and one domestic well. The surrounding land uses includes vacant and agricultural lands and a cluster of single-family residential to the east and an automobile wrecking yard to the south.

The proposed Project is located along the southwestern edge of the San Joaquin Valley. The San Joaquin Valley is characterized by relatively low rainfall, averaging less than 10 inches per year, mostly between January and March. Average temperatures are relatively high, and total evaporation exceeds total precipitation. Summers are mostly cloudless, hot, and dry, with daytime temperatures frequently above 100 °Fahrenheit (°F). Winters are generally cool and foggy, but occasionally freezing temperatures occur.

The Kern County General Plan (KCGP) describes the Valley Region as "the southern San Joaquin Valley below an elevation of 1,000 feet [mean sea level] msl" within Kern County. The proposed Project area is located at elevations between 330 and 340 feet above msl.

Ethnographic and Archaeological Context

The proposed Project is located within the territory historically occupied by the Yokuts. The Yokuts were a California Penutian family of languages population who were allied linguistically with other Penutian speakers of the Uto-Aztecan linguistic stock such as the Miwok, Costanoan, Maiduan and Wintuan. The word "Yokuts" is an English version of the term for "person" or "people" in the Yawelmani dialect, while the word "Yawelmani" itself means "where the animal hole is, at the animal hole". The Yokuts are unique among California natives in that they are divided into true tribes. Each tribe has a name, a dialect, and a territory. The Yokuts occupied the majority of the San Joaquin Valley, as well as some of the foothills of the Sierra Nevada. Distinction has been made between the Southern Valley Yokuts, who inhabited the San Joaquin Valley from the lower Kings River in the north to the Tehachapi Mountains in the South, and the Northern Valley Yokuts who inhabited the Valley from the southern extent of the San Joaquin River to slightly north of the Calaveras River. Additionally, the Foothill Yokuts occupied the foothills of the Sierra Nevada between the Fresno and Kern Rivers. The tribe of the Southern Valley Yokuts that inhabited the Project area was the Yawelmani or Yaudimni, who occupied the village of Woilo ("planting place", "sowing place" – the name was given after mission influences began to reach them) that was situated on the site of present day Bakersfield. Below the City, on one of the channels of the river draining toward Kern Lake was the village of Kuyo and Halau.

Prior to the introduction of European agricultural practices, the San Joaquin Valley was a vast wetland area, comprised on interconnected lakes, sloughs, and rivers, interspersed with marshes of tules and dry ground. This unique environment provided the Yokuts with a great abundance of resources. Waterfowl, fish, turtles, and freshwater mussels were hunted or gathered by the Yokuts from the wetlands, while surrounding plains provided large mammals such as tule elk and pronghorn antelope. The starchy tule root was utilized for food, as were a variety of other plants. Single-family structures were built of tule mats covering a wooden framework; larger communal houses were similarly constructed. Canoes for transport were constructed of bundled balsas or dried tules. The political organization of Southern Valley Yokuts was characterized by small groups or tribes. No overall political unity existed within the several Southern Valley Yokuts tribes. Rather they were split into self-governing local groups or miniature tribes, averaging 350 members. Each had a special name and spoke a different dialect. A strip of territory of approximately 250 square miles belonged to each tribe. The land was owned collectively, and every tribal member utilized its resources. In some localities, tracts that yielded plentiful supplies of seeds were claimed by individual women.

There are three general archaeological periods: The Proto-Archaic, Archaic, and the Post-Archaic. The Proto-Archaic period dates back 11,000 to 8,000 years ago. A deeply buried stratum on the western shore of Buena Vista Lake was radiocarbon-dated at 6,000 B.C. The site was found to contain a meager range of stone artifacts used for the killing and butchering of big game. Thereafter, bands of hunters frequented the area at an early date, exploiting the herds of large game animals. Subsequently, tools uncovered in sites on Buena Vista Lake included seed-grinding implements, which suggested a shift from hunting to a food-collecting economy. The third archaeological period,

the Post Archaic, includes the cultures of the Yokuts and their immediate antecedents. By this period, the native inhabitants had developed a diverse subsistence pattern through greater exploitation of the natural foods from the lakes and marshes. At this time, the people had developed a culture of greater material wealth and lived in larger settlements. It has been estimated that the total Yokut population was about 5,250 for the 15 southern Joaquin Valley tribes. The ancestral Yokuts have possibly been in the valley for the last three-thousand years, and by the eighteenth century were the largest pre-contact population, approximately 40,000 individuals, in California (Hudlow Cultural Resource Associate 2009).

Historical Context

Contact with Europeans began in 1772, when Pedro Fages entered the southern San Joaquin Valley via Tejon Pass with a band of soldiers. Subsequent contact with the Spanish had little effect on the Yokuts' way of life. Unlike other groups, such as the Tongva to the south or the Chumash to the west, the Yokuts were modestly affected by missionization. By the first half of the 19th century, the southern San Joaquin Valley witnessed an influx of Native Americans from other areas seeking to escape mission control. However, the influx of settlers into the San Joaquin Valley after the annexation of California by the United States ended the traditional Yokut way of life. In 1851, the tribes agreed to relinquish their lands, but the United States never ratified the treaty. Subsequently, many of the Yokuts people went to the Tejon and Fresno reservations.

After California's inclusion into the United States, the San Joaquin Valley was utilized for various purposes, which greatly altered the landscape. Cattle ranching was the predominant land use between 1850 and 1867, with grain farming predominate from 1867 until 1900. The arrival of the Southern Pacific Railroad in the 1870s also contributed to economic expansion of the region.

The most important economic factor of the region was the discovery of "black gold" in the Southern San Joaquin Valley. The production of petroleum became a significant factor in the region with the opening of the McKittrick field in 1887 and the Kern River field in 1899. The Kern River field was discovered in a shallow hand dug well on the west bank of the Kern River. The Kern River discovery started an oil boom in the region and numerous wooden oil derricks sprang up overnight on the flood plain just north of Bakersfield. Soon thereafter, the Kern River production accounted for seven out of 10 barrels of oil that came from California. Between 1900 and 1936, the production from this area made California the nation's leading petroleum producer and the second ranking producer in 1958. After the Kern River findings, many discoveries followed including a string of gushers at Coalinga, McKittrick, and Midway-Sunset fields. According to the San Joaquin Geological Society, Kern County has 18 giant oil fields that have produced over 100 million barrels of oil each, including four "super giants" that have each produced over one billion barrels of oil. Among the "super giants" are the Midway-Sunset, the largest oil field in the lower 49 states, and Elk Hills, the former United States Naval Petroleum Reserve.

The 20th Century witnessed the rise of irrigation agriculture in the San Joaquin Valley, along with mechanized farming practices and a diversity of crops. Today, lands once used primarily for oil production and agricultural purposes are rapidly giving way to an expanding suburban community.

4.5.3 Regulatory Setting

Federal

Section 106 of the National Historic Preservation Act (NHPA)

Archaeological resources are protected through the National Historic Preservation Act (NHPA) of 1966, as amended (54 USC 300101 et seq.); and its implementing regulation, Protection of Historic Properties (36 CFR Part 800), the Archaeological and Historic Preservation Act of 1974, and the Archaeological Resources Protection Act of 1979. The NHPA authorized the expansion and maintenance of the National Register of Historic Placed (NRHP), established the position of State Historic Preservation Officer (SHPO), and provided for the designation of State Review Boards, set up a mechanism to certify local governments to carry out the purposes of the NHPA, assisted Native American tribes to preserve their cultural heritage, and created the Advisory Council on Historic Preservation (ACHP). Prior to implementing an "undertaking" (e.g., issuing a federal permit), Section 106 of the NHPA requires federal agencies to consider the effects of the undertaking on historic properties and to afford the ACHP and the SHPO a reasonable opportunity to comment on any undertaking that would adversely affect properties eligible for listing in the National Register of Historic Places (NRHP). As indicated in Section 101(d)(6)(A) of the NHPA, properties of traditional religious and cultural importance to a tribe are eligible for inclusion in the NRHP. Under the NHPA, a resource is considered significant if it meets the NRHP listing criteria at 36 Code of Federal Regulations (CFR) 60.4.

National Register of Historic Places (NRHP)

The NRHP was established by the NHPA of 1966, as "an authoritative guide to be used by federal, state, and local governments, private groups, and citizens to identify the Nation's cultural resources and to indicate what properties should be considered for protection from destruction or impairment" (CFR 36 Section 60.2). The NRHP recognizes both historic-period and prehistoric archaeological properties that are significant at the national, State, and local levels.

To be eligible for listing in the NRHP, a resource must be significant in American history, architecture, archaeology, engineering, or culture. A property (districts, sites, buildings, structures, and objects of potential significance) is eligible for the NRHP if it is significant under one or more of the following four established criteria:

- **Criterion A:** It is associated with events that have made a significant contribution to the broad patterns of our history.
- **Criterion B:** It is associated with the lives of persons who are significant in our past.
- **Criterion C:** It embodies the distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic values; or represents a significant and distinguishable entity whose components may lack individual distinction.
- **Criterion D:** It has yielded, or may be likely to yield, information important in prehistory or history.

Cemeteries, birthplaces, or graves of historic figures; properties owned by religious institutions or used for religious purposes; structures that have been moved from their original locations; reconstructed historic buildings; and properties that are primarily commemorative in nature are not considered eligible for the NRHP unless they satisfy certain conditions. In general, a resource must be at least 50 years of age to be considered for the NRHP, unless it satisfies a standard of exceptional importance.

In addition to meeting the criteria of significance, a property must have integrity. Integrity is defined as "the ability of a property to convey its significance." The NRHP recognizes seven qualities that, in various combinations, define integrity. To retain historic integrity a property must possess several, and usually most, of these seven aspects. Thus, the retention of the specific aspects of integrity is paramount for a property to convey its significance. The seven factors that define integrity are location, design, setting, materials, workmanship, feeling, and association.

Native American Graves Protection and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 sets provisions for the intentional removal and inadvertent discovery of human remains and other cultural items from federal and tribal lands. It clarifies the ownership of human remains and sets forth a process for repatriation of human remains and associated funerary objects and sacred religious objects to the Native American groups claiming to be lineal descendants or culturally affiliated with the remains or objects. It requires any federally funded institution housing Native American remains or artifacts to compile an inventory of all cultural items within the museum or with its agency and to provide a summary to any Native American tribe claiming affiliation.

State

California Environmental Quality Act (CEQA)

CEQA is the principal statute governing environmental review of projects occurring in the State and is codified at Public Resources Code (PRC) Section 21000 et seq. CEQA requires lead agencies to determine if a proposed project would have a significant effect on the environment, including significant effects on historical or archaeological resources.

Under CEQA (PRC Section 21084.1), a project that may cause a substantial adverse change in the significance of a historical resource is a project that may have a significant effect on the environment. The CEQA Guidelines (14 California Code of Regulations [CCR] 15064.4) recognizes that historical resources include:

1. A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the CRHR;

2. A resource included in a local register of historical resources, as defined in PRC Section 5020.1(k) or identified as significant in a historical resource survey meeting the requirements of PRC Section 5024.1(g); and

3. Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California by the lead agency, provided the lead agency's determination is supported by substantial evidence in light of the whole record.

The fact that a resource does not meet the three criteria outlined above does not preclude the lead agency from determining that the resource may be a historical resource as defined in PRC Sections 5020.1(j) or 5024.1.

If a lead agency determines that an archaeological site is a historical resource, the provisions of PRC Section 21084.1 of CEQA and 14 CCR 15064.4 of the CEQA Guidelines apply. If a project may cause a substantial adverse change (defined as physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be materially impaired) in the significance of a historical resource, the lead agency must identify potentially feasible measures to mitigate these effects (14 CCR 15064.4(b)(1), 15064.4(b)(4)).

If an archaeological site does not meet the historical resource criteria contained in the CEQA Guidelines, then the site may be treated as a unique archaeological resource in accordance with the provisions of PRC Section 21083. As defined in PRC Section 21083.2 of CEQA, a unique archaeological resource is an archaeological artifact, object, or site for which it can be clearly demonstrated that without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information;
- Has a special and particular quality such as being the oldest of its type or the best available example of its type; or,
- Is directly associated with a scientifically recognized important prehistoric or historic event or person.

If an archaeological site meets the criteria for a unique archaeological resource as defined in PRC Section 21083.2, then the site is to be treated in accordance with the provisions of PRC Section 21083.2, which state that if the lead agency determines that a project would have a significant effect on unique archaeological resources, the lead agency may require reasonable efforts be made to permit any or all of these resources to be preserved in place (PRC Section 21083.1(a)). If preservation in place is not feasible, mitigation measures shall be required.

The CEQA Guidelines note that if an archaeological resource is neither a unique archaeological nor a historical resource, the effects of the project on those resources shall not be considered a significant effect on the environment (14 CCR 15064.4(c)(4)).

California Register of Historical Resources (CRHR)

Created in 1992 and implemented in 1998, the California Register of Historical Resources (CRHR) as "an authoritative guide in California to be used by State and local agencies, private groups, and citizens to identify the State's historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change." Certain properties, including those listed in or formally determined eligible for listing in the NRHP and California Historical Landmarks numbered 770 and higher, are automatically included in the CRHR. Other properties recognized under the California Points of Historical Interest program, identified as significant in historical resources surveys or designated by local landmarks programs, may be nominated for inclusion in the CRHR. A resource, either an individual property or a contributor to a historic district, may be listed in the CRHR if the State Historical Resources Commission (SHRC) determines that it meets one or more of the following criteria, which are modeled on NRHP criteria:

- **Criterion 1:** It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
- **Criterion 2:** It is associated with the lives of persons important in our past.
- **Criterion 3:** It embodies the distinctive characteristics of a type, period, region, or method of construction; represents the work of an important creative individual; or possesses high artistic values.
- **Criterion 4:** It has yielded, or may be likely to yield, information important in history or prehistory.

Furthermore, under PRC 5024.1, 14 CCR, Section 4852(c), a cultural resource must retain integrity to be considered eligible for the CRHR. Specifically, it must retain sufficient character or appearance to be recognizable as a historical resource and convey reasons of significance. Integrity is evaluated with regard to retention of such factors as location, design, setting, materials, workmanship, feeling, and association. Cultural sites that have been affected by ground-disturbing activities, such as grazing and off-road vehicle use (both of which occur within the project site), often lack integrity because they have been directly damaged or removed from their original location, among other changes.

Typically, a prehistoric archaeological site in California is recommended eligible for listing in the CRHR based on its potential to yield information important in prehistory or history (Criterion 4). Important information includes chronological markers such as projectile point styles or obsidian artifacts that can be subjected to dating methods or undisturbed deposits that retain their stratigraphic integrity. Sites such as these have the ability to address research questions.

California Historical Landmarks (CHLs)

California Historical Landmarks (CHLs) are buildings, structures, sites, or places that have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value and that have been determined to have statewide historical significance by meeting at least one of the criteria listed below. The resource also must be approved for designation by the County Board of Supervisors (or the city or town council in whose jurisdiction it is located); be recommended by the SHRC; and be officially designated by the Director of California State Parks.

To be eligible for designation as a landmark, a resource must meet at least one of the following criteria:

- It is the first, last, only, or most significant of its type in the State or within a large geographic region (Northern, Central, or Southern California);
- It is associated with an individual or group having a profound influence on the history of California; or
- It is a prototype of, or an outstanding example of, a period, style, architectural movement or construction or is one of the more notable works or the best surviving work in a region of a pioneer architect, designer, or master builder.

California Points of Historical Interest

California Points of Historical Interest are sites, buildings, features, or events that are of local (city or county) significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Points of historical interest designated after December 1997 and recommended by the SHRC are also listed in the CRHR. No historic resource may be designated as both a landmark and a point. If a point is later granted status as a landmark, the point designation will be retired. In practice, the point designation program is most often used in localities that do not have a locally enacted cultural heritage or preservation ordinance.

To be eligible for designation as a point of historical interest, a resource must meet at least one of the following criteria:

- It is the first, last, only, or most significant of its type within the local geographic region (city or county);
- It is associated with an individual or group having a profound influence on the history of the local area; or
- It is a prototype of, or an outstanding example of, a period, style, architectural movement or construction or is one of the more notable works or the best surviving work in the local region of a pioneer architect, designer, or master builder.

Native American Heritage Commission (NAHC)

PRC Section 5097.91 established the Native American Heritage Commission (NAHC), the duties of which include inventorying of places of religious or social significance to Native Americans and identifying known graves and cemeteries of Native Americans on private lands. PRC Section 5097.98 specifies a protocol to be followed when the NAHC receives notification of a discovery of Native American human remains from a county coroner.

California Public Records Act

Sections 6254(r) and 6254.10 of the California Public Records Act were enacted to protect archaeological sites from unauthorized excavation, looting, or vandalism. Section 6254(r) explicitly authorizes public agencies to withhold information from the public relating to "Native American graves, cemeteries, and sacred places maintained by the Native American Heritage Commission." Section 6254.10 specifically exempts from disclosure requests for "records that relate to

archaeological site information and reports, maintained by, or in the possession of the Department of Parks and Recreation, the State Historical Resources Commission, the State Lands Commission, the NAHC, another State agency, or a local agency, including the records that the agency obtains through a consultation process between a Native American tribe and a State or local agency."

California Health and Safety Code, Sections 7050 and 7052

Health and Safety Code, Section 7050.5, declares that, in the event of the discovery of human remains outside of a dedicated cemetery, all ground disturbance must cease and the county coroner must be notified. Section 7052 establishes a felony penalty for mutilating, disinterring, or otherwise disturbing human remains, except by relatives.

California Penal Code, Section 622.5

The California Penal Code, Section 622.5, provides misdemeanor penalties for injuring or destroying objects of historic or archaeological interest located on public or private lands, but specifically excludes the landowner.

Public Resources Code, Section 5097.5

PRC Section 5097.5 defines as a misdemeanor the unauthorized disturbance or removal of archaeological, historic, or paleontological resources located on public lands.

Senate Bill (SB) 18

Senate Bill 18 (SB 18), which went into effect January 1, 2005, requires local governments (city and county) to consult with Native American tribes before making certain planning decisions and to provide notice to tribes at certain key points in the planning process. The intent is to "provide California Native American tribes an opportunity to participate in local land use decisions at an early planning stage, for the purpose of protecting, or mitigating impacts to, cultural places."

The purpose of involving tribes at these early planning stages is to allow consideration of cultural places in the context of broad local land use policy, before individual site-specific, project-level, land use designations are made by a local government. The consultation requirements of SB 18 apply to general plan or specific plan processes proposed on or after March 1, 2005.

According to the Tribal Consultation Guidelines: Supplement to General Plan Guidelines published by the Governor's Office of Planning and Research, the following are the contact and notification responsibilities of local governments:

- Prior to the adoption or any amendment of a general plan or specific plan, a local government must notify the appropriate tribes (on the contact list maintained by the Native American Heritage Commission [NAHC]) of the opportunity to conduct consultations for the purpose of preserving, or mitigating impacts to, cultural places located on land within the local government's jurisdiction that is affected by the proposed plan adoption or amendment. Tribes have 90 days from the date on which they receive notification to request consultation, unless a shorter timeframe has been agreed to by the tribe (Government Code Section 65352.3).

- Prior to the adoption or substantial amendment of a general plan or specific plan, a local government must refer the proposed action to those tribes that are on the NAHC contact list and have traditional lands located within the city or county's jurisdiction. The referral must allow a 45-day comment period (Government Code Section 65352). Notice must be sent regardless of whether prior consultation has taken place. Such notice does not initiate a new consultation process.

- Local government must send a notice of a public hearing, at least ten (10) days prior to the hearing, to tribes who have filed a written request for such notice (Government Code Section 65092).

In accordance with Senate Bill 18 and the California Tribal Consultation guidelines, the appropriate native groups were consulted with respect to the project's potential impacts on Native American places, features, and objects. As of the writing of this report, Staff has not received any comments from consulted tribes in regards to the department's SB 18 request. Staff notes consultation with appropriate Native American groups per Senate Bill 18 requirements has occurred.

Assembly Bill (AB) 52

AB 52, which went into effect on July 1, 2015, requires CEQA lead agencies to engage in early consultation with California Native American Tribes on all projects. AB 52 creates a new CEQA resource: Tribal Cultural Resources, which include sites, features, places, cultural landscapes, sacred place, objects, or archeological resources with cultural value to a California Native American Tribe that is listed or eligible for listing in the national, California or local registers.

AB 52 requires lead agencies to consider whether a project may cause a substantial adverse change in the significance of a Tribal Cultural Resource and to consider a tribe's cultural values when determining the appropriate environmental assessment, impacts and mitigation. AB 52 can draw upon SB 18's guidelines and can be completed in tandem.

AB 52 applies to projects with a Notice of Preparation (NOP) or notice of a Negative Declaration or Mitigated Negative Declaration issued on or after July 1, 2015. The OPR must propose and CNRA must adopt revisions to the CEQA Guidelines by July 1, 2016 in order to: (1) separate the consideration of paleontological resources from Tribal Cultural Resources and update the relevant sample questions and (2) add consideration of Tribal Cultural Resources with relevant sample questions. The NOP for this proposed Project was issued on May 1, 2009; therefore, AB 52 does not apply to this proposed Project.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan Land Use Element includes the following relevant goal and policies related to cultural resources (refer to Table 4.5-1, *Metropolitan Bakersfield General Plan Goals and Policies for Cultural Resources*):

Table 4.5-1. Metropolitan Bakersfield General Plan Goals and Policies for Cultural Resources
Goals and Policies: Land Use Element
Goal #6: Accommodate new development that is sensitive to the natural environment, and accounts for environmental hazards.
Policy #105: Development on land containing known archaeological resources (i.e., high sensitivity areas) shall utilize methodology set forth as described necessary by a qualified archaeologist to locate proposed structures, paving, landscaping and fill dirt in such a way as to preserve these resources undamaged for future generations when it is the recommendation of a qualified archaeologist that said resources be preserved in situ.
Policy #107: The preservation of historical resources shall be promoted and other public agencies or private organizations shall be encouraged to assist in the purchase and/or relocation of sites, buildings, and structures deemed to be of historical significance.

4.5.4 Impacts and Mitigation Measures

This section describes the impact analysis relating to cultural resources for the proposed Project. It describes the methods used to determine the proposed Project's impacts, lists the thresholds used to conclude whether an impact would be significant, and discusses the impacts of the proposed Project based on these thresholds.

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative and quantitative basis through a comparison of the anticipated Project effects on cultural resources. The change in the land use is significant if the effects described below occur. The evaluation of proposed Project impacts as based on professional judgment, analysis of the County's cultural resource polices and the significance criteria established by Appendix G of the State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Cause a substantial adverse change in the significance of a historical resource, as defined in CEQA Guidelines Section 15064.5;
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5;
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature; or
- Disturb any human remains, including those interred outside of formal cemeteries.

Section 21083.2(g) of CEQA further defines "unique archaeological resource" for purposes of determination as to whether a project may have a significant effect on archaeological resources. As used in this section "unique archaeological resource" means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information;
- Has a special and particular quality such as being the oldest of its type or the best available of its type; or
- Is directly associated with a scientifically recognized important prehistoric or historic event or person.

CEQA does not define a unique paleontological resource but for purposes of this EIR, a paleontological resource or site is considered "unique" where it meets any of the following criteria:

- It is the best example of its kind locally or regionally;
- Illustrates a geologic principle;
- Provides a critical piece of paleobiological data;
- Encompasses any part of a "type locality" of a fossil or rock unit/formation;
- Contains a unique or particularly unusual assemblage of fossils;
- Occupies a unique position stratigraphically; and/or
- Occupies a unique position, proximally, distally or laterally within a rock unit/formation's extent or distribution.

According to CEQA Guidelines, California Code of Regulations (CCR) Title 14, 15064.5, a project with an effect that may cause a substantial adverse change in the significance of a historical resource is a project that may have a significant effect on the environment (CCR Title 14, 15064.5(b)). The guidelines further state that a substantial adverse change in the significance of a resource means the physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historic resource would be materially impaired. Actions that would materially impair the significance of a historical resource are any actions that would demolish or adversely alter those physical characteristics of a historical resource that convey its historical significance and qualify it for inclusion in the CRHR or in a local register or survey that meet the requirements of PRC Sections 5020.1(k) and 5024.1(g).

Project Impacts

Impact 4.5-1: The Project Would Cause a Substantial Adverse Change in the Significance of a Historical or Archaeological Resource.

No historical or archaeological resources were identified within the proposed Project boundaries during the archaeological resources studies completed for the project site. A Phase I Cultural Resource Survey was prepared in October of 2008 and revised in May 2009. Included in the original report is information from two records searches and complete site survey of the Project area completed between February and March 2006. A subsequent Field Check conducted on-site, and a subsequent records search was performed between February and March 2016. Neither the site survey, field check, or records searches conducted by Hudlow Cultural Resource Associates identified any historical or archaeological resources (Hudlow Cultural Resources Associates 2017). The records searches of the proposed Project and surrounding area were conducted at the Southern San Joaquin Archaeological Information Center (SSJAIC) at California State University, Bakersfield in February 2006 and March 2016. The SSJAIC is the designated repository of the California Historical Resources Information System (CHRIS) for records concerning archaeological and other cultural resources in Kern County. No cultural resources were identified within one mile of the Project site (Hudlow Cultural Resource Associates 2009 and 2017).

As discussed above, pedestrian field surveys were conducted between February 6 and March 8, 2006 and on March 5, 2016. The pedestrian surveys covered the entire Project site and was conducted by walking north/south and east/west transects across the entire site at 15-meter intervals. No archaeological resources were identified.

However; because the potential remains that buried or otherwise hidden historical resources and/or archaeological deposits or isolate artifacts could be located on the Project site, development of the proposed Project has the potential to disturb or destroy undocumented historical and/or archaeological resources. Implementation of mitigation measures would reduce potential impacts to undocumented historical and/or archaeological resources to less than significant levels.

Mitigation Measures

MM 4.5-1: **Archaeological Resources.** Prior to ground disturbance, or the issuance of grading or building permits, the project proponent shall retain a qualified lead archaeologist to carry out all mitigation measures related to archaeological resources.

1. The approved monitor shall monitor all initial ground-disturbing activities (such as site preparation and initial grading) and excavations on the project site.

2. If archaeological resources are encountered during implementation of the project, ground-disturbing activities will cease within the immediate vicinity of the find. The lead archaeologist shall establish a buffer area around the find and make an evaluation of the find to determine appropriate treatment that may

include the development and implementation of a data recovery investigation or preservation in place.

3. All cultural resources recovered will be documented on California Department of Parks and Recreation Site Forms to be filed with the California Historic Resources Information System (CHRIS). The archaeologist will prepare a final report about the find to be filed with the Applicant/landowner and the CHRIS. The report will include documentation and interpretation of resources recovered. Interpretation will include full evaluation of the eligibility with respect to the National Register of Historic Places and California Register of Historical Resources and CEQA. The developer, in consultation with the Lead Agency and Project Archaeologist, will designate repositories in the event that resources are recovered.

MM 4.5-2: **Paleontological Resources.** During project construction, if a paleontological resource is found, the project contractor shall cease ground-disturbing activities within 50 feet of the find. A qualified paleontologist shall be obtained to evaluate the significance of the resource(s) and recommend appropriate treatment measures. Any fossils encountered and recovered shall be catalogued and donated to a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County. Accompanying notes, maps, and photographs shall also be filed at the repository.

MM 4.5-3: **Historical Resources.** Prior to the issuance of grading or building permits, the project proponent shall ensure the following measures are implemented for resources, which are discretionarily considered historical resources for the purposes of this project:

1. The construction zone shall be narrowed or otherwise altered to avoid resources. All avoidance areas delineated on the site plan shall be coordinated through the lead archeologist and submitted to the Kern County Planning and Natural Resources Department for approval.

2. In coordination with the qualified archaeologist avoidance shall be ensured by the delineation of environmentally sensitive areas. Protective fencing shall not identify the protected area as a cultural resource area in order to discourage unauthorized disturbance or collection of artifacts.

3. Consistent with Mitigation Measure 4.5-1 (above) a qualified archaeological monitor and Native American Monitor, shall monitor all project-related ground disturbing activities within 150 feet of the environmentally sensitive areas, in order to ensure avoidance.

4. If avoidance is demonstrated to be infeasible, the resource shall be collected and curated at an appropriate curatorial facility. Or if avoidance is demonstrated to be infeasible, a detailed Cultural Resources Treatment Plan shall be prepared and implemented by a qualified archaeologist. The Cultural

Resources Treatment Plan shall include a research design and a scope of work for data recovery of the portion(s) to be impacted by the project. Treatment may consist of (but would not be limited to):

a. a sufficient avoidance buffer to protect the resource until data recovery and/or removal is completed;

b. sample excavation;

c. surface artifact collection;

d. site documentation; and,

e. historical research, with the aim to target the recovery of important scientific data contained in the portion of the significant resource to be impacted by the project.

5. The Cultural Resources Treatment Plan shall also include provisions for analysis of data in a regional context, reporting of results within a timely manner, and curation of artifacts and data at an approved facility. The reports documenting the implementation of the Cultural Resources Treatment Plan shall be submitted to and approved by the Kern County Planning and Natural Resources Director and shall also be submitted to the Southern San Joaquin Valley Information Center at California State University, Bakersfield.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.5-2: The Project Would Directly or Indirectly Destroy a Unique Paleontological Resource or Site or Unique Geologic Feature.

According to the KCGP and the Metropolitan Bakersfield General Plan, the areas of paleontological resources within Metropolitan Bakersfield are located at the Maricopa and Citric Brea Tar Pits, the Bean Hills Petrified Forest and Shark Tooth Hill at Round Mountain. The proposed Project is not located in or near any of these areas. Furthermore, according to the Metropolitan Bakersfield General Plan, geological records of the region indicate that the proposed Project site is underlain by recent alluvial deposits to all depths likely to be reached by excavations associated with development. These deposits appear to be too young geologically to contain significant fossil remains. However, the destruction of any unique fossil resource would be a significant impact.

Implementation of mitigation measure would reduce potential proposed Project-related adverse impacts to unknown and unidentified paleontological resources encountered during construction of the proposed Project.

Mitigation Measures

MM 4.5-4: **Found Paleontological Resource.** During implementation of the proposed project, if a paleontological resource is found, the project contractor shall cease ground-disturbing activities within 50 feet of the find.

1. A qualified paleontologist shall evaluate the significance of the resource(s) and recommend appropriate treatment measures.

    a. At each fossil locality, field data forms shall be used to record pertinent geologic data, stratigraphic sections shall be measured, and appropriate sediment samples shall be collected and submitted for analysis.

    b. Any fossils encountered and recovered shall be catalogued and donated to a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County. Accompanying notes, maps, and photographs shall also be filed at the repository.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.5-3: The Project Would Disturb Any Human Remains, Including Those Interred Outside of Formal Cemeteries.

Ground-disturbing activities are anticipated to include excavation and grading at shallow depths during proposed Project construction. Ground-disturbing activities associated with development of the proposed Project could unearth previously undocumented human remains. Therefore, development of the proposed Project has the potential to disturb or destroy undocumented human remains. Implementation of the mitigation measure identified below would reduce potential impacts to less than significant levels.

Mitigation Measures

MM 4.5-5: **Found Human Remains.** If human remains are uncovered during project construction, the project proponent shall immediately halt work, contact the Kern County Coroner to evaluate the remains, and follow the procedures and protocols set forth in Section 15064.4 (e)(1) of the California Environmental Quality Act Guidelines. If the County Coroner determines the remains are Native American, the coroner shall contact the Native American Heritage Commission, in accordance with Health and Safety Code Section 7050.5, subdivision (c), and Public Resources Code 5097.98 (as amended by Assembly Bill 2641). The Native American Heritage Commission shall designate a Most Likely Descendent (MLD) for the remains per Public Resources Code 5097.98. Per Public Resources Code 5097.98, the landowner shall ensure that the immediate vicinity, according to generally accepted cultural or archaeological standards or practices, where the Native American human remains

are located, is not damaged or disturbed by further development activity until the landowner has discussed and conferred with the most likely descendent regarding their recommendations, if applicable, taking into account the possibility of multiple human remains. If the remains are determined to be neither of forensic value to the Coroner, nor of Native American origin, provisions of the California Health and Safety Code (7100 et. seq.) directing identification of the next-of-kin will apply.

The MLD shall complete the inspection of the site within 48 hours of notification and may recommend scientific removal and nondestructive analysis of human remains and items associated with Native American burials.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Potential historical, archaeological, and paleontological impacts are considered and evaluated on a project specific basis. Each incremental development would be required to comply with all applicable State, Federal, and County regulations concerning preservation, salvage, or handling of cultural resources including compliance with required mitigation. In consideration and through implementation of these regulations, potential cumulative impacts upon historical, archaeological, and paleontological resources would not be considered significant.

Mitigation Measures

Implement Mitigation Measures MM 4.5-1 through MM 4.5-5, above.

Level of Significance after Mitigation

Impacts would be less than significant.

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Section 4.6

Energy

Section 4.6
Energy

4.6.1 Introduction

This section of the Recirculated Draft Environmental Impact Report (RDEIR) evaluates potential energy impacts associated with implementation of the proposed Project. The analysis in this section relies of some information previously discussed and disclosed in Section 4.3, Air Quality and Section 4.8, Greenhouse Gas (GHG) Emissions, which in part analyzes GHGs emitted from use of energy. The analysis in this Section considers whether implementation of the proposed project would result in wasteful, and unnecessary consumption of energy. This analysis considers the electricity, natural gas, and transportation fuel (petroleum) demands of the Project, as well as potential service delivery impacts. This section also includes where appropriate and feasible mitigation measures based on the Energy Assessment – Energy Mitigation for 99 Houghton Industrial Park, prepared by McIntosh Associates, April 23, 2019 and attached as Appendix O. This section of the RDEIR is closely related to Section 4.8, Greenhouse Gases. Where appropriate, and to minimize redundancy, cross references to the applicable analysis contained within the Section 4.8, Greenhouse Gases is provided.

4.6.2 Environmental Setting

The Environmental Setting describes the existing setting of the Project site as it relates to energy conservation.

California's Energy Use and Supply

Californians consumed 290,567 gigawatt hours (GWh) of electricity in 2016, which is the most recent year for which data is available. Of this total, Kern County consumed 18,440 GWh (CEC, 2017a). In 2016, the California electricity mix included natural gas (33.67 percent), coal (4.13 percent), large hydroelectric plants (14.72 percent), nuclear (9.08 percent), oil (0.01 percent), petroleum coke/waste heat (0.14 percent) and unspecified sources of power (9.25 percent). The remaining 29 percent was supplied from renewable resources, such as wind, solar, geothermal, biomass, and small hydroelectric facilities (CEC, 2017b). In 2017, the state consumed 2,110,829 million cubic feet of natural gas.

Energy usage is typically quantified using the British Thermal Unit (BTU). Total energy usage in California was 7,830 trillion BTU in 2016 (the most recent year for which this specific data is available), which equates to an average of 199 million BTU per capita (EIA, 2017b). Of California's total energy usage, the breakdown by sector is 39 percent transportation, 24 percent industrial, 19 percent commercial, and 18 percent residential. Electricity and natural gas in California are generally consumed by stationary users such as residences and commercial and industrial facilities, whereas petroleum consumption is generally accounted for by transportation-related energy use. In 2017, taxable gasoline sales (including aviation gasoline) in California accounted for 15,540,154,774 gallons of gasoline.

Current Energy Provider

Electricity in Kern County is primarily provided by the Pacific Gas and Electric Company (PG&E). The PG&E 2017 power mix was as follows: 20 percent natural gas, 27 percent nuclear, 33 percent renewables, 18 percent large hydroelectric, and 2 percent unspecified power (PG&E, 2019b).

The electricity consumption attributable to Kern County from 2007 to 2017 is shown in Table 4.6-1 (Electricity Consumption in Kern County 2007-2017). As indicated in Table 4.6-1, energy consumption in Kern County remained relatively constant between 2007 and 2017, with no substantial increase.

Table 4.6-1. Electricity Consumption in Kern County 2007-2018

Year	Electricity Consumption (in millions of kilowatt hours)
2007	17,243
2008	15,450
2009	14,443
2010	14,955
2011	15,953
2012	16,675
2013	15,023
2014	14,295
2015	15,170
2016	16,530
2017	18,440
2018	15,805

Source: CEC, Electricity Consumption by County, 2018 and 2019.

PG&E operates one of the largest natural gas distribution networks in the country, including approximately 42,142 miles of natural gas transmission and distribution pipelines (PG&E, 2019a). In all, PG&E delivers gas to approximately 4.3 million customer accounts and approximately 5.4 million electric customer accounts in Northern and Central California, including in Kern County.

The natural gas consumption in Kern County from 2007 to 2017 is shown in Table 4.6-2 (Natural Gas Consumption in Kern County 2007-2017). Similar to energy consumption, natural gas consumption in Kern County remained relatively constant between 2007 and 2017, with no substantial increase.

The CPUC regulates California natural gas rates and natural gas services, including in-state transportation over transmission and distribution pipeline systems, storage, procurement, metering, and billing. Most of the natural gas used in California comes from out-of-state natural gas basins.

California's regulated utilities do not own any natural gas production facilities. All natural gas sold by these utilities must be purchased from suppliers or marketers. The price of natural gas sold by suppliers and marketers was deregulated by the Federal Energy Regulatory Commission in the mid-1980s and is determined by market forces. However, the CPUC decides whether California's utilities

have taken reasonable steps to minimize the cost of natural gas purchased on behalf of its core customers (CPUC 2017).

Table 4.6-2. Natural Gas Consumption in Kern County 2007-2018

Year	Natural Gas Consumption (in millions of therms)
2007	2,636
2008	2,591
2009	2,497
2010	2,327
2011	2,376
2012	2,326
2013	2,697
2014	2,715
2015	2,762
2016	2,520
2017	2,397
2018	2,427

Source: CEC, Natural Gas Consumption by County, 2018 and 2019.

As indicated in the preceding discussion, natural gas is available from a variety of in-state and out-of-state sources, and is provided throughout the state in response to market supply and demand. Complementing available natural gas resources, biogas may soon be available through existing delivery systems, thereby increasing the availability and reliability of resources.

Existing Infrastructure

The Project site is within Pacific Gas and Electric Company (PG&E) service area. Electric power supply and distribution and natural gas for the proposed Project area is furnished by PG&E. Two PG&E substations, Old River Substation and Panama Substation presently serve the proposed Project area. Existing PG&E electrical distribution facilities are located on the south side of DiGiorgio Road, on the northeast side of SR-99, along the north side of Houghton Road, and on the west side of South Union Avenue with a little intrusion into the area from South Union Avenue and Houghton Road. Currently, there is approximately 5,000 linear feet of PG&E Transmission Line 300B located in the northeast corner of the proposed Project. There is also a six-inch diameter gas distribution line located on the east side of the proposed Project.

Four pole-mounted electrical transformer locations were observed on the proposed Project site. PG&E is the owner of the transformers and should be contacted for their removal prior to Project site development.

Transportation Fuels

California's transportation sector uses roughly half of the energy consumed in the state. In 2016, Californians consumed approximately 15.1 billion gallons of gasoline and 3 billion gallons of diesel fuel, which were down from 15 billion gallons of gasoline and 2.8 billion gallons of diesel in 2008 (BOE, 2017a; 2017b).

FUEL CONSUMPTION

Automotive fuel consumption in Kern County from 2007 to 2019 is shown in Table 4.6-3 (Automotive Fuel Consumption in Kern County 2007-2019) (projections for the year 2019 are also shown). As shown in Table 4.6-3, on-road automotive fuel consumption in Kern County has declined steadily from 2007, although 2014 through 2017 were increased. Heavy-duty vehicle fuel consumption has been increasing since 2012.

Table 4.6-3. Automotive Fuel Consumption in Kern County 2007-2019

Year	On-Road Automotive Fuel Consumption (Gallons)	Heavy-Duty Vehicle/Diesel Fuel Consumption (Gallons)
2007	482,802,885	305,057,882
2008	467,282,258	275,614,151
2009	457,753,568	254,307,817
2010	459,769,506	255,617,083
2011	453,029,571	256,460,303
2012	452,705,414	256,810,320
2013	454,062,915	275,920,754
2014	458,973,481	281,393,333
2015	469,620,303	284,648,995
2016	476,390,995	301,260,345
2017	463,754,740	304,118,169
2018	454,207,143	308,064,466
2019 (projected)	445,151,657	311,403,744

Source: California Air Resources Board, EMFAC2017.

4.6.3 Regulatory Setting

Federal, state, and local agencies regulate energy use and consumption through various means and programs. On the federal level, the U.S. Department of Transportation, the U.S. Department of Energy, and the U.S. Environmental Protection Agency are three federal agencies with substantial influence over energy policies and programs. On the state level, the CPUC and CEC are two agencies with authority over different aspects of energy. Relevant federal, state, and local energy-related regulations are summarized below.

Federal

National Energy Policy and Conservation Act

The National Energy Conservation Policy Act serves as the underlying authority for Federal energy management goals and requirements. Signed into law in 1975, it has been regularly updated and amended by subsequent laws and regulations. Pursuant to the act, the National Highway Traffic Safety Administration is responsible for establishing additional vehicle standards. In 2012, new fuel economy standards for passenger cars and light trucks were approved for model years 2017 through 2021 (77 FR 62624–63200). Fuel economy is determined based on each manufacturer's average fuel economy for the fleet of vehicles available for sale in the United States.

Energy Policy Act of 2005

The Energy Policy Act of 2005 sets equipment energy efficiency standards and seeks to reduce reliance on non-renewable energy resources and provide incentives to reduce current demand on these resources. For example, under the Act, consumers and businesses can attain Federal tax credits for purchasing fuel-efficient appliances and products, including hybrid vehicles; constructing energy-efficient buildings; and improving the energy efficiency of commercial buildings. Additionally, tax credits are available for the installation of qualified fuel cells, stationary micro-turbine power plants, and solar power equipment.

Energy and Independence Security Act of 2007

The Energy and Independence Security Act of 2007 sets Federal energy management requirements in several areas, including energy reduction goals for Federal buildings, facility management and benchmarking, performance and standards for new buildings and major renovations, high-performance buildings, energy savings performance contracts, metering, energy-efficient product procurement, and reduction in petroleum use and increase in alternative fuel use. This act also amends portions of the National Energy Policy and Conservation Act. In addition to setting increased Corporate Average Fuel Economy standards for motor vehicles, the EISA includes the following other provisions related to energy efficiency:

- Renewable Fuel Standard (RFS) (Section 202)
- Appliance and Lighting Efficiency Standards (Sections 301–325)
- Building Energy Efficiency (Sections 411–441)

State

Assembly Bill (AB) 32 and Senate Bill 32

California's major initiative for reducing GHG emissions is outlined in Assembly Bill 32 (AB 32), the "California Global Warming Solutions Act of 2006." AB 32 codifies the statewide goal of reducing GHG emissions to 1990 levels by 2020 (essentially a 15 percent reduction below 2005 emission levels; the same requirement as under S-3-05), and requires CARB to prepare a Scoping

Plan that outlines the main State strategies for reducing GHGs to meet the 2020 deadline. In addition, AB 32 requires CARB to adopt regulations to require reporting and verification of statewide GHG emissions. Reductions in overall energy consumption have been implemented to reduce emissions. See Section 4.8, Greenhouse Gas Emissions, for a further discussion of AB 32.

In September 2016, the Governor signed into legislation SB 32, which builds on AB 32 and requires the state to cut GHG emissions to 40 percent below 1990 levels by 2030. With SB 32, the Legislature also passed AB 197, which provides additional direction for updating the Scoping Plan to meet the 2030 GHG reduction target codified in SB 32. CARB has published a draft update to the Scoping Plan and has received public comments on this draft but has not released the final version.

Additional energy efficiency measures beyond the current regulations are needed to meet these goals as well as the AB 32 greenhouse gas (GHG) reduction goal of reducing statewide GHG emissions to 1990 levels by 2020 and the SB 32 goal of 40 percent below 1990 levels by 2030 (see Section 4.8, Greenhouse Gas Emissions, for a discussion of AB 32 and SB 32). Part of the effort in meeting California's long-term reduction goals include reducing petroleum use in cars and trucks by 50 percent, increasing from one-third to more than one-half of California's electricity derived from renewable sources, doubling the efficiency savings achieved at existing buildings and making heating fuels cleaner; reducing the release of methane, black carbon, and other short-lived climate pollutants, and managing farm and rangelands, forests, and wetlands so they can store carbon.

2008 California Energy Action Plan Update

The 2008 Energy Action Plan Update provides a status update to the 2005 Energy Action Plan II, which is the State's principal energy planning and policy document (CPUC and CEC, 2008). The plan continues the goals of the original Energy Action Plan, describes a coordinated implementation plan for State energy policies, and identifies specific action areas to ensure that California's energy is adequate, affordable, technologically advanced, and environmentally sound. First-priority actions to address California's increasing energy demands are energy efficiency, demand response (i.e., reduction of customer energy usage during peak periods in order to address system reliability and support the best use of energy infrastructure), and the use of renewable sources of power. If these actions are unable to satisfy the increasing energy and capacity needs, the plan supports clean and efficient fossil-fired generation.

California Buildings Standards

CALIFORNIA GREEN BUILDING STANDARDS CODE

The California Green Building Standards Code (California Code of Regulations, Title 24, Part 11), commonly referred to as the CALGreen Code, is a statewide mandatory construction code that was developed and adopted by the California Building Standards Commission and the California Department of Housing and Community Development. CALGreen standards require new residential and commercial buildings to comply with mandatory measures under five topical areas: planning and design; energy efficiency; water efficiency and conservation; material conservation and resource efficiency; and environmental quality. CALGreen also provides voluntary measures (CALGreen Tier 1 and Tier 2) that local governments may adopt which encourage or require additional measures in

the five green building topics. The most recent update to the CALGreen Code was adopted in 2016 and went into effect January 1, 2017.

Among the key mandatory provisions are requirements that new buildings:

- Reduce indoor potable water use by at least 20 percent below current standards;
- Recycle or salvage at least 50 percent of construction waste;
- Utilize low VOC-emitting finish materials and flooring systems;
- Install separate water meters tracking non-residential buildings' indoor and outdoor water use;
- Utilize moisture-sensing irrigation systems for larger landscape areas;
- Receive mandatory inspections by local officials of building energy systems, such as heating, ventilation, and air conditioning (HVAC) and mechanical equipment, to verify performance in accordance with specifications in non-residential buildings exceeding 10,000 square feet; and
- Earmark parking for fuel-efficient and carpool vehicles.

BUILDING ENERGY EFFICIENCY STANDARDS

The Energy Efficiency Standards for Residential and Nonresidential Buildings, as specified in Title 24, Part 6, of the California Code of Regulations, were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. The 2016 Title 24 standards are the current applicable building energy efficiency standards, and became effective on January 1, 2017. The 2019 Building Energy Efficiency Standards will continue to improve upon the 2016 Standards for new construction of, and additions and alterations to, residential and nonresidential buildings. The 2019 Building Energy Efficiency Standards were adopted on May 9, 2018 and take effect on January 1, 2020. Under the 2019 standards, homes will use about 53 percent less energy and nonresidential buildings will use about 30 percent less energy than buildings under the 2016 Title 24 standards.

2006 APPLIANCE EFFICIENCY REGULATIONS

The California Energy Commission adopted Appliance Efficiency Regulations (Title 20, CCR Sections 1601 through 1608) on October 11, 2006. The regulations were approved by the California Office of Administrative Law on December 14, 2006. The regulations include standards for both Federally regulated appliances and non-Federally regulated appliances. While these regulations are now often viewed as "business-as-usual," they exceed the standards imposed by all other states and they reduce GHG emissions by reducing energy demand.

SENATE BILL 1078 AND 107; EXECUTIVE ORDER S-14-08, S-21-09, AND SB 2X

SB 1078 (Chapter 516, Statutes of 2002) requires retail sellers of electricity, including investor-owned utilities and community choice aggregators, to provide at least 20 percent of their supply from renewable sources by 2017. SB 107 (Chapter 464, Statutes of 2006) accelerated the due date of the 20 percent mandate to 2010 instead of 2017. These mandates apply directly to investor-owned

utilities. In November 2008, then-Governor Schwarzenegger signed Executive Order S-14-08, which expands the state's Renewable Portfolio Standard to 33 percent renewable power by 2020. In September 2009, then-Governor Schwarzenegger continued California's commitment to the Renewable Portfolio Standard by signing Executive Order S-21-09, which directs the CARB under its AB 32 authority to enact regulations to help the state meet its Renewable Portfolio Standard goal of 33 percent renewable energy by 2020. CARB approved the Renewable Electricity Standard on September 23, 2010 by Resolution 10-23. SBX1-2 (2011) codified the 33 percent by 2020 goal.

EXECUTIVE ORDER B-30-15; SENATE BILL 100 AND 350

In April 2015, the Governor issued Executive Order B-30-15, which established a GHG reduction target of 40 percent below 1990 levels by 2030. SB 350 (Chapter 547, Statutes of 2015) advanced these goals through two measures. First, the law increases the renewable power goal from 33 percent renewables by 2020 to 50 percent by 2030. Second, the law requires the CEC to establish annual targets to double energy efficiency in buildings by 2030. The law also requires the California Public Utilities Commission (CPUC) to direct electric utilities to establish annual efficiency targets and implement demand-reduction measures to achieve this goal. In 2018, SB 100 revised the goal of the program to achieve the 50 percent renewable resources target by December 31, 2026, and to achieve a 60 percent target by December 31, 2030. SB 100 also established a further goal to have an electric grid that is entirely powered by clean energy by 2045.

STATE VEHICLE STANDARDS (AB 1493)

AB 1493 (Pavley Regulations and Fuel Efficiency Standards), enacted on July 22, 2002, required CARB to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light duty trucks. Implementation of the regulation was delayed by lawsuits filed by automakers and by the EPA's denial of an implementation waiver. The EPA subsequently granted the requested waiver in 2009, which was upheld by the by the U.S. District Court for the District of Columbia in 2011. The regulations establish one set of emission standards for model years 2009–2016 and a second set of emissions standards for model years 2017 to 2025. By 2025, when all rules will be fully implemented, new automobiles will emit 34 percent fewer CO2e emissions and 75 percent fewer smog-forming emissions.

SUSTAINABLE COMMUNITIES STRATEGY

The Sustainable Communities and Climate Protection Act of 2008, or SB 375, coordinates land use planning, regional transportation plans, and funding priorities to help California meet its GHG emissions reduction mandates. As codified in California Government Code Section 65080, SB 375 requires metropolitan planning organizations (e.g., ABAG) to include a Sustainable Communities Strategy in their regional transportation plan. The main focus of the Sustainable Communities Strategy is to plan for growth in a fashion that will ultimately reduce GHG emissions, but the strategy is also part of a bigger effort to address other development issues, including transit and VMT, which influence the consumption of petroleum-based fuels.

RENEWABLE PORTFOLIO STANDARD

In 2002, California established its Renewable Portfolio Standard program with the goal of increasing the annual percentage of renewable energy in the state's electricity mix by the equivalent of at least 1 percent of sales, with an aggregate total of 20 percent by 2017. The California Public Utilities Commission subsequently accelerated that goal to 2010 for retail sellers of electricity (Public Utilities Code Section 399.15(b)(1)). Then-Governor Schwarzenegger signed Executive Order S-14-08 in

2008, increasing the target to 33 percent renewable energy by 2020. In September 2009, then-Governor Schwarzenegger continued California's commitment to the Renewable Portfolio Standard by signing Executive Order S-21-09, which directs the California Air Resources Board under its AB 32 authority to enact regulations to help the State meet its Renewable Portfolio Standard goal of 33 percent renewable energy by 2020. In September 2010, the California Air Resources Board adopted its Renewable Electricity Standard regulations, which require all of the state's load-serving entities to meet this target. In October 2015, then-Governor Jerry Brown signed into legislation Senate Bill 350, which requires retail sellers and publicly owned utilities to procure 50 percent of their electricity from eligible renewable energy resources by 2030. Signed in 2018, SB 100 revised the goal of the program to achieve the 50 percent renewable resources target by December 31, 2026, and to achieve a 60 percent target by December 31, 2030. SB 100 also established a further goal to have an electric grid that is entirely powered by clean energy by 2045.

Local

Kern County General Plan Energy Element

The Kern County General Plan Energy Element primarily discusses the County's wealth of existing and potential energy resources which include oil, natural gas, and renewable electricity producer. The Energy Element has three objectives: resource management and protection; establishing development standards to provide for the protection of the environment, public health, and safety; and promoting and facilitating energy development. However, the policies listed in the Energy Element are primarily directed at the County and are municipal policies rather than project specific.

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals, policies, and implementation measures in order to encourage the conservation of energy by reducing impacts of project on air quality. Applicable goals relative to the proposed Project site within these elements are listed in Table 4.7-4, *Metropolitan Bakersfield General Plan Goals and Policies for Air Quality*, below.

Table 4.6-4. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality

Goals and Policies: Air Quality
Conservation/Air Quality Policy #12: "Encourage the use of mass transit, carpooling and other transportation options to reduce vehicle miles traveled."
Conservation/Air Quality Policy #13: "Consider establishing priority parking areas for carpoolers in projects with relatively large numbers of employees to reduce vehicle miles traveled and improve air quality."
Conservation/Air Quality Policy #14: "Establish park and ride facilities to encourage carpooling and the use of mass transit."
Conservation/Air Quality Policy #16: "Cooperate with Golden Empire Transit [GET] and Kern Regional Transit to provide a comprehensive mass transit system for Bakersfield; require large-scale new development to provide related improvements, such as bus stop shelters and turnouts."

Table 4.6-4. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality
Goals and Policies: Air Quality
Conservation/Air Quality Policy #18: "Encourage walking for short distance trips through the creation of pedestrian friendly sidewalks and street crossings."
Conservation/Air Quality Policy #19: "Promote a pattern of land uses which locates residential uses in close proximity to employment and commercial services to minimize vehicular travel."

4.6.4 Impacts and Mitigation Measures

This section describes energy consumption on three sources of energy that are relevant to the proposed project: electricity, natural gas, and transportation fuel for vehicle trips associated with new development, as well as fuel necessary for project construction.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Appendix F does not prescribe a threshold for the determination of significance, but focuses on reducing and minimizing inefficient, wasteful, and unnecessary consumption of energy. Such an impact would occur if the proposed project would:

- Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation.
- Conflict with or obstruct state or local plan for renewable energy or energy efficiency.

The analysis below generally follows Appendix F of the State CEQA Guidelines, which states that the goal of conserving energy includes decreasing overall per capita energy consumption; decreasing reliance on fossil fuels such as coal, natural gas, and oil; and increasing reliance on renewable energy.

Impact Assessment Methodology

In determining whether implementation of the Project would result in the inefficient, wasteful or unnecessary consumption of fuel or energy, this analysis considers the recommendations of Appendix F (as described above), which states that environmental impact analyses of energy conservation may include:

1. The project's energy requirements and its energy use efficiencies by amount and fuel type for each stage of the project's life cycle including construction, operation, maintenance and/or removal. If appropriate, the energy intensiveness of materials maybe discussed.
2. The effects of the project on local and regional energy supplies and on requirements for additional capacity.
3. The degree to which the project complies with existing energy standards.

4. The effects of the project on energy resources.

5. The project's projected transportation energy use requirements and its overall use of efficient transportation alternatives.

This section analyzes energy consumption on three sources of energy that are relevant to the proposed Project: electricity, natural gas, and transportation fuel for vehicle trips associated with new development, as well as the fuel necessary for project construction.

- The analysis of project electricity/natural gas usage is based on California Emissions Estimator Model (CalEEMod) modeling, which quantifies energy use for occupancy. The results of the CalEEMod modeling are included in Appendix "C" (Air Quality and GHG Data) of this Recirculated Draft EIR.

- Modeling related to transportation fuel consumption was based primarily on the default settings in the computer program for Kern County. The amount of operational fuel use was estimated using CalEEMod outputs for the proposed Project and the California Air Resources Board's Emissions Factor 2017 (EMFAC2017) computer program for typical daily fuel usage in Kern County. Construction fuel consumption was calculated based on CalEEMod emissions outputs and conversion ratios from the Climate Registry. The results of EMFAC2017 modeling and construction fuel estimates are included in Appendix "C", Air Quality and GHG Data.

Project Impacts

Impact 4.6-1: The Project Would Result in Potentially Significant Environmental Impact Due to Wasteful, Inefficient, or Unnecessary Consumption of Energy Resources, During Project Construction or Operation.

Construction (Short-Term)

The energy consumption associated with buildout of the proposed Project includes electricity usage, fuel consumption for construction diesel and gasoline powered equipment, and fuel consumption from on-road worker commute and vendor trips. Temporary electric power for as-necessary lighting and electronic equipment (such as computers inside temporary construction trailers, and heating, ventilation, and air conditioning) would be powered by a generator or temporary electricity connection. The amount of electricity used during construction would be minimal; typical demand would stem from the use of electrically powered hand tools and several construction trailers by managerial staff during the hours of construction activities. The majority of the energy used during construction would be from petroleum. The electricity used for construction activities would be temporary and minimal. The methodology for each category is discussed below. This analysis relies in part on the construction equipment list and operational characteristics, as stated in Chapter 4.3 Air Quality) and Chapter 4.8 Greenhouse Gas Emissions, as well as, Appendix C - Air Quality Impact Analysis of this RDEIR. Quantifications of energy consumption are provided for the proposed Project, followed by an analysis of impacts based on those quantifications.

ELECTRICITY USAGE

Water Consumption for Construction Dust Control

Electricity use associated with water use for construction dust control is calculated based on total water use and the energy intensity for supply, distribution, and treatment of water.

The total number of gallons of water usage is calculated based on acreage disturbed during grading and site preparation, as well as the daily water consumption rate per acre disturbed.

- The total acres disturbed are calculated using the methodology described in Chapter 4.2 of Appendix A of the CalEEMod® User's Guide (Grading Equipment Passes).
- The water application rate of 3,020 gallons per acre per day is from Air and Waste Management Association's Air Pollution Engineering Manual.

The energy intensity value is based on the CalEEMod® default energy intensity per gallon of water for Kern County.

As summarized in Table 4.6-5 (Project Energy Consumption During Construction), the total electricity consumption associated with water consumption for construction dust control would be approximately 579,342 kWh (579 megawatt hours [MWh]) over the duration of buildout of the proposed Project.

PETROLEUM FUEL USAGE

On-Road Diesel Construction Trips

The diesel usage associated with on-road construction mobile trips is calculated based on vehicle miles traveled (VMT) from vehicle trips (i.e., worker, vendor, and hauling), the CalEEMod default diesel fleet percentage, and vehicle fuel efficiency in miles per gallon. Fuel consumption is based on VMT for the entire construction period. Construction fuel consumption was calculated based on CalEEMod emissions outputs and conversion ratios from the Climate Registry. The CalEEMod emissions are specific to construction year and include fleet adjustments based on current regulations and equipment turnover.

As summarized in *Table 4.6-5, Project Energy Consumption During Construction*, the total diesel consumption associated with on-road construction trips would be approximately 108,473 gallons over the duration of buildout of the proposed Project. The exact timing and duration of construction phases are currently unknown and would depend on various market factors. As discussed in the Project Description, the Project is planned to be developed in phases over a twenty-five-year period. The modeled construction timing and phasing is conservative, but represents a realistic worst-case scenario. As such, the analysis accounts for minor modifications as project plans evolve from conceptual planning to final mapping. If construction phases start at a later time, or phases have a longer duration, construction fuel consumption would be lower on an annual basis because the

intensity of construction activities would be lower and spread out over a longer period of time. Construction equipment in future years would also be required to comply with more stringent fuel efficiency standards. Project construction fuel demand would have a lower effect on regional energy supplies.

Off-Road Diesel Construction Equipment

Table 4.6-5. Project Energy Consumption During Construction

Source	Project Construction Usage	Kern County Annual Energy Consumption	Percentage Increase Countywide
Electricity Use	**Megawatt Hours (MWh)**		
Water Consumption [a]	579	18,439,672	0.0031%
Construction Electricity Total	**579**		**0.0031%**
Diesel Use	**Gallons**		
On-Road Construction Trips [b]	108,473	311,043,744	0.0349%
Off-Road Construction Equipment [c]	214,975		0.0691%
Construction Diesel Total	**323,448**		**0.1040%**
Gasoline	**Gallons**		
On-Road Construction Trips [b]	105,562	445,151,657	0.0237%
Construction Gasoline Total	**105,562**		**0.0237%**

Notes:
a. Construction water use estimated based on acres disturbed per day per construction sequencing and estimated water use per acre (AWMA 1992).
b. On-road mobile source fuel use based on vehicle miles traveled (VMT) from CalEEMod and fleet-average fuel consumption in gallons per mile from EMFAC2017 in Placer County. Electricity demand based on VMT and calculated average electric vehicle fuel economy for 2015 models (in kWh per mile) from the DOE Fuel Economy Guide.
c. Construction fuel consumption was calculated based on CalEEMod emissions outputs and conversion ratios from the Climate Registry.
Abbreviations:
CalEEMod: California Emission Estimation Model; EMFAC: Emission Factor Model 2017; kWh: kilowatt-hour; MWh: megawatt-hour.
Sources: AWMA, 1992; DOE 2016; USEPA 1996.

The construction diesel usage associated with the off-road construction equipment is calculated based on CalEEMod emissions outputs and conversion ratios from the Climate Registry. In addition, Mitigation Measure 4.3-1 (Air Quality) would require the Project to minimize personnel and public exposure to potential Valley Fever-containing dust both on- and off-site. As summarized in Table 4.6-5, the total diesel consumption associated with off-road construction equipment is approximately 214,975 gallons for duration of buildout the proposed Project.

GASOLINE USAGE

On-Road Gasoline Construction Trips

The gasoline usage associated with on-road construction mobile trips is calculated based on VMT from vehicle trips (i.e., worker, vendor, and hauling), the CalEEMod default gasoline fleet percentage, and vehicle fuel efficiency in miles per gallon using the same methodology as the construction on-road trip diesel usage calculation discussed above. As summarized in Table 4.6-5, the total gasoline consumption associated with on-road construction trips would be approximately 105,562 gallons over the duration of buildout the proposed Project.

CONSTRUCTION ANALYSIS

Construction activities for the proposed Project are needed to grade and modify the approximate 314-acre site for the construction of 22 acres of GC (General Commercial), 108 acres of LI (Light Industrial), 159 acres SI (Service Industrial), and 25 acres of HC (Highway Commercial). Construction would occur over several phases over a twenty-five-year period and energy use is shown in Table 4.6-5 Project Energy Consumption During Construction. Although the specific layout for the proposed uses are unknown, the uses would be in the amount listed above and the approximate construction period used for analysis purposes represents the most conservative construction phasing impacts). Construction would include the use of fuels and electricity to operate equipment and machinery including graders, scrapers, and other earthmoving equipment, employee vehicles needed for transportation to and from the project site, operation of hand tools, and other common equipment used on construction sites.

Large-scale construction activities can consume a substantial amount of electricity, but the exact level of consumption will vary on a case by case basis depending on the nature and extent of the activities. While smaller scale projects will typically incur fewer construction related energy costs, due to the due to increasing transportation costs and fuel prices and the overall increase in expense of energy needed to run machinery and perform necessary tasks, these construction activities strive to be energy efficient, in part, because contractors and owners have a strong financial incentive to avoid wasteful, inefficient, and unnecessary consumption of energy. There is growing recognition among developers and retailers that sustainable construction is not prohibitively expensive, and that there is a significant cost-savings potential in green building practices and materials. Substantial reductions in energy inputs for construction materials can be achieved by selecting building materials composed of recycled materials that require substantially less energy to produce than non-recycled materials. The incremental increase in the use of energy from the proposed Project for construction materials such as asphalt, steel, concrete, pipes, and manufactured or processed materials (e.g., lumber and gas) would not substantially increase demand for energy compared to overall local and regional demand for construction materials. It is reasonable to assume that production of building materials such as concrete, steel, etc., would employ all available and reasonable energy conservation practices in the interest in minimizing the cost of doing business.

As indicated in the environmental setting above, Kern County consumed 18,439,672 MWh of electricity in 2017 (CEC, 2017a). The proposed Project is estimated to consume 579 MWh of electricity through water consumption which would represent approximately 0.0031 percent of the County's electricity use. This consumption would cease upon completion of construction activities. Therefore, it is anticipated that construction electricity consumption associated with the proposed Project would not be inefficient, wasteful, or unnecessary.

Additionally, Kern County consumed approximately 445,151,657 gallons of gasoline and 311,043,744 gallons of diesel fuel over the same time-period. Kern County occupies approximately 8,163 square miles and has a population of 916,464 people. The proposed Project would require the consumption of approximately 579 MWh of electricity, 323,448 gallons of diesel, and 105,562 gallons of gasoline. As described above, the proposed Project's fuel from the entire construction period would increase fuel use in the Kern County by approximately 0.10 percent for diesel and 0.02 percent for gasoline. Based on the total Project's relatively low construction fuel use proportional to

annual State and County use, the Project would not substantially affect existing energy fuel supplies or resources. As noted above, fuel consumption is based on a conservative construction phasing and conservative estimates for annual construction fuel consumption. Longer phases would result in lower construction intensity and a lower annual fuel consumption, resulting in lower annual demand on energy supplies. Additionally, use of construction fuel would cease once the Project is fully developed. Additionally, it can be expected that over the 25-year build-out scenario that equipment and machinery will become more fuel and energy efficient thereby reducing energy consumption over the long term. As such, Project construction would have a nominal effect on the local and regional energy supplies.

Furthermore, there are no unusual project characteristics that would necessitate the use of construction equipment that would be less energy-efficient than at comparable construction sites in the region or state. In addition, some incidental energy conservation would occur during construction through compliance with State requirements that equipment not in use for more than five minutes be turned off. Project construction equipment would also be required to comply with the latest EPA and CARB engine emissions standards. These engines use highly efficient combustion engines to minimize unnecessary fuel consumption. Contractors would be required to minimize air quality emissions of construction activities with MM 4.3-1 (Air Quality).

Therefore, it is anticipated that construction fuel consumption associated with the proposed Project would not be inefficient, wasteful, or unnecessary. The proposed Project would not substantially affect existing energy or fuel supplies, or resources and new capacity would not be required. With the listed mitigation, impacts would be less than significant in this regard.

Operations (Long-Term)

The energy consumption associated with operation of uses pursuant to the proposed Project would include building electricity, water, and natural gas usage, as well as fuel usage from on-road vehicles. The methodology for each category is discussed below. Note that this energy resources analysis is consistent with the analysis presented in Chapter 4.3 Air Quality and Chapter 4.8 Greenhouse Gas Emissions. Quantifications of operational energy consumption are provided for the proposed Project.

PETROLEUM FUEL

The gasoline and diesel usage associated with on-road vehicular trips is calculated based on total VMT from the CalEEMod analyses, as well as the average fuel efficiency from EMFAC2017 model. The EMFAC2017 fuel efficiency data incorporates the Pavley Clean Car Standards and the Advanced Clean Cars Program. As summarized in Table 4.6-6 (Project Annual Energy Consumption During Operations), the total gasoline and diesel consumption associated with on-road trips would be approximately 2,423,099 gallons per year and 2,430,168 gallons per year, respectively.

ELECTRICITY USAGE

The electricity usage associated with operation of the proposed Project is based on CalEEMod defaults for the proposed uses, including, for the 314-acre site for the construction of 22 acres of GC (General Commercial), 108 acres of LI (Light Industrial), 159 acres SI (Service Industrial), and 25

acres of HC (Highway Commercial. As summarized in Table 4.6-6, Project Annual Energy Consumption During Operations, the buildings would increase 26,930 MWh per year.

The electricity usage associated with operational water consumption is estimated based on the default annual water consumption and the energy intensity factor in CalEEMod for Kern County. Project area water use is based on water demand per square foot factors in CalEEMod. The Project would use approximately 594 million gallons annually (571 million gallons for indoor uses and 23 million gallons for outdoor uses) of water annually which would require 3.2 GWh per year for conveyance and treatment. It should be noted that the CalEEMod water consumption estimates are more conservative than the Project water consumption calculated in the Water Supply Assessment (i.e., the Water Supply Assessment noted the project would use 544.5 acre feet per year, which is equivalent to 177 million gallons per year; refer to Section 4.16). Additionally, the proposed Project would require approximately 187.5 acre feet per year less water than the existing uses. Energy usage based on CalEEMod water consumption estimates were used to provide a conservative analysis.

NATURAL GAS USAGE

The methodology used to calculate the natural gas usage associated with the building envelopes constructed pursuant to the proposed Project is based on CalEEMod default usage rates. As summarized in Table 4.6-6 Project Annual Energy Consumption During Operations, the building area would use 55,841,900 thousand British Thermal Units (kBTU) (558,419 therms) of natural gas per year.

Table 4.6-6. Project Annual Energy Consumption During Operations

Source	Project Operational Usage	Kern County Annual Energy Consumption	Percentage Increase Countywide
Electricity Use		**Megawatt Hour/Year (MWh/year)**	
Building [a]	26,930	18,439,672	0.1460%
Water [a]	3,169		0.0172%
Total Electricity	**30,099**		0.1632%
Natural Gas Use		**Therms/year**	
Building [a]	558,419	2,397,138,219	0.0233%
Diesel Use		**Gallons/Year**	
Mobile [b]	2,430,168	311,403,744	0.7804%
Gasoline Use		**Gallons/Year**	
Mobile [b]	2,423,099	445,151,675	0.544

Notes:
a. The electricity, natural gas, and water usage are based on project-specific estimates and CalEEMod defaults.
b. Calculated based on the mobile source fuel use based on vehicle miles traveled (VMT) and fleet-average fuel consumption (in gallons per mile) from EMFAC2017. For electric vehicles, model year 2015 electric vehicle fuel economy is used from the DOE Fuel Economy Guide.

Abbreviations: CalEEMod: California Emission Estimation Model; EMFAC2017: California Air Resources Board Emission Factor Model; kBTU: thousand British Thermal Units; kWh: kilowatt-hour; MWh: Megawatt-hour.

ANALYSIS

Operation of uses implemented pursuant to the proposed Project would consume approximately 30,099 MWh of electricity and 558,419 therms of natural gas annually. Project operations would consume approximately 2,430,168 gallons of diesel, and 2,423,099 gallons of gasoline.

Kern County consumed 18,439,672 MWh of electricity in 2017 (CEC, 2017a). The proposed Project's operational electricity consumption would represent 0.16 percent of the energy consumption in Kern County. Regarding natural gas, Kern County consumed 2,397 million therms (or 239,714 million kBTU) of natural gas in 2017. Therefore, the proposed Project's operational natural gas consumption would represent 0.02 percent of the natural gas consumption in the County.

In 2018, Californians consumed approximately 15,589,042,965 gallons of gasoline and approximately 3,107,823,655 gallons of diesel fuel. Kern County annual gasoline fuel use in 2018 was 445,151,675 gallons and diesel fuel use was 311,403,744 gallons. Expected proposed Project operational use of gasoline and diesel would represent 0.54 percent of current gasoline use and 0.78 percent of current diesel use in the County.

None of the project energy uses exceed one percent of Kern County use. Therefore, proposed Project operations would not substantially affect existing energy or fuel supplies or resources. The Project would comply with applicable energy standards and new capacity would not be required. Impacts would be less than significant in this regard.

ENERGY EFFICIENCY MEASURES

Mitigation Measure 4.6-1 requires the proposed Project to be designed to include various design features that would improve energy efficiency but at this time, the exact level of design and implementation is not yet know. This is due in part because the final designs of the proposed Project have not been developed and over the expected twenty-five year and it is not known what technology will be available. Over the life of project construction, the proposed Project would promote and encourage green building practices to and to encourage innovative and sustainable design and construction techniques that reduce energy consumption. Therefore, benefits associated with these have not been quantified, which provides a conservative (or "worst case") estimate of impacts

As discussed above, California's Energy Efficiency Standards for Non-Residential Buildings create uniform building codes to reduce California's energy consumption, and provide energy efficiency standards for residential and non-residential buildings. These standards are incorporated within the California Building Code and are expected to substantially reduce electricity and natural gas use. For example, requirements for energy efficient lighting, heating and cooling systems, and green building materials are expected to save additional electricity and natural gas. These savings are cumulative, doubling as years go by. The proposed Project includes MM-4.6-1, which includes energy conservation and design features such as encouraging solar panel installation, including bicycle friendly features, installing LED lights, and including electric vehicle (EV) charging stations.

Title 24 measures would be used to minimize overall energy consumption. Renewable energy generation would be required and shortfalls in renewable energy generation can be offset with excess renewable energy generation from other buildings. Regarding water energy conservation, the proposed Project would incorporate water-conserving landscaping on the site and reduce lawn and turf areas. Water-efficient irrigation controls would also be used in landscape areas as well as recycled water for irrigation. Buildings would incorporate water-efficient fixtures and appliances, to comply with Title 24.

Furthermore, the electricity provider, PG&E, is subject to California's Renewables Portfolio Standard (RPS). The RPS requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33 percent of total procurement by 2020 and to 50 percent of total procurement by 2030. SB 100 revised the goal of the program to achieve the 50 percent renewable resources target by December 31, 2026, and to achieve a 60 percent target by December 31, 2030. SB 100 also established a further goal to have an electric grid that is entirely powered by clean energy by 2045. Renewable energy is generally defined as energy that comes from resources which are naturally replenished within a human timescale such as sunlight, wind, tides, waves, and geothermal heat.

Mitigation Measures

MM 4.6-1: The proposed Project, shall to the extent feasible and to the satisfaction of the Kern County Planning Department incorporate the following energy conservation and design features to reduce the level of energy consumption of the proposed Project. The following list is non-inclusive of all potential mitigation that may be included and may be added to at the discretion of Kern County as new technologies become available and feasible to be incorporated:

- Solar photovoltaics (PV) mounted on proposed structure's roofs to provide a portion of the future electrical demand and offset emissions from fossil fuel fired power plants. Encourage green building measures that contribute to reducing energy use to 25% less than Title 24 requirements;
- Solar water heating to provide non-industrial water heating;
- Ground mounted solar PV arrays to provide a portion of the estimated electrical demand for the proposed Wastewater Treatment and Recycle Facility;
- Commercial buildings shall be designed to meet LEED Silver standards;
- Roofs on all buildings shall be of a light color to reduce heat generation;
- Portions of parking lots (drive aisles) may be paved with concrete versus asphalt to reduce initial solar reflectance;
- Depending on the usage, portions of parking lots may be covered, and the parking lot roofs contain solar PV;
- Use LED lighting fixtures on all public streets and site lighting;
- Include dedicated EV parking at a rate more than required by current codes;
- Include EV charging facilities to encourage the usage of electric vehicles;
- Encourage the utilization of electric forklifts and other material handling vehicles to reduce usage of fossil fuels;

- Design circulation features into the public street improvements to include bus stops and/or other public transportation.
- Include bicycle friendly features to reduce Vehicle Miles Traveled (VMT) and to encourage non-vehicular transportation;
- Encourage the usage of high efficiency electric motors for the industrial uses and the wastewater treatment plant.

Level of Significance after Mitigation

As discussed above, the proposed Project would be required to adhere to all Federal, State, and Local requirements for energy efficiency, including the latest Title 24 standards. Considering these requirements in addition mitigation measure 4.6-1 described above, the Project would not result in the inefficient, wasteful, or unnecessary use of building energy. Therefore, potential impacts are less than significant.

Impact 4.6-2: The Project Would Conflict with or Obstruct State or Local Plan for Renewable Energy or Energy Efficiency.

At of the time of this writing, the Kern County does not have an adopted Energy Plan. Kern County does have an Energy Element in their General Plan, but focuses primarily on the County's energy resources and municipal measures such as encouraging the County to seek State and federal energy grants, have discussions with various energy industries, and developing long-term compensation for wildlife habitat to name a few. The proposed Project design conforms to, and operation would comply with, State Building Energy Efficiency Standards, appliance efficiency regulations, and green building standards. Conformance to the State requirements would substantially reduce the energy consumption from fossil fuels and shift consumption to renewable sources. MM 4.6-1 requires design features such as incorporating passive solar design, heat island mitigation, energy efficient low voltage lighting, and encouraging electric forklifts and other material handling vehicles to name a few. Additionally, implementation of the identified mitigation measures to reduce GHG emissions by 29 percent (MM 4.3-1) would further reduce energy consumption.

The proposed Project would not conflict with or obstruct the implementation of any state or local plan for renewable or energy efficiency. Implementation of the proposed Project would not conflict with existing energy standards, including standards for energy conservation. However, approval of and future implementation of the proposed Project would increase electricity demand over baseline conditions in the County. Electric and natural gas services are provided upon demand from consumers and consistent with local, state, and federal regulations, these services are expanded based on demand. As discussed above in Impact ER-1, development of the proposed Project would not cause inefficient, wasteful or unnecessary energy use, and impacts would be less than significant. Therefore, the project would not conflict with or obstruct state or regional plans and impacts would be less than significant.

Mitigation Measures

Implement Mitigation Measures MM 4.3-1, as described in Section 4.3, *Air Quality*; MM 4.6-1, as described in Section 4.6, *Energy.*

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Construction and operation associated with implementation of the proposed Project would result in the consumption of fuel and energy, but it would not do so in a wasteful manner, as discussed above. The consumption of fuel and energy would not be substantial in comparison to statewide electricity, natural gas, gasoline, and diesel demand; refer to Table 4.6-5 and Table 4.6-6. New capacity or supplies of energy resources would not be required. Additionally, the proposed Project would be subject to compliance with all Federal, State, and local requirements for energy efficiency.

The anticipated project impacts, in conjunction with cumulative development in the site vicinity, would increase urbanization and result in increased energy consumption. Potential land use impacts are site-specific and require evaluation on a case-by-case basis. Each cumulative project would require separate discretionary approval and CEQA assessment, which would address potential energy consumption impacts and identify necessary mitigation measures, where appropriate.

As noted above, the proposed Project would not result in significant energy consumption impacts. The proposed Project would not be considered inefficient, wasteful, or unnecessary with regard to energy. Thus, the proposed Project and identified cumulative projects are not anticipated to result in a significant cumulative impact.

Mitigation Measures

Implement Mitigation Measures MM 4.3-1, as described in Section 4.3, *Air Quality*; MM 4.6-1, as described in Section 4.6, *Energy.*

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.7

Geologic and Seismic Hazards

Section 4.7
Geologic and Seismic Hazards

4.7.1 Introduction

The purpose of this section is to describe the geologic and seismic setting of the proposed Project area, identify potential impacts associated with implementation of the proposed Project and recommend mitigation to reduce the significance of impacts. The issues addressed in this section are risks associated with faults, strong seismic ground shaking, seismic-related ground failure such as liquefaction, landslides, subsidence and earthquake induced dam failure and flooding. A Hazardous Materials Evaluation was prepared by McIntosh & Associates in November 2008 (refer to Appendix N) to address hazardous materials and conditions on the Project site. A subsequent Hazardous Materials Evaluation was prepared by McIntosh & Associates in July 2017. Although these evaluations do not directly address seismic hazards, some of the information is relevant to this section and included in the discussion below. See Appendix F, *Hazardous Materials Evaluation*, and Appendix N, *Original Technical Studies.*

4.7.2 Environmental Setting

Regional Geologic Setting

The proposed Project is located in the Great Valley Geomorphic Province of California, which is an alluvial plain, about 50 miles wide and 400 miles long, between the Coast and Sierra Nevada Mountain Ranges. The Great Valley is drained by the Sacramento and San Joaquin rivers, which ultimately drain in the San Francisco Bay. The Great Valley is a northwesterly trending trough filled with approximately 40,000 feet of sediments deposited by the surrounding mountains. Streams flowing from the Sierra Nevada to the west have formed alluvial fans at the surface. The Kern River fan is the largest, covering about 300 square miles of the Valley, beginning as an incised channel north of downtown Bakersfield.

Local Geologic Setting

Geologic Structure

According to the United States Geological Survey (USGS) 7.5-Minute Topographic Quadrangle Maps, Gosford and Conner, California (1954, photorevised 1968, photoinspected 1973) the topography of the proposed Project site is relatively level, sloping southwesterly at an average rate of approximately 7.5 feet per mile, at an elevation ranging from approximately 331 to 340 feet above mean sea level (msl).

The Project site rests on alluvial fan deposits of Holocene (Recent) age, having been deposited on this part of the valley floor during the last 11,000 years. Near surface soils within the proposed Project area consist of interbedded sand, silt, gravels and clay overlying marine and continental sedimentary formations, which rest on a crystalline basement complex. This basement complex is estimated to

underlie the proposed Project at approximately 12,000 feet below the surface layer (McIntosh & Associates, 2017).

Soils

The following information regarding soils is based on the Custom Soil Survey of Kern County, California, Southwestern Part prepared by the United States Department of Agriculture (USDA), the Farmland Conversion Study, and the Hazardous Materials Evaluation. The proposed Project is entirely underlain by the Bakersfield fine sandy loam, drained, 0 to 1 percent slopes and Cajon sandy loam series, 0 to 2 percent slopes, overwash. The following are brief descriptions of the soil types on-site:

Bakersfield fine sandy loam, drained, 0 to 1 percent slopes: This soil is very deep, poorly drained on alluvium weathered from granite. The soil was derived predominately from granitic rock at elevations generally from 300 to 475 feet. Permeability is moderately slow, runoff is slow, available water capacity is high and the hazard of water erosion is slight and wind erosion is moderate. The shrink-swell potential is low and the corrosivity class is high for steel and moderate for concrete. The soil occurs on approximately 60 percent of the proposed Project site.

Cajon sandy loam, 0 to 2 percent slopes, overwash: This soil is deep, somewhat excessively drained on sandy alluvium dominantly granitic rocks. The soil was derived predominately from granitic sources at elevations generally from 320 to 400 feet. Permeability is moderate, available water capacity is low, runoff is very slow, and the hazard of water erosion is slight and wind erosion is severe. The shrink-swell potential is low and the corrosivity class is high for steel and low for concrete. The soil occurs on approximately 40 percent of the proposed Project site, traversing the middle of the site from the northeast corner to the southwest corner.

Faults

A fault is a fracture in the crust of the earth along which land on one side has moved relative to land on the other side. Most faults are the result of repeated displacements over a long period of time. A fault trace is the line on the earth's surface defining the fault.

An active fault is defined by the State Mining and Geology Board as a fault that has "had surface displacement within Holocene times (about the last 11,000 years)." This definition does not mean that faults lacking evidence of surface displacement within Holocene times are necessarily inactive. A fault may be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity is sometimes difficult to obtain and locally may not exist. A potentially active fault is a fault that shows evidence of surface displacement during Quaternary time (last 1.6 million years).

The Alquist-Priolo Earthquake Fault Zoning Act, passed in 1972, is primarily intended to prevent the construction of buildings used for human occupancy on the surface traces of active faults. The Act addresses only the hazard of surface fault rupture and not other earthquake hazards. The law required the State Geologist to establish regulatory zones known as "Earthquake Fault Zone" around the surface traces of active faults and to issue appropriate maps.

There are numerous geologic fractures in the earth's crust within the San Joaquin Valley, with the San Andreas Fault being the most prominent. Other fault systems occur in the Bakersfield region, as in most of California, due to the continual and historical convergence of the continental plates. Several active fault systems are located within a 50-mile radius of the proposed Project site (refer to Figure 4.7-1, *Fault Locations Map*). They include the Garlock Fault, located approximately 35 miles to the southeast, the Breckenridge-Kern Canyon Fault located approximately 30 miles to the northeast, the White Wolf Fault located approximately 12 miles to the south and the Pond Poso Fault located approximately 20 miles to the north of the proposed Project site.

White Wolf Fault

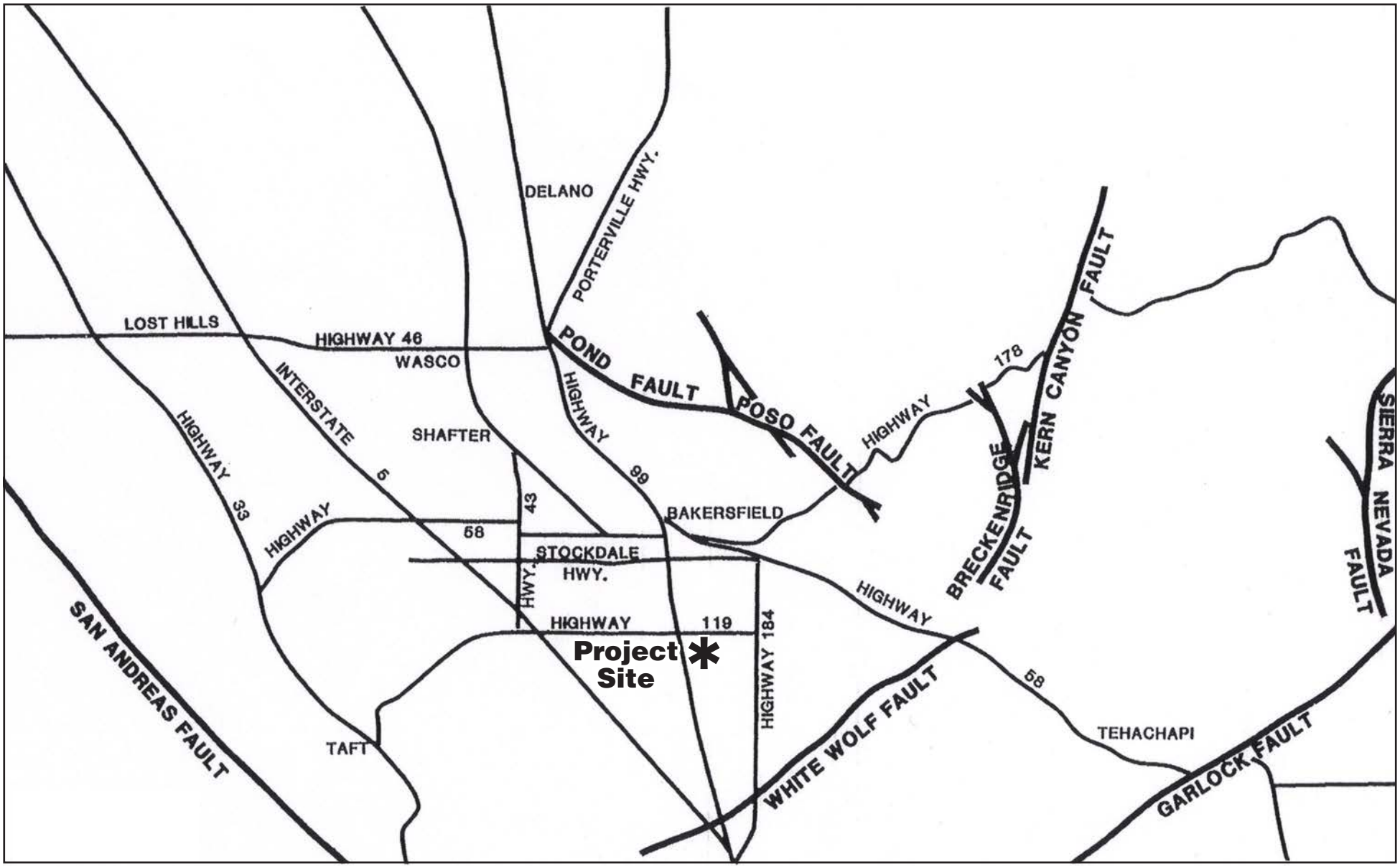
The White Wolf fault is a southeast dipping, left-lateral, oblique, reverse fault with a length of approximately 45 miles. This fault is located approximately 6 miles south of the Project site and traverses the southeastern end of the San Joaquin Valley, from Wheeler Ridge to northeast of Caliente. On July 21, 1952, the White Wolf fault ruptured, producing an earthquake of magnitude 7.5 and subsequently an extensive sequence of aftershocks. Although surface rupture formed along only 17 miles of the surface trace of this fault, rupture probably occurred along most of its length. The magnitude 7.5 of 1952 on the White Wolf Fault has been the only event in historic time. Significant features caused by the fault are the valley at the junction of Highways 58 and 223 (sometimes called "White Wolf Valley"), and the Arvin cutoff along State Route 223. This fault has been designated by the State as an Alquist-Priolo Special Studies Zone.

Breckenridge-Kern Canyon Fault

The Breckenridge-Kern Canyon fault is located in the southern Sierra Nevada Mountains, approximately 25 miles east of the Project site. It trends northward from the north end of Walker Basin to the north of Mount Whitney, a distance of approximately 100 miles. Uncertainty exists as to the degree of activity of this fault system and its classification. It is designated as active with a maximum credible earthquake of 8.0. This fault is capable of damaging the Bakersfield area. Areas along this fault have been designated by the State as Alquist-Priolo Special Studies Zones.

Pond Poso Fault

The Pond Poso Fault is located approximately 19 miles north of the Project site. It trends in a northwesterly direction. The Pond Poso Fault consists of four parallel breaks, forming a zone approximately two-thirds of a mile wide. This fault is designated as active with a maximum credible earthquake of 7.0. This is an active fault capable of damaging the Bakersfield area. Areas along the Pond Poso Fault have been designated by the State as Alquist-Priolo Special Studies Zones.



Source: Metropolitan Bakersfield, General Plan, December 11, 2002.

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AGRICULTURAL PRESERVE #13 EXCLUSION

Fault Locations Map

Figure 4.7-1

San Andreas Fault

The San Andreas Fault is located approximately 30 miles southwest of the Project site. The fault is approximately 650 miles in length, reaching from the Mendocino Escarpment on the north to the Imperial Valley to the south. Along this extent, the San Andreas is considered to be the boundary between the North American Plate and the Pacific Plate. The segment of the San Andreas within Kern County is relatively short compared to its 650-mile length. However, it is important, since this segment breaks from the system's predominantly 350-degrees trending direction between the San Luis Obispo and Los Angeles County lines. The last great earthquake on this segment was the 1857 Fort Tejon earthquake, which is believed to have caused a rupture extending 200 miles or more. Geologists consider this fault as having the potential to generate an earthquake of magnitude 8.3 on the Richter scale, which is designated as the maximum credible earthquake. This is an active fault capable of damaging the proposed Project area. Areas along this fault have been designated by the State as Alquist-Priolo Special Studies Zones.

Garlock Fault

The Garlock fault extends eastward from its point of intersection with the San Andreas Fault, near Lebec, for a distance of approximately 150 miles. The fault is located approximately 30 miles southeast of the Project site. The Garlock fault zone is one of the most obvious geologic features in southern California, clearly marking the northern boundary of the area known as the Mojave Block, as well as the southern ends of the Sierra Nevada's and the valleys of the westernmost Basin and Range province. While no earthquake has produced surface rupture on the Garlock fault in historic times, there have been a few sizable quakes recorded along the Garlock fault zone. The most recent was a magnitude 5.7 near the town of Mojave on July 11, 1992. It was believed to have been triggered by the Landers earthquake, just two weeks earlier. At least one section of the fault has shown movement in recent years. This is an active fault capable of damaging the area. The slip rate is listed by the Southern California Earthquake Data Center to be between 2 and 11 millimeters per year (mm/yr), but averages approximately 7 mm/yr. Areas along this fault have been designated by the State as Alquist-Priolo Special Studies Zones.

Other Significant Faults

Other major fault systems in or near the Bakersfield area consist of the Sierra Nevada, Edison, and Kern Front systems.

Seismic Hazards

Seismicity is the geographic and historical distribution of earthquakes, including their frequency, intensity, and distribution. Seismic hazards include surface rupture, ground shaking, liquefaction, landslides, subsidence, expansive soils, and soils and soil erosion.

As described above, the southern end of the San Joaquin Valley is bordered by major active fault systems, making Kern County a historically active seismic area. To evaluate the effect a major earthquake might have on the site, the Metropolitan Bakersfield General Plan indicates which faults have been identified in the vicinity of Bakersfield capable of causing damage to the Bakersfield area; refer to Table 4.7-1, *Possible Damage Inducing Faults*.

Table 4.7-1. Possible Damage Inducing Faults

Fault	Approximate Distance from Project Site (mi)	Maximum Earthquake Magnitude	Maximum Credible Bedrock Acceleration (g)
San Andreas	30	8.0-8.3	0.2-0.25
Sierra Nevada	60	6.5-8.25	0.07-0.12
Garlock	35	7.5-8.0	0.17-0.18
Breckenridge-Kern Canyon	30	6.0-8.0	0.09-0.47
White Wolf	12	7.5-8.0	0.28-0.45
Pond Poso	20	7.0	0.31-0.48

Source: Metropolitan Bakersfield General Plan EIR, June 26, 2002.
Approximate Distance from Project Site is measured in miles (mi)
Maximum Credible Bedrock Acceleration is measured in terms of gravitation force (g)

Table 4.7-1 indicates that a maximum peak ground acceleration of 0.48g would be felt at the proposed Project site as a result of a maximum earthquake of magnitude 7.0 on the Pond Poso Fault approximately 20 miles away. A maximum probable earthquake of magnitude 8.0 on the White Wolf Fault would create a maximum credible bedrock acceleration of 0.45g at the Project site. A maximum probable earthquake of magnitude 8.3 on the San Andreas Fault would create a peak site ground acceleration of 0.25g at the proposed Project site. Due to the numerous geologic fractures in the earth's crust within the San Joaquin Valley, all development within the Metropolitan Bakersfield area is subject to seismic hazards.

Fault Rupture

Surface rupture occurs when movement on a fault deep within the earth breaks through to the surface. Fault ruptures almost always follow pre-existing faults that are zones of weakness. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. Sudden displacements are more damaging to structures because they are accompanied by shaking. Fault creep is the slow rupture of the earth's crust. It is not likely that rupture would occur at the Project site because it is not located within 500-feet of a known active fault trace.

Ground Shaking

The southern California region is characterized by, and has a history of, faults and associated seismic activity. Earthquakes are classified by their magnitude, a measure of the amount of energy released during an event. During a seismic event, the proposed Project site may be subjected to high levels of ground shaking due to its proximity to active faults in the area. As explained above, several significant, active faults are in the vicinity of the proposed Project, including the San Andreas, Pond Poso, and White Wolf faults. The Project is not in the Alquist-Priolo Earthquake Fault Zones of any of these faults. The largest of these faults is San Andreas Fault, which is considered active. The maximum probable and credible earthquake magnitude near the proposed Project area would come from the San Andreas Fault at a magnitude 8.3 on the Richter scale. The maximum bedrock acceleration at the proposed Project site due to an earthquake from the San Andreas Fault is 0.25 times the rate of acceleration due to gravity.

Liquefaction

Liquefaction occurs when saturated, loose materials (e.g., sand or silty sand) are weakened and transformed from a solid to a near-liquid state due to increased pore water pressure. The increase in pressure is caused by strong ground motion from an earthquake. The proposed Project's susceptibility to liquefaction is a function of depth, density, and groundwater level, in addition to the magnitude of an earthquake. Liquefaction-related phenomena can include lateral spreading, ground oscillation, flow failure, loss of bearing strength, subsidence, and buoyancy effects.

The surficial soils described above consist generally of medium-dense sands and gravels. For liquefaction to occur, the soil must be saturated (i.e., shallow groundwater), and the soil must be relatively loose. Properly compacted structural fills are not susceptible to liquefaction, and the risk of liquefaction and associated lateral spread and/or ground lurching is low for areas within the proposed Project area.

Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. Liquefaction is caused by a sudden temporary increase in pore water pressure due to seismic densification or other displacement of submerged granular soils. Liquefaction more often occurs in areas underlain by young alluvium where the groundwater table is higher than 50 feet below ground surface (bgs). According to the Metropolitan Bakersfield General Plan, the proposed Project is not likely to be located within an area of high groundwater and loose soils. The depth to water at the Project site is approximately 165-175 feet bgs; therefore, the proposed Project is not anticipated to be located within an area of high groundwater (McIntosh & Associates, 2017).

Landslides and Rockfalls

Landslides are large movements of land downgradient. They can be induced by seismic events or wet, saturated soil conditions and can cause significant damage to life and property. The proposed Project area is flat and not susceptible to landslides.

The proposed Project is located on relatively flat topography and is not located adjacent to any steep slopes or areas that would otherwise be subject to landslides, debris flow and/or rockfall. According to the Metropolitan Bakersfield General Plan, the areas of Metropolitan Bakersfield with slopes subject to failure are predominantly found along the river terraces, bluffs and foothills to the northeast and east of the City of Bakersfield.

Subsidence

Land subsidence is the gradual, local setting or shrinking of the earth's surface with little or no horizontal motion. Subsidence is normally the result of gas, oil or water extraction, hydrocompaction, peat oxidation and not the result of landslide or ground failure. The Metropolitan Bakersfield General Plan has indicated that although subsidence is not a significant hazard, damage to wells, foundations and underground utilities may occur.

Due to the petroleum and groundwater withdrawal activities throughout Kern County, the potential for subsidence to occur exists. The amount of petroleum withdrawal in Kern County is too small an

amount to result in serious subsidence. The State Division of Oil, Gas and Geothermal Resources monitors subsidence in oil and gas fields and regulates oil and gas withdrawal and repressurizing of the field. If subsidence is noted, remediation is accomplished by raising the water table by injecting water or reducing the volume of groundwater being pumped. The remediation activities ensure that no significant impacts from subsidence would occur.

Dam Failure

Isabella Dam is located approximately 40 miles northeast of Bakersfield (approximately 45 miles from the proposed Project) and is built near a major earthquake fault. Isabella Dam is earth-filled and is approximately 185 feet high, 1,725 feet long, and can hold 570,000 acre-feet of water.

If an earthquake were to occur near Isabella Dam, it could result in a break in the dam. This could cause the entire lake storage to be released, which would flood 60 square miles of Bakersfield. The Metropolitan Bakersfield General Plan indicates the chances of the dam failing entirely, with the lake at capacity, was judged as one day in 10,000 years.

Flooding

The proposed Project is located in an area of potential surface waters and it is possible that some flooding would occur at this site during a major earthquake from an upstream catastrophe, such as a dam collapse. The proposed Project is located within the Federal Emergency Management Agency Flood Insurance Rate Map Zone X. Flood Zone X contains areas of minimal flooding. Therefore, the proposed Project is outside the 0.2 percent annual chance floodplain.

Expansive Soils

Expansive soils generally result from specific clay minerals that expand in volume when saturated and shrink in volume when dry. The presence of this soil type can damage structures when expansion and contraction of soil cracks rigid building materials (i.e., concrete, wood, drywall, etc.). The proposed Project area's substrate is mapped as Bakersfield fine sandy loam and Granoso sandy loam.

4.7.3 Regulatory Setting

Geologic resources and geotechnical hazards are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for the protection of geologic features and avoidance of hazards.

The California Environmental Quality Act (CEQA) is the major environmental statute that guides the design and construction of projects on non-Federal lands in California. This statute sets forth a specific process of environmental impact analysis and public review. In addition, the project proponent must comply with other applicable State and local applicable statutes, regulations and policies. Relevant and potentially relevant statutes, regulations, and policies are discussed below.

Federal

International Building Code (IBC)

Related to the proposed Project, the International Building Code (IBC), applies to the construction, use and occupancy, location, and maintenance of buildings and structures that would be constructed after project approval. Title 24 of the California Building Code (CBC) incorporates by adoption the 2015 IBC of the International Code Council (ICC) with necessary California amendments. The adoption of the IBC and relation to the CBC is discussed in additional detail under the State regulatory setting below. These development standards require the proposed Project to comply with appropriate seismic design criteria found in the IBC, adequate drainage facility design, and preconstruction soils and grading studies. Seismic design standards have been established to reduce many of the structural problems occurring because of major earthquakes, the significant design code and construction standards include:

- Upgrade the level of ground motion used in the seismic design of buildings;
- Add site amplification factors based on local soils conditions; and
- Improve the way ground motion is applied in detailed design.

Section 1613 of the IBC references modern earthquake construction standards and includes the American Society of Civil Engineers (ASCE) minimum design loads standard, specifically ASCE Standard 7, which bases seismic design on-site class (soil specific) and seismic design category (based on risk category).

Clean Water Act (CWA)

The Clean Water Act (CWA) (33 U.S.C. Section 1251 et seq.), formally the Federal Water Pollution Control Act of 1972, was enacted with the intent of restoring and maintaining the chemical, physical, and biological integrity of the waters of the United States. The CWA requires states to set standards to protect, maintain, and restore water quality through the regulation of point source and certain non–point source discharges to surface water. Those discharges are regulated by the National Pollutant Discharge Elimination System (NPDES) permit process (CWA Section 402). Projects that disturb one or more acre of land are required to obtain NPDES coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (General Permit), State Water Resources Control Board Order No. 2009-0009-DWQ. The General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP), which includes Best Management Practices (BMPs) to protect stormwater runoff. Requirements of the Federal CWA and associated SWPPP requirements are described in further detail in Section 4.10, *Hydrology and Water Quality*.

Earthquake Hazards Reduction Act

The National Earthquake Hazards Reduction Program (NEHRP) was established by the U.S. Congress when it passed the Earthquake Hazards Reduction Act of 1977, Public Law (P.L.) 95–124. At the time of its creation, Congress' stated purpose for NEHRP was "to reduce the risks of life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program." Congress recognized that earthquake-related losses could be reduced through improved design and construction methods and practices, land use

controls and redevelopment, prediction techniques and early-warning systems, coordinated emergency preparedness plans, and public education and involvement programs. Since NEHRP's creation, it has become the federal government's coordinated long-term nationwide program to reduce risks to life and property in the United States that result from earthquakes. Four basic NEHRP goals are as follows:

- Develop effective practices and policies for earthquake loss reduction and accelerate their implementation
- Improve techniques for reducing earthquake vulnerabilities of facilities and systems
- Improve earthquake hazards identification and risk assessment methods, and their use
- Improve the understanding of earthquakes and their effects.

Congress has recognized that several key federal agencies can contribute to earthquake mitigation efforts. Today, there are four primary NEHRP agencies:

- Federal Emergency Management Agency (FEMA) of the Department of Homeland Security.
- National Institute of Standards and Technology (NIST) of the Department of Commerce (NIST is the lead NEHRP agency).
- National Science Foundation (NSF).
- USGS of the Department of the Interior.

Congress completed a review of NEHRP, resulting in the NEHRP Reauthorization Act of 2004, PL 108–360. PL 108–360 directed that NEHRP activities be designed to develop effective measures for earthquake hazard reduction; promote the adoption of earthquake hazards reduction measures by government agencies, standards and codes organizations, and others involved in planning and building infrastructure; improve the understanding of earthquakes and their effects through interdisciplinary research; and, develop, operate, and maintain both the Advanced National Seismic System (ANSS) and the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES). In a major new initiative, PL 108–360 also directed that NEHRP support development and application of performance-based seismic design (PBSD).

State

California Building Code (CBC 2016)

The State of California provides minimum standards for building design through the California Building Code (CBC). The CBC is based on the International Building Code (IBC), which is used widely throughout the United States (generally adopted on a state-by-state or district-by-district basis) and has been modified for conditions within California. Starting in 1989, revised editions of California Code of Regulations (CCR) Title 24 has been published every three years. The 2016 edition of the CBC is based on the 2015 IBC published by the International Code Council. The current version of the CBC became effective January 1, 2017. Local agencies must ensure that development in their jurisdictions complies with guidelines contained in the CBC. Cities and counties can, however, adopt building standards beyond those provided in the code.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) was passed in 1972 to regulate development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. Under the Alquist-Priolo Act, the California State Geologist (CSG) identifies areas that are at risk of surface fault rupture. The primary purpose of the Alquist-Priolo Act is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. An active fault is defined by the State Mining and Geology Board (SMGB) as one which has "had surface displacement within Holocene time (about the last 11,000 years)." The CSG, previously known as the California Division of Mines and Geology (CDMG), has compiled Special Publication 42 – Fault Rupture Hazard Zones that delineates and defines active fault traces and zones that require specific studies to address rupture hazards with respect to "structure[s] for human occupancy." Any project that involves the construction of buildings or structures for human occupancy is subject to the Alquist-Priolo Act, and any structures for human occupancy must be located at least 50 feet from any active fault.

Seismic Hazards Mapping Act of 1990

In accordance with Public Resources Code, Chapter 7.8, Division 2, the CGS, formerly CDMG, is directed to delineate Seismic Hazard Zones through the Seismic Hazards Zonation Program. The purpose of the Act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards, such as those associated with strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. Cities, counties, and State agencies are directed to use seismic hazard zone maps developed by CGS in their land-use planning and permitting processes. In accordance with the Seismic Hazards Mapping Act, site-specific geotechnical investigations must be performed prior to permitting most urban development projects within seismic hazard zones.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan Safety Element has identified various implementation programs with respect to fault rupture. These programs specify various requirements, including:

- Detailed geologic investigations are to be conducted, in conformance with guidelines of the California Division of Mines and Geology (CDMG), for all construction designed for human occupancy in an Alquist-Priolo Fault Study Zone;
- Construction of buildings for human occupancy within 50 feet of the trace of an active fault is prohibited;
- Plans and permits for installation of major lifeline components such as highways, utilities and petroleum or chemical pipelines are to incorporate design features to accommodate potential fault movement in areas of active faults without prolonged disruption of an essential service or threat to health and safety;

- Field information is to be developed as part of any California Environmental Quality Act (CEQA) investigations, and geologic reports by the City and County geologists should be kept current and accessible for use in report preparation, geologic reviews, and policy development.

Active faults may potentially exist outside of the Special Studies Zones. As a result, development of critical and important facilities proposed outside of these zones would require additional fault investigation. The Safety Element has specified a policy that requires that the development of critical facilities be supported by documentation of thorough hazard investigation. Critical facilities are defined by the California Seismic Safety Commission as the following three basic types of facilities:

- "Essential facilities," whose continued functioning is necessary to maintain public health and safety following a disaster. These facilities include fire and police stations, communication facilities, emergency operation centers, hospitals, administrative buildings and schools designated as mass care shelters. Also included are key transportation facilities and utility "lifeline" facilities such as water supply, sewage disposal, oil and gas storage facilities and transmission lines and electric generation stations and transmission lines.
- Those facilities where damage or failure could pose hazards to life and property well beyond their immediate vicinity. This category includes such facilities as dams and reservoirs, petroleum storage facilities and nuclear waste processing and storage facilities.
- Public or private structures for housing or assembly of large populations, where failure could pose hazards to life and property within the structures and in their immediate vicinity. These high-occupancy facilities include schools, prisons, coliseums, theaters, conference and convention facilities, high-rise buildings, and similar facilities used by large numbers of people.

Further, the Safety Element of the Metropolitan Bakersfield General Plan has identified various implementation programs to be carried out by the City and County affecting seismic safety of critical facilities. These programs include:

- Detailed site studies for fault rupture potential are to be conducted as background to the design process for critical facilities under City and County discretionary approval.
- Existing critical facilities are to be reviewed for any significant siting, design or construction problems that would make them vulnerable in an earthquake;
- The findings shall be incorporated into emergency operations plans as well as addressed in longer-term programs of facilities upgrading or relocation; and
- Construction of critical facilities is prohibited within 300 feet of the trace of an active fault.

The Metropolitan Bakersfield General Plan sets forth goals and policies to ensure public safety during seismic events and potential geologic effects, including liquefaction and subsidence. The applicable goals and policies are discussed in Table 4.7-2, *Metropolitan Bakersfield General Plan Goals and Policies for Geologic and Seismic Hazards*, below.

Table 4.7-2. Metropolitan Bakersfield General Plan Goals and Policies for Geologic and Seismic Hazards
Goals and Policies: Safety Element - Seismic
Goal 1: Substantially reduce the level of death, injury, property damage, economic and social dislocation and disruption of vital services that would result from earthquake damage.
Goal 2: Ensure the availability and effective response of emergency services following an earthquake.
Goal 3: Prepare the Planning area for effective response to, and rapid, services following an earthquake.
Goal 7: Protect land uses from the risk of dam failure inundation including the assurances that: the functional capabilities of essential facilities are available in the event of a flood; hazardous materials are not released; effective measures for mitigation of dam failure inundation are incorporated into the design of critical facilities; and the rapid and orderly evacuation of populations in the inundation area will occur.
Policy 7: Continue to address seismically hazardous buildings pursuant to Chapter 12.2 (8875 et. Seq.), Division 1 of Title 2 of the Government Code.
Policy 8: Require seismic review of other potentially hazardous buildings upon any change in their use or occupancy status.
Policy 9: Adopt and maintain high standards for seismic performance of buildings, through prompt adoption and careful enforcement of the most current seismic standards of the Uniform Building Code.
Policy 10: Prohibit development designed for human occupancy within 50 feet of a known active fault and prohibit any building from being placed astride an active fault.
Policy 11: Require site-specific studies to locate and characterize specific fault traces within an Alquist-Priolo Earthquake Fault Zone for all construction designed for human occupancy.
Policy 12: Design significant lifeline installations such as highway, utilities and petrochemical pipelines which cross an active fault, to accommodate potential fault movement without prolonged disruption of an essential service or creating threat to health and safety.
Policy 13: Determine the liquefaction potential at sites in areas of high groundwater prior to development and determine specific mitigation to be incorporated into the foundation design, as necessary to prevent or reduce damage from liquefaction in an earthquake.
Policy 14: Route major lifeline installations around potential liquefaction areas or otherwise protect them against significant damage from liquefaction in an earthquake.
Policy 15: Compile information on areas of potential hazards and field information developed as part of CEQA investigations and geologic reports and keep geologic reviews and policy development current and accessible for use in report preparation.
Policy 18: Design discretionary critical facilities located within the potential inundation area for dam failure in order to: mitigate the effects of inundation on the facility; promote orderly shut-down and evacuation (as appropriate); and, prevent on-site hazards from affecting building occupants and the surrounding communities in the event of dam failure.
Policy 19: Design discretionary facilities in the potential dam inundation area used for the manufacture, storage or use of hazardous materials to prevent on-site hazards from affecting surrounding communities in the event of inundation.
Policy 20: Require emergency response plans for the Planning area to include specific procedures for the sequential and orderly evacuation of the potential dam inundation area.
Policy 21: Encourage critical and high-occupancy facilities as well as facilities for elderly, handicapped and other special care occupants located in the potential inundation area below the dam to develop and maintain plans for the orderly evacuation of their occupants.

Table 4.7-2. Metropolitan Bakersfield General Plan Goals and Policies for Geologic and Seismic Hazards
Goals and Policies: Safety Element - Flooding
Goal 1: Minimize hazards to planning area residents resulting from flooding.
Goal 2: Reduce the risk of flooding to land uses.
Policy 1: Ensure that the Bakersfield metropolitan area maintains a high level of public safety for its citizenry.
Policy 2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development or metropolitan police and fire facilities and services.

Kern County Building and Construction Ordinance (Title 17 of the Ordinance Code of Kern County)

Chapter 17.08 Kern County Building Code

All construction in Kern County is required to conform to the Kern County Building Code (Chapter 17.08, Building Code, of the Ordinance Code of Kern County). Kern County has adopted the CBC, 2016 Edition, with some modifications and amendments.

Chapter 17.28 of Kern County Grading Code

The purpose of the Kern County Grading Code is to safeguard life, limb, property, and the public welfare by regulating grading on private property. All requirements of the Kern County Grading Code will be applied during implementation of the project. All required grading permit(s) shall be obtained prior to commencement of construction activities. Sections of the Grading Code that are particularly relevant to geology and soils are provided below.

Section 17.28.140 Erosion Control

A. Slopes. The faces of cut and fill slopes shall be prepared and maintained to control against erosion. This control may consist of effective planting. The protection for the slopes shall be installed as soon as practicable and prior to calling for final approval. Where cut slopes are not subject to erosion due to the erosion-resistant character of the materials, such protection may be omitted.

B. Other Devices. Where necessary, check dams, cribbing, riprap or other devices or methods shall be employed to control erosion and provide safety.

C. Temporary Devices. Temporary drainage and erosion control shall be provided as needed at the end of each work day during grading operations, such that existing drainage channels would not be blocked. Dust control shall be applied to all graded areas and materials and shall consist of applying water or another approved dust palliative for the alleviation or prevention of dust nuisance. Deposition of rocks, earth materials or debris onto adjacent property, public roads or drainage channels shall not be allowed.

Section 17.28.170 Grading Inspection

A. General. All grading operations for which a permit is required shall be subject to inspection by the building official. Professional inspection of grading operations and testing shall be provided by the civil engineer, soils engineer, and the engineering geologist retained to provide such services in accordance with Subsection 17.28.170(E) for engineered grading and as required by the building official for regular grading.

B. Civil Engineer. The civil engineer shall provide professional inspection within such engineer's area of technical specialty, which shall consist of observation and review as to the establishment of line, grade and surface drainage of the development area. If revised plans are required during the course of the work they shall be prepared by the civil engineer.

C. Soils Engineer. The soils engineer shall provide professional inspection within such engineer's area of technical specialty, which shall include observation during grading and testing for required compaction. The soils engineer shall provide sufficient observation during the preparation of the natural ground and placement and compaction of the fill to verify that such work is being performed in accordance with the conditions of the approved plan and the appropriate requirements of this chapter. Revised recommendations relating to conditions differing from the approved soils engineering and engineering geology reports shall be submitted to the permittee, the building official and the civil engineer.

D. Engineering Geologist. The engineering geologist shall provide professional inspection within such engineer's area of technical specialty, which shall include professional inspection of the bedrock excavation to determine if conditions encountered are in conformance with the approved report. Revised recommendations relating to conditions differing from the approved engineering geology report shall be submitted to the soils engineer.

E. Permittee. The permittee shall be responsible for the work to be performed in accordance with the approved plans and specifications and in conformance with the provisions of this Code, and the permittee shall engage consultants, if required, to provide professional inspections on a timely basis. The permittee shall act as a coordinator between the consultants, the contractor and the building official. In the event of changed conditions, the permittee shall be responsible for informing the building official of such change and shall provide revised plans for approval.

F. Building Official. The building official may inspect the project at the various stages of the work requiring approval to determine that adequate control is being exercised by the professional consultants.

G. Notification of Noncompliance. If, in the course of fulfilling their responsibility under this chapter, the civil engineer, the soils engineer, or the engineering geologist finds that the work is not being done in conformance with this chapter or the approved grading plans, the discrepancies shall be reported immediately in writing to the permittee and to the

building official. Recommendations for corrective measures, if necessary, shall also be submitted.

H. Transfer of Responsibility. If the civil engineer, the soils engineer, or the engineering geologist of record is changed during the course of the work, the work shall be stopped until:

1. The civil engineer, soils engineer, or engineering geologist, has notified the building official in writing that they will no longer be responsible for the work and that a qualified replacement has been found who will assume responsibility.

2. The replacement civil engineer, soils engineer, or engineering geologist notifies the building official in writing that they have agreed to accept responsibility for the work.

Kern County Multi-Hazard Mitigation Plan

The 2005 Kern County Multi-Hazard Mitigation Plan (MHMP) describes natural hazards and impacts (including those resulting from earthquakes, landslides, and soil hazards) that threaten communities, and establishes mitigation goals and strategies. Information contained in the MHMP could also be used to help guide and coordinate mitigation activities and local policy decisions for future land use decisions. The MHMP divides the County into three regions, Valley, Mountain, and Desert. The Project site Area is located within the both the Valley region.

The governing federal law requires that the MHMP be reviewed and updated within five years in order to continue to be eligible for mitigation grant project funding. The County released a Comprehensive Update in September 2012 for its Kern Multi Jurisdiction Hazard Mitigation Plan.

4.7.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative and quantitative basis through a comparison of the anticipated Project effects on geologic resources. The change in the land use is significant if the effects described below occur. The evaluation of project impacts as based on professional judgment, analysis of the County's safety policies, and the significance criteria established by Appendix G of the State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving;
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
    - Strong seismic ground shaking;
    - Seismic-related ground failure, including liquefaction; or
    - Landslides;
- Result in substantial soil erosion or loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;
- Expose people or structures to a significant risk of loss, injury or death including flooding, as a result of the failure of a levee or a dam;
- Be located on expansive soil, as defined in Section 1803.5.3 of the California Building Code (2016), creating substantial risks to life or property; and/or
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

Based on the standards, the potential effects of Project implementation have been categorized as either "no impact," a "less than significant impact" or a "potentially significant impact." If a potentially significant impact cannot be reduced to a less than significant level through the application of goals, policies, standards or mitigation, it is categorized as a significant and unavoidable impact.

Project Impacts

Impact 4.7-1: The Project Would Expose People or Structures to Substantial Adverse Effects, Including the Risk of Loss, Injury, or Death Involving the Rupture of a Known Earthquake Fault.

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazards of surface faulting and fault rupture to built structures. Fault rupture is a break in the ground's surface and associated deformation resulting from the movement of a fault. Rupture has the potential to occur when a strong earthquake happens along specific active or potentially active faults. Areas around such faults are designated as Alquist-Priolo Earthquake Fault Zones and are shown in detail on the Alquist-Priolo Earthquake Fault Zone Maps. The proposed Project is not located in an Alquist-Priolo Earthquake Fault Zone. No active faults cross through or are located adjacent to the proposed Project. The nearest fault, the White Wolf Fault, is not identified as part of an Alquist-Priolo Earthquake Fault Zone. Some of the faults in the Bakersfield area are in the Alquist-Priolo Special Study Zone. Impacts involving fault rupture would be less than significant.

Given the highly seismic character of the southern San Joaquin Valley region, moderate to severe ground shaking associated with earthquakes on the nearby faults can be expected throughout the Metropolitan Bakersfield area. Maximum probable ground motion on the proposed Project site would likely be the result of movement along the White Wolf, San Andreas, or Pond Poso faults due to a maximum probable magnitude earthquake along each fault and distance to the proposed Project site. It is probable that faults within the region will move in the future. The proposed Project site is expected to experience ground shaking in the event of a major earthquake because of regional seismic activity; therefore, future residents may be exposed to seismic ground shaking. The proposed Project shall be designed and constructed to withstand the magnitude of an earthquake. The proposed Project will be constructed in conformance with the California Building Standards Code in order to minimize seismic impacts. Accordingly, the proposed Project will be required to construct all proposed structures in compliance with State law and local ordinances required by the most recent CBC (CCR Title 24) and to adhere to all modern earthquake construction standards. Modern earthquake construction standards include the American Society of Civil Engineers (ASCE) seismic design standard, specifically ASCE 7, which base seismic design on-site class (soil specific) and seismic design category (based on risk category). The required compliance with applicable CBC criteria, Alquist-Priolo Act, goals and policies of the Metropolitan Bakersfield General Plan, and the Kern County Zoning Ordinance (Kern County Building Code Chapter 17.08) would reduce impacts to less than significant levels.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-2: The Project Would Expose People or Structures to Adverse Effects, Including the Risk of Loss, Injury, or Death Involving Strong Seismic Ground Shaking Including That Would Result in Potential Substantial Adverse Effects.

Active or potentially active faults are located within the southern San Joaquin Valley region. The southern end of the San Joaquin Valley is bordered by five major fault systems, all of which are considered to be active: San Andreas, Garlock, Breckenridge-Kern Canyon, Sierra Nevada, and White Wolf faults. It is probable that faults near the proposed Project will move in the future; however, it is unlikely that ground rupture would occur on-site because it is not located within an Alquist-Priolo Earthquake Fault Zone or within 500 feet of a known active fault trace. Therefore, impacts are considered to be less than significant.

Given the highly seismic character of the southern San Joaquin Valley region, moderate to severe ground shaking associated with earthquakes on the nearby faults can be expected throughout the Metropolitan Bakersfield area. Maximum probable ground motion on the proposed Project would likely be the result of movement along the White Wolf, San Andreas, or Pond Poso faults due to a maximum probable magnitude earthquake along each fault and distance to the proposed Project. It is probable that faults within the region will move in the future. The proposed Project is expected to

experience ground shaking in the event of a major earthquake because of regional seismic activity; therefore, future Project employees may be exposed to seismic ground shaking. It is assumed that future Project employees would be people from the Metropolitan Bakersfield area as opposed to people relocating to the area, therefore, the proposed Project is not anticipated to introduce additional people to seismic ground shaking hazards.

The proposed Project shall be designed and constructed to withstand the magnitude of an earthquake. The proposed Project would be required to construct structures in compliance with State law and local ordinances in accordance with the most recent CBC and to adhere to all modern earthquake construction standards. The required compliance with applicable CBC criteria, Alquist-Priolo Act, goals and policies of the Metropolitan Bakersfield General Plan, the Kern County Ordinance Code (Kern County Building Code Chapter 17.08), and adherence to Mitigation Measures MM 4.7-1 through MM 4.7-7, would reduce impacts to less than significant levels.

Mitigation Measures

MM 4.7-1: **Phased Grading.** The project proponent shall limit grading to the minimum area necessary for construction. Prior to the initiation of construction, the project proponent shall retain a California registered professional engineer to approve the final grading earthwork and foundation plans prior to construction.

MM 4.7-2: **Geotechnical Study.** Prior to the issuance of building or grading permits for the project, the Project proponent shall conduct a full geotechnical study to evaluate soil conditions on the Project site and submit it to the Kern County Public Works Department for review and approval.

1. The geotechnical study must be signed by a California-registered professional engineer and must identify the following:

    a. Maximum considered earthquake and associated ground acceleration;

    b. Potential for seismically induced liquefaction, landslides, differential settlement, and mudflows;

    c. Stability of any existing or proposed cut-and-fill slopes;

    d. Collapsible or expansive soils;

    e. Foundation material type;

    f. Recommendations for placement and design of facilities, foundations, and remediation of unstable ground.

2. The project proponent shall determine the final siting of project facilities based on the results of the geotechnical study and implement recommended measures to minimize geologic hazards. The project proponent shall not locate project facilities on or immediately adjacent to a fault trace. All structures shall be

offset at least 100-feet from any mapped fault trace. Alternatively, a detailed fault trenching investigation may be performed to accurately locate the fault trace(s) to avoid sighting improvements on or close to these fault structures and to evaluate the risk of fault rupture. After locating the fault, accurate setback distances can be proposed.

3. The Kern County Public Works Department shall evaluate any final facility siting design developed prior to the issuance of any building or grading permits to verify that geological constraints have been avoided.

MM 4.7-3: **Seismic Design On-Site.** Prior to the issuance of grading permits, the project proponent shall retain a California registered engineer to design the project facilities to withstand probable seismically induced ground shaking at the site. All grading and construction on-site shall adhere to the specifications, procedures, and site conditions contained in the final design plans, which shall be fully compliant with the seismic recommendations of the California-registered professional engineer. The procedures and site conditions shall encompass site preparation, foundation specifications, and protection measures for buried metal. The final structural design shall be subject to approval and follow-up inspection by the Kern County Building Inspection Department. Final design requirements shall be provided to the on-site construction supervisor and the Kern County Building Inspector to ensure compliance.

MM 4.7-4: Building locations shall be stabilized against the occurrence of liquefaction by dynamic compaction, or other accepted soil stabilization method approved by the County Building official.

MM 4.7-5: **Geotechnical Evaluation.** Prior to the issuance of grading permits, a geotechnical evaluation, consisting of field exploration (drilling and soil sampling), laboratory testing of soil samples, and engineering analysis, shall be prepared to determine soil properties related, but not limited, to ground-motion acceleration parameters, the amplification properties of the subsurface units at the specific site, the potential for hydrocompaction to affect the proposed facilities, and the potential for collapsible, subsiding, or expansive soils to affect the proposed facilities.

These studies shall be used to determine the appropriate engineering for foundations and support structures as well as building requirements to minimize geotechnical hazard impacts. Copies of all analyses shall be submitted to the Kern County Public Works Department for review and approval. An approved copy of the evaluation shall be submitted to the Kern County Planning and Natural Resources Department.

MM 4.7-6: **Minimizing Erosion.** The project proponent shall continuously comply with the following:

1. The project proponent shall use existing roads to the greatest extent feasible to minimize erosion.

2. Prior to approval of the grading permit, final plans shall be reviewed and approved by the Kern County Public Works Department to confirm existing roads were used to the greatest extent feasible.

MM 4.7-7: **Minimizing Grading.** The project proponent shall continuously comply with the following:

1. The project proponent shall limit grading to the minimum area necessary for construction and operation of the project. Final grading plans shall include best management practices (BMPs) to limit on-site and off-site erosion, a water plan to treat disturbed areas during construction and reduce dust, and a plan for the disposal of drainage waters originating on-site and from adjacent right-of-ways (if required).

2. The plans shall be submitted to the Kern County Public Works Department for review and approval.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-3: The Project Would Result in Substantial Soil Erosion or Loss of Topsoil.

As discussed above, the proposed Project is located on relatively flat terrain and consists of soils that are not considered highly erosive, with the exception of wind erosion for the Cajon sandy loam soil. Due to the characteristics of the on-site soil types and the relatively flat terrain, implementation of the proposed Project has the potential to result in minimal erosion.

Project grading activities would remove or cover existing topsoil that is used for agricultural operations and may expose soils to wind and water erosion both during and after the construction phase of the proposed Project. To mitigate the potential effects of erosion on-site, temporary and permanent erosion control measures would be required, such as the use of sandbags, hydroseeding, landscaping and/or soil stabilizers. The Project proponent(s) would be required to submit a Stormwater Pollution Prevention Plan (SWPPP), which includes erosion control measures in order to comply with the National Pollutant Discharge Elimination System (NPDES) requirements of the Federal Clean Water Act (CWA) and the requirements of the California Water Quality Order No. 2009-0009-DWQ as amended by 2010-0014-DWQ and 2012-0006-0006-DWQ as implemented by the Kern County NPDES Permit Process. Any individual parcel Project proponent(s) would be responsible for the preparation of the SWPPPs for the individual site development. In addition, the proposed Project would be subject to County ordinances and standards relative to soils and geology. Standard compliance requirements include detailed site-specific soil analysis prior to issuance of building permits and adherence to applicable building codes in accordance with the most recent CBC. All earthwork is required to be performed in accordance with applicable County requirements as stipulated in the Kern County Ordinance Code. Implementation of Mitigation Measure MM 4.7-8 as well as mitigation measures in Section 4.10, *Hydrology and Water Quality* and compliance with applicable CBC criteria, goals and policies of the Metropolitan Bakersfield General Plan, and the Kern County Ordinance Code.

Mitigation Measures

Refer to Section 4.10, *Hydrology and Water Quality*, regarding water quality mitigation measures.

MM 4.7-8: **Soil Erosion and Sedimentation Control Plan.** The project proponent shall prepare a Soil Erosion and Sedimentation Control Plan to mitigate potential loss of soil and erosion. The plan shall be prepared by a California registered civil engineer or other professional approved to prepare said Plan and submitted for review and approval by the Kern County Public Works Department. The Soil Erosion and Sedimentation Control Plan shall include, but is not limited to, the following:

1. Best Management Practices to minimize soil erosion consistent with Kern County grading requirements and the California Regional Water Quality Control Board requirements pertaining to the preparation and approval of a Stormwater Pollution Prevention Plan (Best Management Practices recommended by the Kern County Public Works Department shall be reviewed for applicability);

2. Sediment collection facilities as may be required by the Kern County Public Works Department;

3. A timetable for full implementation, estimated costs, and a surety bond or other security as approved by the County; and

4. Other measures required by the County during permitting, including long-term monitoring (post-construction) of erosion control measures until site stabilization is achieved.

Provisions to comply with local and state codes relating to drainage and runoff, including use of pervious pavements, and/or other methods to the extent feasible, to increase stormwater infiltration and reduce runoff onto agricultural lands.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-4: The Project Would be Located on an Unstable Geologic Unit or Soil That Would Result in On-site or Off-site Landslide, Lateral Spreading, Subsidence, Liquefaction, or Collapse.

The Metropolitan Bakersfield General Plan indicates that liquefaction most often occurs in areas underlain by young alluvium where the groundwater table is higher than 50 feet bgs. According to the Metropolitan Bakersfield General Plan EIR, the proposed Project is not likely to be located within an area of high groundwater and loose soils. The Project site is underlain by Bakersfield fine sandy loam and Cajon sandy loam-overwash. However, the depth of groundwater on-site is approximately 165-175 feet bgs. Therefore, the potential for liquefaction on the proposed Project is considered low and impacts are anticipated to be less than significant.

The proposed Project is located on relatively flat topography and is not located adjacent to any steep slopes or other areas that would be subject to seismically induced landslides. Therefore, no impacts are anticipated in this regard.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-5: The Project Would Result in Adverse Impacts to People or Structures Resulting in a Risk of Loss, Injury or Death Including Flooding, as a Result of the Failure of a Levee or a Dam.

As indicated above, a break in Isabella Dam caused by an earthquake would flood 60 square miles of the Bakersfield area. It would take approximately eight to 12 hours from the time the dam breaks for water to reach the proposed Project. Therefore, allowing from a minimum of eight hours up to 12 hours for evacuation. This lag time would make injury or death from dam failure unlikely in the area of the proposed Project site. The chance of the Isabella Dam failing entirely, with the lake at capacity, is approximately one day out of 10,000 years. The Safety Element of the Metropolitan Bakersfield General Plan has identified policies including a response plan for dam failure as well as the maintenance of disaster response plans, development of discretionary approval procedures for critical facilities and the review of zoning designations, street widths and circulation patterns for compatibility with evacuation plans. The proposed Project would be designed and constructed in strict adherence to policies in the Metropolitan Bakersfield General Plan; therefore, less than significant impacts would occur.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-6: The Project Would Result in Impacts from Being Located on Expansive Soil, as Defined in Section 1803.5.3 of the CBC (2016) Creating Substantial Risks to Life or Property.

The proposed Project is located on Bakersfield fine sandy loam and Cajon sandy loam-overwash. None of these soil types exhibits expansive characteristics; shrink-swell potential is low. The proposed Project would be required to construct structures in compliance with State law and local ordinances in accordance with the most recent CBC (CCR Title 24) and to adhere to all modern construction standards. In addition, the proposed Project would be built to modern construction standards, which include the ASCE minimum design load standard, specifically Standard 7-10 and/or

7-15, which base seismic design on-site class (soil specific) and seismic design category (based on risk category). Furthermore, light and medium industrial structures constructed within the proposed Project would be required to comply with the most recent CBC (specifically Section 1803.5.3 regarding expansive soil), Kern County Ordinance Code, and the Metropolitan Bakersfield General Plan. Therefore, the potential for risks to life and property are low.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.7-7: The Project Would Be Constructed on Soils Incapable of Adequately Supporting the Use of Septic Tanks or Alternative Wastewater Disposal Systems Where Sewers Are Not Available for the Disposal of Wastewater.

The proposed Project site area has never been served by a sewer system. There are no existing septic systems located on the proposed Project site. Currently, neighboring residential and commercial properties are served by individual, privately-owned septic systems. A private package sewer treatment plant is proposed to provide services for the proposed Project site. The proposed Project would be designed and constructed in strict adherence to policies in the Metropolitan Bakersfield General Plan, Kern County Ordinance Code, and CBC criteria. In addition, Mitigation Measure MM 4.7-9 would be implemented. Therefore, impacts would be less than significant in this regard.

Mitigation Measures

MM 4.7-9: **Septic Design Plans.** Prior to the issuance of permits, the project proponent shall provide evidence to the Kern County Planning and Natural Resources Department that the siting, design and construction of proposed septic system(s) and leach field disposal system(s) comply with the 2016 Kern County Onsite Systems Manual as authorized by the California Water Board Local Agency Management Program (LAMP) and administered locally by the Kern County Environmental Health Services Department (KCEHS). Proving the proposed septic design plans comply with these requirements will ensure that all standards for septic tanks, seepage pits, and soils are capable of adequately supporting the use of septic tanks.

MM 4.7-10: **Final Leach Field Disposal System.** The final leach field disposal system shall be designed by a licensed engineer, taking into full consideration the requirements provided in the June 2016 Kern County Onsite Systems Manual.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Soils and geologic conditions in the proposed Project vicinity may vary by location. Short-term cumulative impacts such as erosion and sedimentation would occur as a result of implementation of the proposed Project. The only cumulative long-term impact related to geology is the exposure of people to the potential for seismically induced ground shaking. Implementation of other cumulative projects would incrementally increase the number of people and structures potentially subject to a seismic event. However, such exposure would be minimized through strict engineering standards required at each respective site. The seismic and geologic significance would be considered on a project-by-project basis. Therefore, cumulative effects of increased seismic risk would be mitigated to a less than significant level on a project-by-project basis. The required compliance with applicable CBC criteria, goals and policies of the Metropolitan Bakersfield General Plan, and the Kern County Ordinance Code would reduce cumulatively considerable impacts to geologic and seismic hazard to less than significant levels.

Mitigation Measures

Implement Mitigation Measures MM 4.7-1 through MM 4.7-10, above.

Level of Significance after Mitigation

Impacts would be less than significant.

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Section 4.8

Greenhouse Gases

Section 4.8
Greenhouse Gases

4.8.1 Introduction

This section of the Recirculated Draft Environmental Impact Report (RDEIR) evaluates the greenhouse gas (GHGs) conditions associated with buildout of the proposed Project. It also describes the impacts associated with GHGs that would result from implementation of the project, and, as necessary mitigation measures that would avoid or lessen these impacts. Insight Environmental Consultants completed an Air Quality Impact Analysis in June 2009 that evaluated the proposed Project's potential impacts on air quality. Due to the time between the technical study and this RDEIR, a second Air Quality Impact Analysis was prepared by Insight Environmental Consultants in July 2017. See Appendix C, *Air Quality Impact Analysis*, and Appendix N, *Original Technical Studies*. Information supporting this analysis is also based on the information and guidelines provided in the California Environmental Quality Act (CEQA), the San Joaquin Valley Air Pollution Control District (SJVAPCD) 2015 Guidance for Assessing and Mitigating Air Quality Impacts (GAMAQI), and Kern County's Guidelines for the Preparation of Air Quality Assessment for Environmental Impact Reports.

4.8.2 Environmental Setting

The California Air Resources Board (CARB) has divided California into regional air basins according to topographic drainage features. The proposed Project site is located in Kern County, which is within the jurisdiction of the San Joaquin Valley Air Basin (SJVAB) and locally controlled by the San Joaquin Valley Air Pollution Control District (SJVAPCD).

Greenhouse Gases (GHGs) and Global Climate Change

In the early 1960's scientists recognized that carbon dioxide (CO_2) levels in the atmosphere were rising every year. It was also noted that several other gases, including methane (CH_4) and nitrous oxides (N_2O) were also increasing. Levels of these gases have increased by about 40 percent since large-scale industrialization began around 150 years ago, according to the United States Environmental Protection Agency (EPA). After numerous computer-simulated model runs on the effects of these increases in the atmosphere, it was concluded that the rising concentrations almost always resulted in an increase of average global temperature. Rising temperatures may, in turn, produce changes in weather, sea levels and land use patterns, commonly referred to as "climate change". There is general scientific consensus that climate change is occurring, and that human activity contributes in some measure (perhaps substantially) to that change. It is difficult to determine the extent of change that humans may be causing due to the natural variability of the Earth's climate.

During the planet's history, the climate has changed many times, with events ranging from ice ages to long periods of warmth. Natural factors such as volcanic eruptions, changes in the Earth's orbit, and the amount of energy released from the sun historically have affected the Earth's climate. Human activities associated with the Industrial Revolution beginning in the late 18th century, have also

changed the composition of the atmosphere. The burning of fossil fuels, such as coal and oil, and deforestation has caused the concentrations of heat-trapping greenhouse gases (GHGs) to increase significantly in our atmosphere.

Many chemical compounds found in the Earth's atmosphere act as GHGs, which allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth's surface, some of it is reflected back towards space as infrared radiation (heat). GHGs absorb this infrared radiation and trap the heat in the atmosphere. Over time, the amount of energy sent from the sun to the Earth's surface should be about the same as the amount of energy radiated back into space, leaving the temperature of the Earth's surface roughly constant. Many gases exhibit these "greenhouse" properties. Some of them occur in nature (water vapor, carbon dioxide, methane, and nitrous oxide), while others are exclusively human-made (like gases used for aerosols). The most relevant GHGs are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. These gases prevent heat from escaping to space.

GHGs, in most cases, have both natural and anthropogenic sources. Natural mechanisms already exist as part of the 'carbon cycle' for removing GHGs from the atmosphere (often called land or ocean sinks). Levels of GHGs, due to the increase in anthropogenic sources, have exceeded the normal rates of natural absorption. This has resulted in increased atmospheric concentrations of GHGs and potentially human-induced global warming.

Our GHG emissions in the United States come mostly from energy use. These are driven largely by economic growth, fuel used for electricity generation, and weather patterns affecting heating and cooling needs. Energy-related carbon dioxide emissions, resulting from petroleum and natural gas account for approximately three-quarters of the human-generated GHG emissions in the United States, primarily in the form of carbon dioxide emissions from burning fossil fuels. More than half the energy-related emissions come from large stationary sources such as power plants; approximately a third comes from transportation; while industrial processes, agriculture, forestry, other land uses, and waste management make up a majority of the remainder of sources.

Methane, another GHG, comes from landfills, coal mines, oil and gas operations, and agriculture; representing nine percent of total GHG emissions in the United States. Nitrous oxide only represents five percent of the gas emissions, and is emitted from burning fossil fuels and through the use of certain fertilizers and industrial processes. Two percent of the total emissions are released as byproducts of industrial processes and through leakage.

The United States has the highest emissions of GHGs of any nation on Earth, though CO_2 emissions in California are less than the national average, both in per capita emissions and in emissions per gross state product. Transportation is the largest source of CO_2 emissions in California, accounting for approximately 41 percent of total emissions. Electricity generation accounts for approximately 22 percent of CO_2 emissions in California, and the industrial sector accounts for approximately 20.5 percent. California GHG emissions and the increase in project emissions of CO_2, methane (CH_4), and N_2O, are summarized in Table 4.8-1*, California Greenhouse Gas Emissions of CO_2, CH_4, AND N_2O*.

Table 4.8-1. California Greenhouse Gas Emissions of CO2, CH4, and N2O

Net - Million Tons – Carbon Dioxide Equivalent			
Greenhouse Gas	2013	2014	2015
Carbon Dioxide (CO_2)	376.1	371.8	369.9
Methane (CH_4)	39.8	40.1	39.6
Nitrous Oxide (N_2O)	12.3	12.2	11.7
High GWP Gases (HFC, PFC, SF_6)	16.8	17.8	19.1
Global Warming Potential	445.0	441.9	440.3

Source: CARB, 2017.

Global carbon dioxide emissions are expected to increase by 1.9 percent annually between 2001 and 2025. Much of the increase in these emissions is expected to occur in the developing world where emerging economies are fueled with fossil energy, such as China and India. Around 2,018 developing countries' emissions are expected to surpass the emissions of industrialized countries; increasing by 2.7 percent annually between 2001 and 2025, faster than the world average.

GHGs are a necessity to life as we know it. They keep the planet's surface warmer than it otherwise would be. However, as the concentrations of these gases increase in the atmosphere and continue to, the Earth's temperature is also increasing, exceeding past levels. The Earth's average surface temperature has increased by about 1.2 to 1.4 degrees Fahrenheit (ºF) since 1900 according to National Oceanic and Atmospheric Administration (NOAA) and National Aeronautical and Space Administration (NASA) data. On average the warmest global temperatures on record have all occurred within the past 15 years. Climate models predict that the average temperature at the Earth's surface could increase from 2.5 to 10.4ºF above 1990 levels by the end of this century if GHGs continue to increase. Other aspects of the climate are also changing such as rainfall patterns, snow and ice cover, and sea level.

Climate change affects people, plants, and animals. Scientists are certain that increasing the concentration of GHGs will change the planet's climate; however, they are not sure by how much it will change, at what rate it will change, or what the exact effects will be. They are working to better understand future climate change and how the effects will vary by region and over time.

Some climate changes are already occurring. These include; rise of sea level, shrinking glaciers, changes in the range and distribution of plants and animals, lengthening of growing seasons, trees blooming earlier, ice on rivers and lakes freezing later and breaking up earlier, and thawing of permafrost.

Scientists believe that most areas in the United States will to continue to warm, although some will likely warm more than others. Predicting which parts of the country will become wetter or drier is extremely difficult, but scientists generally expect increased precipitation and evaporation, and drier soil in the middle parts of the country. The northern regions such as Alaska are expected to experience the most warming. Alaska has already been experiencing significant climate change in recent years that may be attributable to human caused global climate change.

In addition to the changes already discussed, human health can also be affected both directly and indirectly by climate change in part through extreme periods of heat and cold, storms, climate-sensitive diseases such as malaria, and smog episodes.

In order to address climate change concerns the United States government has established a comprehensive policy to deal with global warming. This policy has three basic components:

- Slowing the growth of emissions;
- Strengthening science, technology and institutions; and
- Enhancing international cooperation.

Currently, the Federal government is using voluntary and incentive-based programs to reduce emissions and has established a variety of programs promoting climate technology and science. The United States prepared a comprehensive strategy in February 2002 to reduce the GHG intensity by 18 percent over the 10-year period from 2002 to 2012. Greenhouse gas intensity is a measurement of GHG emissions per unit of economic activity. By meeting this commitment, the United States will prevent the release of more than 500 million metric tons cumulatively between 2002 and 2012.

4.8.3 Regulatory Setting

Regulatory oversight for air quality in the SJVAB rests at EPA Region IX office at the Federal level, the CARB at the State level, and the regional level with the SJVAPCD.

Global Climate Change Regulatory Issues

In 1988, the United Nations established the Intergovernmental Panel on Climate Change to evaluate the impacts of global warming and to develop strategies that nations could implement to curtail global climate change. In 1992, the United Nations Framework Convention on Climate Change established an agreement with the goal of controlling GHG emissions, including methane. As a result, the Climate Change Action Plan was developed to address the reduction of GHGs in the United States. The Plan consists of more than 50 voluntary programs.

The Kyoto Protocol treaty was negotiated in December 1997. The agreement came into force on February 16, 2005 following ratification by Russia on November 18, 2004. As of December 2006, a total of 169 countries and other governmental entities have ratified the agreement. Notable exceptions include the United States and Australia. Other countries, like India and China, which have ratified the protocol, are not required to reduce carbon emissions under the present agreement despite their relatively large populations.

Additionally, the Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere (chlorofluorocarbons [CFCs], halons, carbon tetrachloride, and methyl chloroform) were to be phased out by 2000 (methyl chloroform was to be phased out by 2005).

On September 27, 2006, Assembly Bill (AB) 32, the California Global Warming Solutions Act, of 2006 was enacted by the State of California. The legislature stated that "global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California." (AB 32). The Act caps California's GHG emissions at 1990 levels by 2020. The Act

defines GHG emissions as all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexaflouride. This agreement represents the first enforceable state-wide program in the U.S. to cap all GHG emissions from major industries that includes penalties for non-compliance. While acknowledging that national and international actions will be necessary to fully address the issue of global warming, AB 32 lays out a program to inventory and reduce GHG emissions in California and from power generation facilities located outside the state that serve California residents and businesses.

AB 32 charges CARB with responsibility to monitor and regulate sources of GHG emissions in order to reduce those emissions. By July 1, 2007, CARB adopted a list of discrete early action measures to be adopted and implemented before January 1, 2010, to reduce GHG emissions. CARB staff recommended an amount of 427 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) as the total statewide greenhouse gas 1990 emissions level and 2020 emissions limit. The Board approved the 2020 limit on December 6, 2007. This limit is an aggregated statewide limit, rather than sector- or facility-specific. CARB is then to conduct rulemaking, culminating in rule adoption by January 1, 2011, for reducing GHG emissions to achieve the emissions cap by 2020. The rules must take effect no later than 2012. In designing emission reduction measures, CARB must aim to minimize costs, maximize benefits, improve and modernize California's energy infrastructure, maintain electric system reliability, maximize additional environmental and economic co-benefits for California, and complement the state's efforts to improve air quality.

At this time, the EPA does not regulate GHG emissions; however, in *Massachusetts et al. v, EPA (Environmental Protection Agency)*, the U.S Supreme Court determined that the EPA does have the authority to regulate GHGs under the Clean Air Act (CAA). The Court also instructed the EPA to review its policies toward regulation of vehicle emissions under the CAA. It is now anticipated that regulations will eventually be promulgated by the EPA to further control GHG emissions from vehicles as well as other sources.

Global warming and climate change have received substantial public attention for more than 15 years. For example, the United States Global Change Research Program was established by the Global Change Research Act of 1990 to enhance the understanding of natural and human-induced changes in the Earth's global environmental system, to monitor, understand and predict global change, and to provide a sound scientific basis for national and international decision making. Even so, the analytical tools have not been developed to determine the effect on worldwide global warming from a particular increase in GHG emissions, or the resulting effects on climate change in a particular locale. The scientific tools needed to evaluate the impacts that a specific project may have on the environment are even farther in the future.

Accordingly, there is no local or statewide significance threshold developed to evaluate the impacts of the proposed Project, or any project, on global climate change or on the environment in California.

Federal

U.S. Environmental Protection Agency (EPA)

On April 2, 2007, in *Massachusetts v. EPA*, 549 U.S. 497 (2007), the Supreme Court found that greenhouse gases are air pollutants covered by the CAA. The Court held that the EPA must determine whether or not emissions of GHGs from new motor vehicles cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or whether the science is too uncertain to make a reasoned decision. In making these decisions, the EPA is required to follow the language of section 202(a) of the Clean Air Act. The Supreme Court decision resulted from a petition for rulemaking under section 202(a) filed by more than a dozen environmental, renewable energy, and other organizations.

On April 17, 2009, the Administrator signed Proposed Endangerment and Cause or Contribute Findings for GHGs under Section 202(a) of the CAA. EPA held a 60-day public comment period, which ended June 23, 2009, and received over 380,000 public comments. These included both written comments as well as testimony at two public hearings in Arlington, Virginia and Seattle, Washington. EPA carefully reviewed, considered, and incorporated public comments and has now issued these Final Findings.

The EPA found that six GHGs taken in combination endanger both the public health and the public welfare of current and future generations. The EPA also found that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG air pollution that endangers public health and welfare under CAA section 202(a). These Findings were based on careful consideration of the full weight of scientific evidence and a thorough review of numerous public comments received on the Proposed Findings published April 24, 2009. These Findings were effective on January 14, 2010.

Specific GHG Regulations that the U.S. EPA has adopted to date are as follows:

40 CFR Part 98. Mandatory Reporting of Greenhouse Gases Rule

This rule requires mandatory reporting of GHG emissions for facilities that emit more than 25,000 $MTCO_2e$ emissions per year. CO_2e is a quantity that describes, for a given mixture and amount of GHG, the amount of CO_2 that would have the same GWP, when measured over a specified timescale (generally, 100 years). It is also a measure for comparing CO_2 with other GHGs (which generally have a higher GWP), based on the amount of those other gases multiplied by the appropriate GWP factor, commonly expressed as $MTCO_2e$. CO_2e is calculated by multiplying the metric tons of gas by the appropriate GWP. Additionally, reporting of emissions is required for owners of SF_6- and PFC-insulted equipment when the total nameplate capacity of these insulating gases is above 17,280 pounds. The proposed project would not be expected to trigger GHG reporting according to the rule; however, GHG emissions of the proposed project are quantified in this Recirculated Draft Environmental Impact Report (RDEIR).

40 CFR Part 52. Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule

The U.S. EPA mandated application of the Prevention of Significant Deterioration (PSD) requirements to facilities whose stationary source CO_2e emissions exceed 75,000 tons per year.

National Climate Action Plan

In June 2013, the President enacted a national Climate Action Plan (Plan) that consisted of a wide variety of executive actions and had three pillars discussed below (EOP 2013).

Cut Carbon in America – The Plan consists of actions to help cut carbon by deploying clean energy such as cutting carbon from power plants, promoting renewable energy, and unlocking long-term investment in clean energy innovation.

Prepare the United States for Impacts of Climate Change – The Plan consists of actions to help prepare for the impacts through building stronger and safer communities and infrastructure by supporting climate resilient investments, supporting communities and tribal areas as they prepare for impacts, and boosting resilience of building and infrastructure; protecting the economy and natural resources by identifying vulnerabilities, promoting insurance leadership, conserving land and water resources, managing drought, reducing wildfire risks, and preparing for future floods; and using sound science to manage climate impacts.

Lead International Efforts – The Plan consists of actions to help the United States lead international efforts through working with other countries to take action by enhancing multilateral engagements with major economies, expanding bilateral cooperation with major emerging economies, combating short-lived climate pollutants, reducing deforestation and degradation, expanding clean energy use and cutting energy waste, global free trade in environmental goods and services, and phasing out subsidies that encourage wasteful use of fossil fuels and by leading efforts to address climate change through international negotiations.

In June of 2014, the Center for Climate and Energy Solutions (C2ES) published a one-year review of progress in implementation of the Plan (C2ES, 2014). The C2ES found that the administration had made marked progress in its initial implementation. Notable areas of progress included steps to limit carbon pollution from power plants; improve energy efficiency; reduce CH_4 and HFC emissions; help communities and industry become more resilient to climate change impacts; and end U.S. lending for coal-fired power plants overseas.

Greenhouse Gas Endangerment Findings

As of January 14, 2010, the U.S. EPA's finding that six GHGs, taken in combination, endanger the public health and the public welfare of current and future generations became effective. The U.S. EPA also found that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that endangers public health and welfare under CAA Section 202(a). Subsequently, federal agencies have adopted specific GHG-related regulations and initiatives, including:

Transportation/Mobile Sources

U.S. EPA and National Highway Traffic Safety Administration Standards to Cut Greenhouse Gas Emissions and Fuel Use for New Motor Vehicles: coordinated steps to enable the production of a new generation of clean vehicles.

Renewable Fuel Standard Program: transportation fuel sold in the United States is required to contain a minimum volume of renewable fuel.

Stationary Sources

Carbon Pollution Standards for Power Plants: In September 2013, the U.S. EPA proposed a rule to reduce carbon emissions from new power plants. On June 2, 2014, the U.S. EPA issued a proposal to cut carbon pollution from existing power plants (the "Clean Power Plan"). U.S. EPA's May 2015 "Unified Agenda" indicates that both of these rules are expected to be issued in August 2015.

Final Greenhouse Gas Tailoring Rule: On May 13, 2010, the U.S. EPA set GHG emissions thresholds to define when permits under the New Source Review PSD and Title V Operating Permit programs are required for new and existing industrial facilities. This final rule "tailors" the requirements of these CAA permitting programs to limit covered facilities to the nation's largest GHG emitters: power plants, refineries, and cement production facilities.

Timing of Applicability of the PSD Permitting Program to GHGs: On March 29, 2010, the U.S. EPA completed its reconsideration of the December 18, 2008, memorandum entitled "EPA's Interpretation of Regulations that Determine Pollutants Covered by Federal Prevention of Significant Deterioration (PSD) Permit Program" (the so-called "Johnson memo"). The final action confirmed that GHGs become covered under the PSD program on January 2, 2011, when the cars rule took effect.

In June 2014, the U.S. Supreme Court ruled that the U.S. EPA cannot classify facilities as major PSD or Title V sources based solely on its GHG emissions meeting the major source threshold. However, the Supreme Court said that the U.S. EPA could continue to require that PSD permits, required due to criteria pollutant emissions, contain Best Available Control Techniques (BACT) limits for GHG emissions. This ruling struck down Step 2 of the Tailoring Rule but kept in effect Step 1 (U.S. EPA, 2014).

Emissions Reporting

GHG Reporting Program: This program collects reported GHG emissions from facilities that emit more than 25,000 $MTCO_2e$ emissions per year. Additionally, reporting of emissions is required for owners of SF_6- and PFC-insulated equipment when the total nameplate capacity of these insulating gases is above 17,280 pounds. The Petroleum and Natural Gas Systems source category consists of onshore production; offshore production; natural gas processing; natural gas transmission; underground natural gas storage; natural gas distribution; liquefied natural gas import and export terminals; and liquefied natural gas storage equipment.

Notification Requirements for Gas Well Completions (40 CFR Parts 60 and 63): Air pollution standards established by the U.S. EPA under the New Source Performance Standard, Final Rule August 16, 2012, for oil and gas production require companies to provide notifications of natural gas well completions. The U.S. EPA expects to use the notifications required by the 2012 standards and ongoing technical studies through 2014 to make a foundation for determining how best to require additional control of methane and other air pollutants from the oil and gas sector, including completions and associated gas from ongoing production and hydraulically fractured oil wells.

State

Assembly Bill (AB) 1493

On July 22, 2002, Governor Gray Davis signed Assembly Bill (AB) 1493, also known as the Pavley Regulations or the Clean Car Standards. AB 1493 required the State to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of GHG emissions emitted by passenger vehicles and light-duty trucks. Subsequent regulations were adopted by CARB in September 2004.

The regulations were threatened by automaker lawsuits and were stalled by the U.S. EPA's initial denial to allow California to implement GHG standards for passenger vehicles. The U.S. EPA later granted California the authority to implement GHG emission reduction standards for new passenger cars, pickup trucks and sport utility vehicles on June 30, 2009. On September 24, 2009, the CARB adopted amendments to the Pavley regulations that reduce GHG emissions in new passenger vehicles from 2009 through 2016.

Executive Order S-3-05

Executive Order S-3-05 was established by Governor Arnold Schwarzenegger in June 2006. Executive Order S-3-05 establishes statewide emission reduction targets through the year 2050:

- By 2010, reduce greenhouse gas emissions to 2000 levels,
- By 2020, reduce greenhouse gas emissions to 1990 levels, and
- By 2050, reduce greenhouse gas emission to 80 percent below 1990 levels.

This Executive Order does not include any specific requirements that pertain to the proposed Project. However, actions taken by the State to implement these goals may affect the proposed Project, depending on the specific implementation measures that are developed.

Executive Order S-1-07

Issued on January 18, 2007, Executive Order S-1-07 sets a declining Low Carbon Fuel Standard for GHG emissions measured in CO2e grams per unit of fuel energy sold in California. The target of the Low Carbon Fuel Standard is to reduce the carbon intensity of California passenger vehicle fuels by at least 10 percent by 2020. The carbon intensity measures the amount of GHG emissions in the

lifecycle of a fuel, including extraction/feedstock production, processing, transportation, and final consumption, per unit of energy delivered. CARB adopted the implementing regulation in April 2009. The regulation is expected to increase the production of biofuels, including those from alternative sources, such as algae, wood, and agricultural waste. In addition, the Low Carbon Fuel Standard would drive the availability of plug-in hybrid, battery electric, and fuel-cell power motor vehicles. The Low Carbon Fuel Standard is anticipated to lead to the replacement of 20 percent of the fuel used in motor vehicles with alternative fuels by 2020.

Executive Order Executive Order B-30-15 – 2030 Statewide Emission Reduction Target

EO B-30-15 was signed by Governor Jerry Brown Jr. on April 29, 2015. This EO establishes an interim statewide GHG reduction target of 40 percent below 1990 levels by 2030, which is necessary to guide regulatory policy and investments in California in the midterm, and put California on the most cost-effective path for long-term emission reductions. Under this EO, all State agencies with jurisdiction over sources of greenhouse gas emissions will need to continue to develop and implement emissions reduction programs to reach the State's 2050 target and attain a level of emissions necessary to avoid dangerous climate change. According to CARB's Scoping Plan Update, this EO is in line with the scientifically established levels needed in the United States to limit global warming below 2°C - the warming threshold at which scientists say there will likely be major climate disruptions such as super droughts and rising sea levels (CARB, 2014).

Assembly Bill (AB) 32

AB 32, also known as the California Global Warming Solutions Act of 2006, was established to mandate the quantification and reduction of GHGs to 1990 levels by the year 2020. The law establishes periodic targets for reductions, and requires certain facilities to report emissions of GHGs annually. The legislation authorizes CARB to reduce emissions from certain sectors that contribute the most to statewide emissions of GHGs.

The AB 32 Scoping Plan identifies the strategies for achieving the maximum technologically feasible and cost-effective GHG reductions by 2020, and to maintain and continue reductions beyond 2020. The scoping plan includes a range of GHG emission reduction actions, which include direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, market-based mechanisms such as a Cap-and-Trade system, and an AB 32 cost of implementation fee regulation to fund the program. The initial scoping plan was approved at the CARB Board hearing on December 12, 2008. CARB approved the First Update to the Scoping Plan in May 2014.

Senate Bill (SB) 97

Senate Bill (SB) 97, enacted in August 2007, required the Office of Planning and Research (OPR) to develop guidelines for the mitigation of GHG emissions or effects related to releases of GHG emissions. On April 13, 2009, OPR submitted proposed amendments to the California Natural Resources Agency (CNRA), in accordance with SB 97, regarding analysis and mitigation of GHG emissions. Formal rulemaking was conducted in 2009 prior to adopting the amendments.

As part of the guidelines, OPR recommends that CARB set statewide thresholds of significance and emphasized the need to have a consistent threshold available to analyze projects. The draft guidelines also noted that the analyses should be based on the best available information. As directed by SB 97, the CNRA adopted amendments to the State CEQA Guidelines for GHG emissions on December 30, 2009. On February 16, 2010, the Office of Administrative Law approved the amendments and filed them with the Secretary of State for inclusion in the California Code of Regulations. The amendments became effective on March 18, 2010.

Other Mobile Source Reduction Requirements

Several other State provisions address the GHG emissions reduction targets set by CARB for mobile sources, including trucks, passenger vehicles, trains, and ships. These measures include:

- Low Carbon Fuel Standard (EO S-01-07)
- Advanced Clean Cars Program
- SmartWay Truck Efficiency Regulation
- AB 32 Cap-and-Trade Program as applicable to transportation fuel suppliers (beginning January 1, 2015)
- SB 375 (Land Use Planning) including the development of a Sustainable Communities Strategy as part of a Metropolitan Planning Organization's Regional Transportation Plan.

In particular, SB 375 requires the Air Resources Board to set regional targets for GHG emission reductions from passenger vehicles and light duty trucks, and requires each regional Metropolitan Planning Organization (MPOs) to adopt a Sustainable Communities Strategy (SCS) into its regional transportation plan that would allow the region to meet its GHG emission reduction target. The Kern County Council of Governments adopted the SCS for Kern County as part of its Regional Transportation Plan (RTP) in 2014. The RTP and SCS incorporate forecasted development patterns, modeling and measures designed to integrate land use and transportation planning to reduce local and regional GHG emissions. Oil and gas resources, as well as other land uses, are components of the SCS. While SB 375 does not require local governments to amend their General Plans to implement the SCS, it provides incentives for them to do so. Implementation of SB 375 is expected to substantially reduce GHG emissions in the County and throughout the State.

California Air Pollution Control Officers Association (CAPCOA)

The California Air Pollution Control Officers Association (CAPCOA) is the association of air pollution control officers representing all 35 air quality agencies throughout California. CAPCOA is not a regulatory body, but it has been an active organization in providing guidance in addressing the CEQA significance of GHG emissions and climate change as well as other air quality issues. The GHG analysis set forth in this report has been informed, in part, by the expertise and methodologies described in the following documents published by CAPCOA: (1) CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (CAPCOA, 2008); and (2) Quantifying Greenhouse Gas Mitigation

Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures (CAPCOA, 2010). The methodologies used in this GHG analysis are consistent with the CAPCOA guidelines

California Environmental Quality Act (CEQA)

There are a variety of statewide rules and regulations which have been implemented or are in development in California which mandate the quantification or reduction of GHGs. Under CEQA, an analysis and mitigation of emissions of GHGs and climate change in relation to a project is required where it has been determined that a project will result in a significant addition of GHGs. Certain Air Pollution Control Districts (APCDs) have proposed their own thresholds of significance and /or best performance standards.

California Code of Regulations Title 24

Title 24 of the California Code of Regulations was established in 1978, and serves to enhance and regulate California's building standards. While not initially promulgated to reduce GHG emissions, Part 6 of Title 24 specifically establishes energy efficiency standards for residential and non-residential buildings constructed in the State of California in order to reduce energy demand and consumption. Part 6 is updated periodically to incorporate and consider new energy efficiency technologies and methodologies. The current version of the California Building Code became effective January 1, 2017. Local agencies must ensure that development in their jurisdictions complies with guidelines contained in the California Building Code. Cities and counties can, however, adopt building standards beyond those provided in the code.

San Joaquin Valley Air Pollution Control District (SJVAPCD)

On December 17, 2009, the SJVAPCD's Governing Board adopted the first comprehensive regional policy and guidance on addressing and mitigating GHG emission impacts caused by industrial, commercial, and residential development in the San Joaquin Valley. This set of guidance documents is designed to assist local permitting agencies and businesses by answering several questions related to CEQA and how to address GHG impacts under existing CEQA law.

To assist Lead Agencies, project proponents, permit applicants, and interested parties in assessing and reducing the impacts of project specific GHG emissions on global climate change, the SJVAPCD has adopted the guidance: *Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA* and the policy: *District Policy – Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency*. The following criteria was outlined in the document to determine whether a project could have a significant impact:

- Projects determined to be exempt from the requirements of CEQA would be determined to have a less than significant individual and cumulative impact for GHG emissions and would not require further environmental review, including analysis of project specific GHG emissions. Projects exempt under CEQA would be evaluated consistent with established rules and regulations governing project approval and would not be required to implement BPS.

- Projects complying with an approved GHG emission reduction plan or GHG mitigation program which avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions. Such plans or programs must be specified in law or approved by the lead agency with jurisdiction over the affected resource and supported by a CEQA compliant environmental review document adopted by the lead agency. Projects complying with an approved GHG emission reduction plan or GHG mitigation program would not be required to implement BPS.

- Projects implementing Best Performance Standards would not require quantification of project specific GHG emissions. Consistent with CEQA Guideline, such projects would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects not implementing Best Performance Standards would require quantification of project specific GHG emissions and demonstration that project specific GHG emissions would be reduced or mitigated by at least 29 percent, compared to Business-as-Usual (BAU*), including GHG emission reductions achieved since the 2002-2004 baseline period. Projects achieving at least a 29 percent GHG emission reduction compared to BAU would be determined to have a less than significant individual and cumulative impact for GHG.

- Notwithstanding any of the above provisions, projects requiring preparation of an Environmental Impact Report for any other reason would require quantification of project specific GHG emissions. Projects implementing BPS or achieving at least a 29 percent GHG emission reduction compared to BAU would be determined to have a less than significant individual and cumulative impact for GHG.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals, policies, and implementation measures in order to reduce impacts of projects on air quality. Applicable goals relative to the proposed Project site within these elements are listed in Table 4.8-2, *Metropolitan Bakersfield General Plan Goals and Policies for Air Quality*, below.

Table 4.8-2. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality

Goals and Policies: Air Quality
Conservation/Air Quality Goal #1: "Promote air quality that is compatible with health, well being, and enjoyment of life by controlling point sources and minimizing vehicular trips to reduce air pollutants."
Conservation/Air Quality Goal #2: Continue working toward attainment of Federal, State and Local standards as enforced by the San Joaquin Valley Air Pollution Control District."
Conservation/Air Quality Goal #3: "Reduce the amount of vehicular emissions in the planning area."

Table 4.8-2. Metropolitan Bakersfield General Plan Goals and Policies for Air Quality

Goals and Policies: Air Quality
Conservation/Air Quality Policy #1: "Comply with and promote San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) control measures regarding Reactive Organic Gases (ROG). Such measures are focused on: (a) steam driven well vents, (b) Pseudo-cyclic wells, (c) natural gas processing plant fugitives, (d) heavy oil test stations, (e) light oil production fugitives, (f) refinery pumps and compressors, and (g) vehicle inspection and maintenance."
Conservation/Air Quality Policy #2: "Encourage land uses and land use practices which do not contribute significantly to air quality degradation."
Conservation/Air Quality Policy #3: "Require dust abatement measures during significant grading and construction operations."
Conservation/Air Quality Policy #4: Consider air pollution impacts when evaluating discretionary permits for land use proposals. Considerations should include: a) Alternative access routes to reduce traffic congestion, b) Development phasing to match road capacities, c) Buffers including increase vegetation to increase emission dispersion and reduce impacts of gaseous or particulate matter on sensitive uses."
Conservation/Air Quality Policy #11: "Improve the capacity of the existing road system through improved signalization and traffic control systems."
Conservation/Air Quality Policy #12: "Encourage the use of mass transit, carpooling and other transportation options to reduce vehicle miles traveled."
Conservation/Air Quality Policy #13: "Consider establishing priority parking areas for carpoolers in projects with relatively large numbers of employees to reduce vehicle miles traveled and improve air quality."
Conservation/Air Quality Policy #14: "Establish park and ride facilities to encourage car pooling and the use of mass transit."
Conservation/Air Quality Policy #16: "Cooperate with Golden Empire Transit [GET] and Kern Regional Transit to provide a comprehensive mass transit system for Bakersfield; require large-scale new development to provide related improvements, such as bus stop shelters and turnouts."
Conservation/Air Quality Policy #18: "Encourage walking for short distance trips through the creation of pedestrian friendly sidewalks and street crossings."
Conservation/Air Quality Policy #19: "Promote a pattern of land uses which locates residential uses in close proximity to employment and commercial services to minimize vehicular travel."

4.8.4 Impacts and Mitigation Measures

This section describes the air quality significance thresholds, the air quality methodology used to evaluate whether the proposed Project would exceed the thresholds, and an evaluation of the proposed Project's impacts.

Methodology

The primary source of emissions (approximately 50 percent) from the proposed Project is from mobile sources. There are a number of factors available for estimating the GHG from mobile sources. Not all GHGs exhibit the same ability to induce climate change; as a result, GHG contributions are commonly quantified in carbon dioxide equivalencies (CO_2e). The CO_2e portion of GHG emissions from the proposed Project were estimated using the URBEMIS2007 v9.2.4 program and the California Climate Action Registry (CCAR) General Reporting Protocol.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment;
- Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

Project Impacts

Impact 4.8-1: The Project Would Generate Greenhouse Gas Emissions, Either Directly or Indirectly, That May Have a Significant Impact on the Environment.

Neither the SJVAPCD nor any other federal, state, or local agency has adopted a threshold to measure a project's impact on global climate change. Global climate change is an international phenomenon, and the regulatory background and scientific data are changing rapidly. In 2006, the California State Legislature adopted AB 32, the California Global Warming Solutions Act of 2006. AB 32 describes how global climate change would impact the environment in California. The impacts described in AB 32 include changing sea levels, changes in snow pack and availability of potable water, changes in storm flows and flood inundation zones, and other impacts.

The list of impacts included in AB 32 may be considered substantial evidence of environmental impacts requiring analysis in CEQA documents. AB 32 requires CARB, the State agency charged with regulating statewide air quality, to adopt rules and regulations that would achieve greenhouse gas emissions equivalent to statewide levels in 1990 by 2020. By July 1, 2007, CARB adopted a list of discrete early action GHG emission reduction measures that could be implemented by January 1, 2010.

As required by AB 32, CARB determined what the statewide GHG emissions level was in 1990, and approved a statewide GHG emissions limit that is equivalent to that level, to be achieved by 2020. CARB approved the 2020 limit on December 6, 2007. CARB's GHG inventory has estimated 427 million $MTCO_2e$ in California in 1990. In 2004, the emissions were estimated at 480 $MMTCO_2e$.

Climate Change Impacts on the Project

AB 32 indicates that "the potential effects of global climate change include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snow pack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidence of infections, disease, asthma, and other health-related problems" (AB 32, section 38501[a]).

According to the California Climate Change Center (CCCC), climate change impacts would affect all of the sectors considered in this report: sea level rise, agriculture, snowpack and water supply, forestry, wildfire risk, public health, and electricity demand and supply. Additionally, climate change could produce compounding impact. For instance, in the San Francisco Bay Delta, heightened sea levels and high river inflows from warmer storms would place levee systems in greater jeopardy of flooding. The CCCC indicates that some of the most dramatic climate change impacts would be experienced as increased frequency and severity of extreme events, such as heat waves, wildfires, flooding, and conditions conducive to air pollution formation.

The proposed Project must comply with Title 24 energy efficiency standards. Vehicles purchased by residents would produce fewer GHG emissions than those produced today with implementation of AB 1493. Regulations stemming from AB 32 would result in reductions in emissions from major sources such as electrical power generation and cement production. Although it is unknown if AB 32 alone is enough to reduce California's fair-share contribution to global GHG inventory, it is currently the only well-defined and widely accepted benchmark for GHG emissions in California. The threshold that is to be used for this proposed Project is as follows:

Would the project be consistent with California's strategies to reduce greenhouse gas emissions to the levels in AB 32?

This threshold is qualitative in nature, and is addressed as such in this analysis. Note that the thresholds and the analysis may not be relevant to other projects. Therefore, this analysis does not establish thresholds in Kern County.

Project GHG Inventory

The primary source of GHG emissions (approximately 50 percent) from the proposed Project during operation would result from mobile sources. Proposed Project construction and operational activities would generate GHG emissions. Criteria and GHG emissions were estimated using the California Emissions Estimator Model (CalEEMod) version 2013.2.2 (Insight Environmental Consultants 2017).

There are a number of factors available for estimating the GHGs from mobile sources. Not all GHGs exhibit the same ability to induce climate change; therefore, GHG contributions are commonly quantified in CO_2e.

The 2005 BAU and mitigated proposed Project emissions are summarized shown in Table 4.8-3, *Estimated Annual Greenhouse Gas Emissions*.

Table 4.8-3. Estimated Annual Greenhouse Gas Emissions

Source	CO_2	CH_4	N_2O	CO_2e
Construction Emissions				
2016 Construction Emissions	195.03	0.04	0.00	195.86
2017 Construction Emissions	536.28	0.07	0.00	537.67
2018 Construction Emissions	718.28	0.10	0.00	720.46
2019 Construction Emissions	361.72	0.06	0.00	362.99
2020 Construction Emissions	337.31	0.04	0.00	338.18
2021 Construction Emissions	685.16	0.10	0.00	687.26

Table 4.8-3. Estimated Annual Greenhouse Gas Emissions

Source	CO_2	CH_4	N_2O	CO_2e
2022 Construction Emissions	348.46	0.06	0.00	349.70
2023 Construction Emissions	333.10	0.04	0.00	333.93
2024 Construction Emissions	681.33	0.10	0.00	683.40
Operational Emissions				
Area Emissions	0.05	0.0001	0.00	0.05
Energy Emissions	10,814	0.41	0.13	10,862
Mobile Emissions	43,523	0.94	0.00	43,543
Waste Emissions	689.03	40.72	0.00	1,544.2
Water Emissions	1,103.1	18.64	0.45	1,633.0
Total Proposed Project Operational Emissions	*56,129*	*60.7*	*0.58*	*57,582*
Annualized Construction Emissions[1]	*139.89*	*0.02*	*0.00*	*140.32*
Proposed Project Emissions	**62,301**	**54.44**	**0.55**	**63,614**

Notes: emissions are measures in tons/year; 0.00 could represent <0.00

[1] Per South Coast AQMD's Methodology: Construction emissions are annualized over a 30-year period.

Source: Insight Environmental Consultants, 2017.

Emission Estimation Assumptions

The proposed Project's construction and operational GHG emissions were estimated using the CalEEMOD program and can be found in Appendix C. BAU emissions were calculated based on the proposed Project activities using 2005 regulations and technologies built into CalEEMod, available as defaults. According to the SJVAPCD, in order for the proposed Project to conform with the goals of AB32 at least a 29 percent reduction from the 2002-2004 BAU period by 2020 must be demonstrated (Insight Environmental Consulting 2017). Because 2002 to 2004 emission factors were not available in CalEEMod, year 2005 was used for BAU. Using 2005 as BAU results in more conservative emission reduction estimations as the emission factors in 2005 are lower (more efficient), thereby producing a smaller reduction between mitigated and BAU. Mitigated proposed project emissions were calculated using updated emission factors from CalEEMod for the anticipated years of operation and corresponding land uses (Insight Environmental Consultants 2017).

Electricity usage for industrial land uses was estimated using CCAR Protocol. The CCAR emission factors for electricity use are 804.54 pounds of CO_2 per megawatt hour (MWh), 0.0067 pounds of NH_4 per MWh, and 0.0037 pounds of N_2O per MWh.

The proposed Project does not contribute substantially to water vapor because water vapor concentrations in the upper atmosphere are primarily due to climate feedbacks rather than emissions from project-related activities.

The proposed Project would not result in the emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), or sulphur hexafluoride (SF_6), the other gases identified as GHG in AB 32. The proposed Project would be subject to any regulations developed under AB32, the California Global Warming Solutions Act of 2006, as determined by CARB. As demonstrated in Table 4.8-4, *Comparison of BAU and Proposed Mitigated Emissions (Tons/Year*), below, the mandated required 29 percent reduction needed to conform with AB 32 goals would be reached with already in place state regulations for mobile sources such as low carbon fuel standards. This would result in a 33 percent reduction from the proposed Project's BAU GHG operation emissions of 85,842 $MTCO_2e$ per year to 57,582 $MTCO_2e$ per year as shown in Table 4.8-4, *Comparison of BAU and Proposed*

Mitigated Emissions (Tons/Year). Therefore, the proposed project would be considered less than significant.

Table 4.8-4. Comparison of BAU and Proposed Project Mitigation Emissions (Tons/Year)

	2011 BAU	Proposed Project Mitigated (2020)
Co2e Emissions	85,842	57,582
Percent Reduction		33%

Source: Insight Environmental Consultants 2017.

Attorney General Mitigation Analysis

The Office of the California Attorney General maintains a website with a list of CEQA Mitigations for Global Climate Change Impacts. The Attorney General has listed some examples of types of mitigations that local agencies may consider in order to offset or reduce global climate change impacts from a project. The Attorney General assures that the presented lists are examples and not intended to be exhaustive but instead provides measures and policies that could be undertaken. Moreover, the measures cited may not be appropriate for every project, so the Attorney General suggests that the lead agency should use its own informed judgment in deciding which measures it would analyze, and which measures it would require, for a given project.

The Attorney General suggests measures that could be undertaken or funded by a diverse range of projects, related to energy efficiency; renewable energy; water conservation and efficiency; solid waste measures; land use measures; transportation and motor vehicles; and carbon offsets. Implementation of the required mitigation measures will reduce the project specific generated GHGs to a less than significant level as the project proponent will be required to off-set impacts by 29 percent below business as usual, thus achieving the mandated emission reduction targets established by AB 32. Additionally, the proposed Project is located in an area of similar type industrial development, and along State Route 99, thus allowing existing infrastructure s to serve multiple users. In conclusion, the proposed Project by its design and mitigation measures would satisfy many of the suggested measures proposed by the Attorney General, which are shown in Table 4.8-5 *California Greenhouse Gas Emissions Reduction Strategies*, below.

Table 4.8-5. California Greenhouse Gas Emission Reduction Strategies

Strategy	Project Design/Mitigation to Comply with Strategy
Vehicle Climate Change Standards: AB 1493 (Pavley) required the state to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of climate change emissions emitted by passenger vehicles and light duty trucks. Regulations were adopted by CARB in September 2004.	These are CARB enforced standards; vehicles that access the proposed Project that are required to comply with the standards would comply with these strategies.
Other Light Duty Vehicle Technology: New standards would be adopted to phase in beginning in the 2017 model.	
Heavy-Duty Vehicle Emission Reduction Measures: Increased efficiency in the design of heavy-duty vehicles and an education program for the heavy-duty vehicle sector.	

Table 4.8-5. California Greenhouse Gas Emission Reduction Strategies

Strategy	Project Design/Mitigation to Comply with Strategy
Diesel Anti-Idling: In July 2004, CARB adopted a measure to limit diesel-fueled commercial motor vehicle idling.	Project would be subject to State law.
Hydrofluorocarbon Reduction: 1) Ban retail sale of HFC in small cans; 2) Require that only low GWP refrigerants be used in new vehicular systems; 3) Adopt specifications for new commercial refrigeration; 4) Add refrigerant leak-tightness to the pass criteria for vehicular Inspection and Maintenance programs; 5) Enforce federal ban on releasing HFCs.	This measure applies to consumer products. When CARB adopts regulations for these reduction measures, any products that the regulations apply to would comply with the measures.
Transportation Refrigeration Units (TRU), Off-Road Electrification, Port Electrification: Strategies to reduce emissions from TRUs, increase off-road electrification, and increase use of shore-side/port electrification.	Not applicable.
Manure Management: The proposed San Joaquin Valley Rule 4570 will reduce volatile organic compounds from confined animal facilities through implementation of control options.	Not applicable.
Alternative Fuels - Biodiesel Blends: CARB would develop regulations to require the use of 1 to 4 percent biodiesel displacement of California diesel fuel.	Not applicable.
Alternative Fuels - Ethanol: Increased use of ethanol fuel.	Not applicable.
Achieve 50 percent Statewide Recycling Goal: Achieving the State's 50 percent waste diversion mandate as established by the Integrated Waste Management Act of 1989, (AB 939, Sher, Chapter 1095, Statutes of 1989), will reduce climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. A diversion rate of 48 percent has been achieved on a statewide basis. Therefore, a 2 percent additional reduction is needed.	Consistent with Mitigation in Section 4.17, UTILITIES, which requires construction recycling within the proposed Project.
Zero Waste - High Recycling: Additional recycling beyond the State's 50 percent recycling goal.	Consistent with Mitigation in Section 4.17, UTILITIES, which requires construction recycling within the proposed Project.
Landfill Methane Capture: Install direct gas use or electricity projects at landfills to capture and use emitted methane.	Not applicable.
Urban Forestry: A new statewide goal of planting 5 million trees in urban areas by 2020 would be achieved through the expansion of local urban forestry programs.	Consistent. Project would be subject to landscaping standards identified in the Kern County Zoning Ordinance.
Afforestation/Reforestation Projects: Reforestation projects focus on restoring native tree cover on lands that were previously forested and are now covered with other vegetative types.	Not applicable. The proposed Project area was not forested in recent times.
Water Use Efficiency: Approximately 19 percent of all electricity, 30 percent of all natural gas, and 88 million gallons of diesel are used to convey, treat, distribute and use water and wastewater. Increasing the efficiency of water transport and reducing water use would reduce greenhouse gas emissions.	Consistent with Mitigation.

Table 4.8-5. California Greenhouse Gas Emission Reduction Strategies

Strategy	Project Design/Mitigation to Comply with Strategy
Building Energy Efficiency Standards in Place and in Progress: Public Resources Code 25402 authorizes the CEC to adopt and periodically update its building energy efficiency standards (that apply to newly constructed buildings and additions to and alterations to existing buildings).	Consistent with Mitigation. Mitigation requires a 29 percent decrease of annual GHG emissions.
Appliance Energy Efficiency Standards in Place and in Progress: Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its appliance energy efficiency standards (that apply to devices and equipment using energy that are sold or offered for sale in California).	Project would be consistent with State law.
Cement Manufacturing: Cost-effective reductions to reduce energy consumption and to lower carbon dioxide emissions in the cement industry.	Consistent with mitigation. The specific use is not proposed at this time. Mitigation requires GHG emission reductions regardless of the proposed project. Additionally, the preparation of a Precise Development (PD) Plan prior to the commencement of any ground disturbing activities will be required. The PD requirement will allow for additional review of any specific use and the incorporation of specific conditions to ensure compliance with State law, consistency with any locally adopted plans and compatibility with surrounding uses.
Smart Land Use and Intelligent Transportation Systems (ITS): Smart land use strategies encourage jobs/housing proximity, promote transit-oriented development, and encourage high-density residential/ commercial development along transit corridors. ITS is the application of advanced technology systems and management strategies to improve operational efficiency of transportation systems and movement of people, goods and services. Governor Schwarzenegger is finalizing a comprehensive 10-year strategic growth plan with the intent of developing ways to promote, through state investments, incentives and technical assistance, land use, and technology strategies that provide for a prosperous economy, social equity, and a quality environment.	The proposed Project is consistent with this strategy as the project is located along an existing State Highway. The site is located in an area with other similar type development, thus allowing all uses to capitalize on existing industrially related infrastructure.
Smart land use, demand management, ITS, and value pricing are critical elements for improving mobility and transportation efficiency. Specific strategies include: promoting jobs/housing proximity and transit-oriented development; encouraging high density residential/commercial development along transit/rail corridor; valuing and congestion pricing; implementing intelligent transportation systems, traveler information/ traffic control, incident management; accelerating the development of broadband infrastructure; and comprehensive, integrated, multimodal/ intermodal transportation planning.	Refer to response, above.
Enteric Fermentation: Cattle emit methane from digestion processes. Changes in diet could result in a reduction in emissions.	Not applicable.

Table 4.8-5. California Greenhouse Gas Emission Reduction Strategies

Strategy	Project Design/Mitigation to Comply with Strategy
Green Buildings Initiative: Green Building Executive Order, S-20-04 (CA 2005), sets a goal of reducing energy use in public and private buildings by 20 percent by the year 2015, as compared with 2003 levels. Consistent with Mitigation.	Mitigation requires compliance with State law and includes increased GHG emission reduction requirements.
California Solar Initiative: Installation of 1 million solar roofs or an equivalent 3,000 MW by 2017 on homes and businesses; increased use of solar thermal systems to offset the increasing demand for natural gas; use of advanced metering in solar applications; and creation of a funding source that can provide rebates over 10 years through a declining incentive schedule.	Not applicable.

Source: Insight Environmental Consulting, 2017.

Feasible and Reasonable Mitigation

CEQA, as well as the SJVAPCD Rule 9510, requires that all feasible and reasonable mitigation be applied to the proposed Project to reduce the impacts from construction and operations on air quality. The SJVAPCD's "Non-Residential On-Site Mitigation Checklist" was utilized in preparing the mitigation measures and evaluating the proposed Project's features. These measures include using controls that limit the exhaust from construction equipment and using alternatives to diesel when possible. Additional reductions will be achieved through the regulatory process of the air district and CARB as required changes to diesel engines are implemented which will affect the product delivery trucks and limits on idling.

While it is not possible to determine whether the proposed Project individually would have a significant impact on global warming or climate change, the proposed Project emissions will constitute a small fraction of the statewide GHG emissions. The strategies currently being implemented by CARB would help in reducing the proposed Project's GHG emissions and are summarized above in Table 4.8-5*, California Greenhouse Gas Emission Reduction Strategies*, above.

The impacts on global warming and climate change are indirect, not direct, and the emissions cannot be correlated with specific impacts based on currently available science. Climate change is a worldwide phenomenon, and local government lacks the expertise, or regulatory authority, to develop the scientific tools and policy needed to select a CEQA significance threshold for climate change or GHG emissions. The proposed Project will be subject to any regulations or requirements adopted under AB 32 or imposed by the state or federal government. In addition, as mentioned above, the proposed Project would result in a 33 percent reduction from the proposed Project's BAU GHG operation emissions of 85,842 $MTCO_2e$ per year to 57,582 $MTCO_2e$ per year as shown in Table 4.8-4, *Comparison of BAU and Proposed Project Mitigation Emissions (Tons/Year)*. Therefore, the proposed Project would be considered less than significant. The determination of project level significance, is therefore, considered less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.8-2: The Project Would Conflict with an Applicable Plan, Policy or Regulation Adopted for the Purpose of Reducing the Emissions of Greenhouse Gases.

At of the time of this writing, the County of Kern does not have an adopted GHG Climate Action Plan. Implementation of the proposed project with the identified mitigation measure to reduce business as usual (BAU) GHG emissions by 29 percent is consistent with standards established by the CARB and the California Global Warming Solutions Act of 2006. As such, impacts are considered less than significant.

Mitigation Measures

Implement Mitigation Measure MM 4.3-1, as described in Section 4.3, *Air Quality*.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

While it is not possible to determine whether the proposed Project individually would have a significant impact on global warming or climate change, the proposed Project clearly would contribute to cumulative GHG emissions in California (see Table 4.8-3) as well as related potential health effects.

Kern County and the SJVAB currently do not have GHG inventories. On December 6, 2007, the CARB established a GHG emissions limit based on the 1990 level for the year 2020 and adopted regulations requiring mandatory reporting of GHGs for large facilities. After a year of investigation, CARB has established that the state's 1990 emissions are 427 million $MTCO_2e$. Preliminary estimates indicate that 2020 emission projections could be 600 million $MTCO_2e$ if no actions are taken to reduce GHGs ("business as usual" scenario). CARB determined that California must prevent 173 million tons of $CO_e e$ from being emitted by 2020 in order to meet the 1990 level as required by AB 32.

The main contribution of GHG emissions from the proposed Project is from motor vehicles trips. Transportation sources account for approximately 42 percent of California's total GHG emissions. The proposed Project's emissions would, therefore, contribute to the increase in emissions. The effect on these emissions from other anticipated actions by CARB to address transportation issues, such as the development of fuels with less carbon, is not known at this time.

However, without the necessary science and analytical tools, it is not possible to assess, with certainty, whether the proposed Project's contribution would be cumulatively considerable within the meaning of State CEQA Guidelines Sections 15065(a)(3) and 15130. CEQA, however, does note that more severe environmental problems have lower thresholds for determining that a proposed Project's contribution to cumulative impacts is significant. Given the position of the legislature in AB 32, which

states that global warming poses serious detrimental effects, and the requirements of CEQA for the lead agency to determine that a project not have a cumulatively considerable contribution, the effect of 57,582 $MTCO_2e$ can be considered cumulatively considerable. This determination is based on the lack of clear scientific or other criteria for determining the significance of the proposed Project's contribution to the already-degraded air quality in the SJVAB

State CEQA Guidelines Section 15130 notes that sometimes the only feasible mitigation for cumulative impacts may involve the adoption of ordinances or regulations rather than the imposition of conditions on a project-by-project basis. Global climate change is this type of issue. Causes and effects are not just regional or statewide, they are worldwide. Given the uncertainties in identifying, let alone quantifying, the impact of any single project on global warming and climate change, and the efforts made to reduce emissions of GHGs from the project through design, in accordance with State CEQA Guidelines Section 15130, any further feasible mitigation will be accomplished through CARB regulations adopted pursuant to AB 32. The cumulative impacts of the proposed Project to global climate change as demonstrated in Table 4.8-4, above, would achieve greater than the required 29 percent reduction needed to conform with AB 32 goals.

Mitigation Measures

Implement Mitigation Measure MM 4.3-1, as described in Section 4.3, *Air Quality*.

Level of Significance after Mitigation

Cumulative impacts on global climate change and associated health effects are considered significant. and unavoidable.

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Section 4.9

Hazards/Hazardous Materials

Section 4.9
Hazards/Hazardous Materials

4.9.1 Introduction

The purpose of this section is to identify, to the extent feasible, the potential for hazards associated with historic and current site uses, surrounding sites and recognized environmental conditions (RECs) in connection with the proposed Project site and to identify potential risks to human health, including future residents surrounding the site, users of the proposed Project site, workers and construction workers. A Hazardous Materials Evaluation was prepared by McIntosh & Associates in November 2008 and a subsequent Hazardous Materials Evaluation was prepared by McIntosh & Associates in July 2017. In addition, A Petroleum and Natural Gas Pipeline Assessment was prepared by McIntosh & Associates in July 2017. See Appendix F, *Hazardous Materials Evaluation*, Appendix G, *Petroleum and Natural Gas Pipeline Assessment*, and Appendix N, *Original Technical Studies*.

4.9.2 Environmental Setting

Local Character

The proposed Project site is undeveloped and is used mainly for agricultural purposes. A shop building is located in the easternmost portion of the Project site, near South Union Avenue. According to the California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR), the proposed Project is not located within an oil or gas field. There is one plugged and abandoned well with the proposed Project boundaries. A Pacific Gas and Electric (PG&E) natural gas transmission pipeline, number L-300B, traverses the site at a diagonal from northwest to southeast. Six pole-mounted electrical transformers (PMT) were observed within and adjacent to the proposed Project boundaries.

Surrounding Property Uses

Existing rural residential, agricultural, and commercial/light industrial land uses currently surround the proposed Project. The land uses for the adjacent properties is presented in the Table 4.9-1, *Surrounding Land Uses.*

Table 4.9-1. Surrounding Land Uses

Location	Adjacent Roads	Land Use
North	DiGiorgio Road Unpaved Western	Agricultural and roadway uses are present to the north. The land is designated R-IA (Resource-Intensive Agriculture), LMR (Low Medium Density Residential, 4 to 10 units per acre), HMR (High Medium Density Residential, 7.26 to 17.42 units per acre), SR (Suburban, 4 units per acre), GC (General Commercial)

Table 4.9-1. Surrounding Land Uses

Location	Adjacent Roads	Land Use
South	Houghton Road	Undeveloped agriculture land and State Route (SR) 99 off-ramp south of Houghton Road. The land is designated as R-IA (Resource-Intensive Agriculture), RR (Rural Residential, 2½ acres per unit), HC (Highway Commercial).
East	South Union Avenue is adjacent to 40 acres in the eastern most portion	Agricultural and rural residential with corralsand equestrian facilities, and mobile homes along South Union Avenue and on the northeast, east and southeast adjacent to the proposed project. There is an automobile wrecking yard (Higgins Auto Wrecking, 12825 South Union Avenue) located adjacent to the southeast portion of the proposed project. The land is designated as R-IA (Resource-Intensive Agriculture), RR (Rural Residential), SI (Service Industrial)
West	SR-99	SR-99 and undeveloped agricultural land. The land is designated as PT (Public Transportation) and R-IA (Resource-Intensive Agriculture)

Historical Use of Property

In 1934, an exploratory oil well was drilled; however, it failed to produce and was abandoned in 1935. The proposed Project has remained undeveloped and has been utilized for agricultural purposes from 1940's to the present. Currently there are approximately 63 acres of alfalfa being grown along the south portion of the Project site, and the balance of the Project site is fallow due to the recent drought conditions but has been prepared to resume farming operations.

A steel shop building is located on the east side of the Project site, near South Union Avenue along Lamb Avenue and was probably used for field equipment, vehicle maintenance, and storage. A retention basin, used for agricultural purposes, is located on the south edge of the Project site at the Houghton Road/Chevalier Road intersection.

A 34-inch diameter high pressure gas transmission pipeline (Line 300B), owned and operated by PG&E, traverses the Project site. The pipeline is marked at the east boundary of South Union Avenue and at the west boundary adjacent to State Route (SR) 99. There is a 6-inch natural gas distribution pipeline operated by Pacific Gas and Electric Company that is located on the west side of the South Union Avenue.

Aerial photographs were provided by Kern County Public Works Department and Western Photogrammetrics. Additionally, aerial photographs from Google Earth online website for the years 2008, 2009, 2011, 2012, 2013, 2014, 2015, and 2016 were reviewed to assess the history of the proposed Project site. (McIntosh & Associates 2017; refer to Appendix F and Appendix N). The following provides a summary of the aerial photographs:

1937: The project site is visible as fallow land. Some scarring from sheet-flooding is visible trending generally north to south. South Union Avenue is visible along the east boundary of the Project site. Small farms and rural residences are visible to the northeast, east, and south.

1952: A grove of trees is visible adjacent to South Union Avenue in the northeast corner of the easternmost portion of the Project site. Two parcels appear to be under cultivation.

Houghton Road is visible along the south boundary of the site. Two small farms/rural residences are visible in the parcel currently occupied by Higgins Auto Wrecking, near the south boundary of the site. The rural residence and corrals immediately north of the easternmost portion of the Project site is visible in this aerial photograph. Agricultural land is visible to the north, south, east, and west.

1956: The proposed Project site appears to be under cultivation with the exception of two fallow portions of the site. The on-site location of the west irrigation well and the concrete ditch are visible. Conditions on the adjacent properties appear relatively similar to those noted in the 1952 aerial photograph.

1963: SR 99 is visible along the west boundary of the Project site, having opened in 1961. The "cloverleaf" on- and off-ramps at Houghton Road, adjacent to the southwest corner of the Project site, appear to be under construction. On- and off-site conditions appear relatively similar to those noted in the 1956 and 1952 aerial photographs.

1975: Plowed/cultivated land has replaced trees in the easternmost portion of the Project site. A clearing with a small structure, possibly a small shed or shop, is visible in the east portion of the site. The south tailwater pit located near Houghton Road is visible. The SR-99/ Houghton Road interchange has been completed, and a dairy appears to be visible on the west side of SR-99, opposite the south half of the proposed Project. The original PG&E natural gas pipeline station is visible adjacent to South Union Avenue. Additional off-site conditions appear relatively similar to those viewed in the 1963 aerial photograph.

1981: A large oak tree is visible in the west part of the site, where the domestic well is located. The north portion of the site appears fallow. Rows of wrecked automobiles are visible at the location of Higgins Auto Wrecking, adjacent to the southern Project boundary. Additional on- and off-site conditions appear relatively similar to those noted in the 1975 aerial photograph.

1990: The steel shop building is visible in the small clearing in the west part of the easternmost portion of the Project site. On- and off-site conditions appear relatively similar to those noted in the 1981 aerial photograph.

1995: Conditions on- and off-site appear relatively similar to those noted in the 1990 aerial photograph. Mobile home lots are visible off-site, located north of the easternmost proposed Project boundary. North of the proposed Project, at a distance of 0.5-mile or greater, several residential subdivisions are visible.

2000: On- and off-site conditions appear relatively similar to those noted in the 1995 aerial photograph.

2002: Conditions on- and off-site appear relatively similar to those observed on the 1995 and 2000 aerial photographs.

2003: Conditions on- and off-site appear relatively similar to those observed on the 1995, 2000, and 2002 aerial photographs. More than 50 percent of the land comprising the proposed Project appears fallow or recently plowed.

2006: Conditions on- and off-site appear relatively similar to those observed on the 1995, 2000, 2002, and 2003 aerial photographs. Approximately 50 percent of the land comprising the proposed Project site appears to have been cultivated with alfalfa.

2008: The proposed Project is comprised of agricultural land. Portions of the Project site have crops growing, and the rest has been disked. A brushy retention basin in on the south edge of the Project site and has been used for agriculture purposes. A steel shop building is located on the east side of the Project site near South Union Avenue along Lamb Avenue. The proposed Project is adjacent to other related agricultural land, rural residential properties, and an automobile wrecking yard (Higgins Auto Wrecking).

2009: Conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the year 2008 and 2009 aerial photograph

2011: Conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the year 2008 and 2009 aerial photograph

2013: Conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the year 2008, 2009, and 2011 aerial photograph.

2014: Conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the year 2008, 2009, 2011, and 2012 aerial photograph.

2015: Conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the year 2008, 2009, 2011, 2012, 2013, and 2014 aerial photograph.

2016: The conditions on the proposed Project and other adjacent properties appear relatively similar to those observed in the years 2008,2009, 2011,2012, 2013, 2014 and 2015. The proposed Project is comprised of agricultural land. A portion of the proposed Project has crop growing, and the remained of the Project site has been disked in preparation for cultivation. A brushy retention basin is on the south edge of the Project site and has been used for agriculture purposes. A steel shop building is located on the east side of the Project site, near South Union Avenue along Lamb Avenue. The proposed Project is adjacent to other related agricultural land, rural residential properties, and an automobile wrecking yard (Higgins Auto Wrecking).

Records Review

A review of regulatory agency records was conducted for the site and surrounding one-mile radius. The following documents have been reviewed: U.S. Environmental Protection Agency (EPA) Toxic Release Inventory (TRI) records; California Air Resources Board (CARB) Community Health Air Pollution Information System (CHAPIS) records, EDR Report; DOGGR records; Kern County

Environmental Health Serves Department (KCEHSD) records; and Kern County Agricultural Commissioner records.

U.S. EPA Toxic Release Inventory (TRI)

Toxics Release Inventory (TRI), a US EPA database, contains information on toxic chemical releases. The 2006 TRI Explorer Chemical Releases Report for Bakersfield area facilities provides information on all regulated industries in Kern County. The report indicated that 1,591,813 pounds of various chemicals and hazardous wastes were disposed to Class I Underground Injection Wells, RCRA Subtitle C Landfills, and other unspecified landfills during the 2006 calendar year. The TRI Explorer report also indicated that 104,181 pounds of point-source air emissions and 61,211 pounds of fugitive air emissions were released into the atmosphere in 2006. This data was released by the EPA to the public on February 21, 2008.

The proposed Project was not identified in the 2006 TRI Explorer report, and no other sites were identified within a one-mile radius of the proposed Project. Additionally, the proposed Project was not identified in the 2017 US EPA TRI Facilities for Explorer Chemical Releases Report for Bakersfield, California area facilities, and no other properties were identified within a one-mile radius of the proposed project. This data was released by the US EPA data source and updated June 2, 2017 (McIntosh & Associates 2017; refer to Appendix F).

California Air Resources Board (CARB) CHAPIS Hazardous Air Pollutant Records

Toxic air pollutants are chemicals that have the potential to cause adverse health effects, such as cancer, birth defects, and organ damage. The online CHAPIS records were reviewed June 2017 and are listed from the year 2015 database for emissions by facilities and reflect the most current data available. The proposed Project was not identified with any emission inventory, and one-mile radius of the proposed project was not identified with any emission inventory and/or any facilities were identified (McIntosh & Associates 2017; refer to Appendix F).

The closest emission facility is Kern Oil & Refining Company located at 7724 East Panama Lane, in Bakersfield. It is approximately 5.75 miles northeast of the proposed Project with Particulate Matter Emissions of 5.671 tons for the year 2015 (McIntosh & Associates 2017; refer to Appendix F).

Environmental Data Resources, Inc. (EDR) Report

In July 2008, an Environmental Data Resources, Inc. (EDR) Radius Search was conducted for the proposed Project site and properties within a one-mile radius. The EDR report includes: 1) search of Federal, State and local agencies environmental records and 2) search for information about the physical setting of the sites and their surroundings. A copy of the EDR Report is included in Appendix N, *Original Technical Studies*.

The search of Federal, State, and local agencies environmental records found no records for the proposed Project site. Three facilities were identified on one or more of the databases searched for the EDR report. In addition, five "orphan sites" were identified in the EDR report. "Orphan sites" are sites that the EDR report cannot map due to insufficient information.

The EDR report indicated that two water wells are located on-site. The irrigation wells were listed by their U.S. Geological Survey well numbers. The west on-site irrigation well was correctly identified as well no. 31S28E-7P1, and the northwest on-site water well was correctly identified as well no. 31S28E-7D1. The total depths for both wells were not reported.

Lamb Chops

Lamb Chops, a Solid Waste/Landfill-listed facility, is located at 12336 South Union Avenue. Its agricultural composting operation was listed at the address of 300 Buena Vista Road. The permitted manure throughput for the composting facility was 1,000 cubic yards per day, and its permitted capacity was 2,500 cubic yards per day. The Lamb Chops composting facility was closed on March 31, 1999.

Young's Commercial Transfer (YCT)

Young's Commercial Transfer (YCT), is located at 300 Buena Vista Road, and is listed on the following databases: Hazardous Waste and Substances Sites (CORTESE); Leaking Underground Storage Tank (LUST); Historical Underground Storage Tank (HIST UST); State Facility Inventory Database (CA FID) UST; and Statewide Environmental Evaluation and Planning System (SWEEPS) Underground Storage Tank (UST).

The CORTESE database identifies public drinking water wells with detectable levels of contamination, hazardous substance sites selected for remedial action, sites with known toxic materials identified through the abandoned site assessment program, sites with USTs having a reportable release, and all solid waste sites from which there is known migration. No details were listed by CORTESE for YCT, and it is not considered a direct or indirect threat to the project site.

The LUST database contains reported leaking UST incidents that originate within the State Water Resources Control Board's Hazardous Substance Storage Container Database. YCT had operated two diesel USTs that leaked into soil only. The case was opened by KCEHSD, on March 4, 1992, and the last reporting date was October 3, 1994; the case was closed.

The HIST UST database contains listings from the State Water Resources Control Board (SWRCB). The diesel USTs were removed from the former YCT facility in 1992 had been installed in 1972 and 1973, respectively.

CA FID UST identified the former YCT facility as located within one-half to one mile of the proposed Project site. SWEEPS UST database identifies two diesel USTs with capacities of 10,000 gallons each on the YCT facility. No further details were provided.

Limi Brothers Farm

The CA FID UST database identified Limi Brothers Farm shop facility located at 11437 South Union Avenue. No further details were provided.

Orphan Sites

No orphan sites were identified less than one mile from the project site. The nearest sites are located at the junction of Taft Highway (SR-119) and SR-99, more than one mile to the north-northwest of the proposed Project. All of the orphan sites are off-site fueling stations/minimarts and none are situated upgradient of the proposed Project. These orphan sites are located at sufficient distances from the proposed Project such that they present no significant risks to the Project site.

Kern County Environmental Health Services (KCEHS) Department Records

The KCEHS was contacted in July 2008 regarding any records associated with aboveground storage tanks (ASTs), USTs, hazardous materials business plans (HMBPs), or hazardous materials incident reports (HMIRs) for the proposed Project site and surrounding locations. One soil remediation report was on file for the proposed Project site, in the location of the irrigation water wells. The remediation report for the proposed Project site was approved by KCEHS and a closure letter was issued on December 1, 2006. No other records were identified for the proposed Project.

One HMBP was identified for Higgins Auto Wrecking and two UST removal files were identified for Louis Limi Farm Shop and Young's Commercial Storage. The KCEHS issued a closure letter on for Louis Limi Farm Shop on October 8, 1991 and a closure letter for young's Commercial Storage on October 3, 1994. At the time the three facilities identified through KCEHS records review do not appear to represent current and/or material environmental risks to the Project site.

On June 26, 2017, KCEHS was contacted regarding the potential for records associated with Aboveground Storage Tanks (ASTs), Underground Storage Tanks (USTs), HMBPs, or Hazardous Materials Incident Reports (HMIRs) for the Project site and within a one-mile radius of the Project site. No HMBPs were on file with KCEHS for the Project site. However, KCEHS reported one Soil Remediation report and three UST removal files. KCEHS also reported several sites with a history of spills and Hazardous Material Business Inventories. Those sites specifically noted in the Hazardous Materials Evaluation (McIntosh & Associates 2017) are summarized below. Refer to Appendix F, *Hazardous Materials Evaluation*, and Appendix G, *Petroleum and Natural Gas Pipeline Assessment*, for further detail.

99 Houghton Industrial Park

In 2006, petroleum hydrocarbon impacted soil was observed in the vicinity of the location of two on-site irrigation wells along the west boundary, and in the northwest corner of, the Project site. Observations regarding soil were also made surrounding a waste oil AST, adjacent to a steel shop building located on the east side near South Union Avenue along Lamb Avenue (refer to Appendix F, *Hazardous Materials Evaluation*).

The Hazardous Materials Evaluation (McIntosh & Associates 2017) also notes information regarding characterizations and cleanups of petroleum hydrocarbon contaminated soil at the two irrigation wells and the waste oil AST in 2006. Impacted, non-hazardous soil, totaling 21.1 tons, was removed and transported to the McKittrick Waste Treatment Site in western Kern County for disposal and/or recycling. Confirmation samples were collected from each of the three on-site locations to ensure that the impacted soil had been removed to appropriate levels as required by the KCEHS. KCEHS issued

a December 1, 2006 closure letter indicating that no further action was required (refer to Appendix F, *Hazardous Materials Evaluation*).

Richard Limi Custom Harvesting

Richard Limi Custom Harvesting is located at 11437 South Union Avenue, approximately 0.45 miles northeast of the proposed Project. On September 19, 1991, one 10,000-gallon capacity, single wall, steel, diesel UST was removed for off-site destruction. Soil samples collected two feet beneath the dispenser exhibited diesel at 36 milligrams per kilogram (mg/kg), less than the KCEHS action level of 100 mg/kg. Groundwater was not affected. KCEHS subsequently issued a closure letter dated October 8, 1991, indicating that no further action was required (refer to Appendix F, *Hazardous Materials Evaluation).*

KCEHS did a routine Hazardous Material Business Plan Inventory (HMBPI) Inspection and Hazardous Waste Generator Inspection on May 26, 2015 at the site. No violations were observed. Limited materials are stored on-site and consist of gear oil, hydraulic oil, and motor oil (55 gallons each), used oil filters (350 pounds), waste oil (500 gallons, and oxygen (250 cubic feet) (refer to Appendix F, *Hazardous Materials Evaluation*).

Young's Commercial Transfer Company

Young's Commercial Transfer Company is located at 300 Buena Vista Road, approximately 0.21 miles east from the proposed Project. On February 18, 1992, two 10,000-gallon capacity, single-wall, steel, diesel USTs were removed and soil samples from under the tank were taken and analyzed. Approximately, 1,000 cubic yards of diesel impacted soil were removed from the former tank settings and bio-remediated on-site between November 1992 and July 1994. Monitoring wells indicated that petroleum hydrocarbons were not detected in groundwater during monitoring activities. A site closure report/letter dated August 11, 1994 indicating that no further action is needed at this site in relation to the former diesel underground tank (McIntosh & Associates 2017; refer to Appendix F, *Hazardous Materials Evaluation*).

Souza Properties

Souza Properties is located 9869 South Union Avenue approximately one-mile northeast of the proposed Project site. In March 1993, a fluid sample was taken from a small waste oil sump and it was determined that future testing was needed. On May 21, 1993 five USTs were removed and soil samples indicated that significant contamination existed beneath the tanks to a depth of 45 feet. On May 23, 1994, a Remedial Action Plan was implemented and excavation to 51 feet was undertaken. A total of 900 cubic yards of soil was removed and spread on-site to be treated via bioremediation and aerated. A closure letter was issues dated November 15, 1994 (McIntosh & Associates 2017; refer to Appendix F, *Hazardous Materials Evaluation*).

DOGGR Records

The primary mineral resource currently under development in portions of Kern County is oil. The proposed Project is located outside the administrative boundaries of any oil or gas field. DOGGR

Wildcat Map 4-2 and records searched as part of the records review for the Hazardous Materials Evaluation identified one plugged and abandoned exploratory oil well. The exploratory well, "Sea Cliff-Houghton" 1, was drilled by the Big McKittrick Oil Company of California between November 1934 and June 1935. The oil well was a dry hole that was subsequently abandoned by October 1935. Because the well was filled only with drilling mud prior to abandonment in 1935, the DOGGR requires that the well be reabandoned to current standards prior to construction.

DOGGR Wildcat Map W4-2 indicates that the nearest active producing oil fields are: the Mountain View Field approximately 4.75 miles northeast of the Project site; the Stockdale Field approximately 4.1 miles northwest of the Project site; and the Lakeside Field approximately 7.7 miles west of the Project site. The nearest producing gas field is the Paloma Field approximately 7.1miles southwest of the Project site (McIntosh & Associates 2017; refer to Appendix G, *Petroleum and Natural Gas Pipeline Assessment*).

Kern County Agricultural Department and Measurement Standards (Agricultural Commissioner)

The Kern County Agricultural Department and Measurement Standards (Agricultural Commissioner) has a monitoring program that maintains information about the farming companies, agricultural activities and pesticides use. A Restricted Materials Permit (RMP), obtained from the Agricultural Commissioner, is required for the application of chemicals to crops. The Project site has been utilized for agricultural purposes since the 1940s. Doug Kaiser Farms (DKF) is the current grower, and alfalfa is the current crop. DKF possesses RMP No. 1500666 for applications of pesticides and herbicides, which expired on December 31, 2008. Mitchell Property Management LP, Permit Number 1502896, was the grower for the years 2010 to 2017. A total of 45 pesticides, herbicides, fertilizers, and general soil amendments have been licensed for application to the proposed Project from the years until the year 2017.

Organochlorine pesticides are defined as persistent because they are stable in the environment and resist decay with time. Organochlorine pesticides include broad groups including: Hexachlorocyclohexane (Lindane), Dichiaro Diphenyl Trichloroethane (DDT) and related compounds, Dichlorodiphenyldichloroethylene (DDE) and Dichlorodiphenyldich loroethane (DOD), Cyclodienes (Aldrin, Heptachlor, and others), and Mirex and Chlordecone. The ability of these organochlorine pesticides to persist in the environment made them highly effective and therefore widely used in agricultural insect control efforts during the years 1940s to 1970s. Most organochlorine pesticides were banned for use in the United States by the mid-years 1980s; those that remain in legal use are the active, low concentration ingredients of some home and garden products and some agricultural and environments.

Table 4.9-2, *Chemicals Used On-Site Between 2008 and 2017* provides a summary of the agricultural crops and chemical products used within the proposed Project boundaries between 2008 and 2017.

Table 4.9-2. Chemicals Used On-site Between 2008 and 2017

Restricted Materials Permitted

Product Name	Years Permitted
41-A	2008, 2016

Table 4.9-2. Chemicals Used On-site Between 2008 and 2017

Restricted Materials Permitted

Product Name	Years Permitted
AD-WET	2008, 2011
BRANDT ONSITE	2016
BUCTRIL 4EC HERBICIDE	2008, 2010, 2011
BWC SPREADER 90	2010, 2011, 2012, 2014, 2015
CHLORPYRIFOS 4E AG	2009
CLARITY HERBICIDE	2008
COMITE	2014
DIMETHOATE 2.67 EC	2014
DRIFTSTOP	2010, 2011
FIRST CHOICE NO FOAM A	2009
GRAMOXONE INTEON	2011, 2012
HELENA PENETRATOR	2010
HERBIMAX	2009
HI=WETT SUPER-SPREADER	2016
HONCHO PLUS HERBICIDE	2011, 2016
INTENSITY ONE POST-EMERGENCE GRASS HERBICIDE	2016
LOCK-ON INSECTICIDE	2011, 2012
MAESTRO 4EC (CA)	2015
MIST-CONTROL (REVISE FORMULA)	2013, 2014, 2015
MSO CONCENTRATE WITH LECI-TECH	2011
NO FOAM B	2014
NUFARM RHOMENE MCPA BROADLEAF HERBIDIDE	2008, 2009
ON-SITE	2016
OUTLOOK I HERBICIDE	2016
POAST	2011
PROI(R) H20 HERBICIDE	2011, 2012, 2014, 2015, 2016
PURSUIT HERBICIDE	2009, 2010
QUEST	2010
RAMPART FUNGICIDE	2016
RAPTOR HERBICIDE	2008, 2009, 2010
RIDOMIL GOLD BRAVO SC	2016
RNA CROP OIL CONCENTRATE 1915	2008
ROUNDUP POWERMAX HER	2012, 2013, 2014, 2015, 2016
ROVRAL BRAND 4 FLOWABLE FUNGICIDE	2016
SHARK EW	2009
SILENCER	2013
SIMPLICITY CA	2016
SOURCE 1 NO FOAM B	2009
SURF-90	2016

Table 4.9-2. Chemicals Used On-site Between 2008 and 2017

Restricted Materials Permitted

Product Name	Years Permitted
SURROUND WP CROP PROTECTANT	2016
WARRIOR II WITH ZEON TECHNOLOGY	2011, 2016
VULCAN	2014
YUKON	2014
ZEAL WDG MITICIDE	2016

Source: McIntosh & Associates, Hazardous Materials Evaluation, 2017.

Site Reconnaissance

Hazardous materials and the generation of hazardous waste raise environmental concerns when altering, changing or developing land uses. Hazardous materials can take the form of petroleum products (including oil and gasoline), vehicular fluids, paint, solvents, cleaning fluids and pesticides. By-products generated as a result of activities using hazardous materials (such as dry-cleaning solvents, oil and gasoline) are considered to be hazardous waste. Commercial uses, especially those with underground storage tanks, are most suspected for the contamination of soils and groundwater. With remediation techniques and strict guidelines currently in practice, soil contamination (unlike groundwater contamination) typically does not pose a serious health risk. The Hazardous Materials Evaluation conducted for the proposed Project noted areas of concern, which are discussed below; for further detail refer to Appendix F, *Hazardous Materials Evaluation*, Appendix G, *Petroleum and Natural Gas Pipeline Assessment*, and Appendix N, *Original Technical Studies*.

A site reconnaissance was conducted on July 1, 2008. The objective of the site reconnaissance was to visually inspect, observe and record the current physical conditions of the proposed Project and surroundings. A subsequent site reconnaissance visit was conducted on June 15, 2017 for the proposed Project and the surrounding area. The site was evaluated using a record search and site visit for the purpose of obtaining information to locate recognized environmental conditions (RECs) such as hazardous substances and petroleum products in connection with the proposed Project, including soils, surface waters, and groundwater. Emphasis was placed on the on-site area to determine if visible and recognizable hazardous materials or substances were present.

On-Site Observations

The following are observations from the July 1, 2008 and June 15, 2017 proposed Project site reconnaissance. Photographs of these observations are available in the Hazardous Materials Evaluation (refer to Appendix F and Appendix N).

- The proposed Project was observed to be agricultural land and cultivated and ready for growing crops. Some areas of the Project site were in production and some appeared to be being prepared or were fallow.
- PG&E has single pole mounted transformers at the southwest corner and approximately in the center along the west boundary edge of the proposed Project. Steel irrigation standpipes were along the west boundary edge of the proposed Project site.

- Four PG&E single Pole-Mounted Transformers (PMTs) were observed on-site. A blue label was observed affixed to one of the PMTs, indicating that it is free of electrolytic fluid containing polychlorinated biphenyls (PCBs).
- In 2017, the proposed Project was observed to be agricultural land and alfalfa was the current crop at the time of the 2017 site visit.
- The west irrigation well, powered by a late-model Cummins engine with an associated diesel AST mounted on a flatbed trailer, was observed near the west boundary, one-half mile north of the southwest corner. A 5-gallon bucket containing a small amount of waste oil was observed between the AST and the pump turbine. No oil- or diesel-stained soil was observed about the location. A decomposing, concrete-lined irrigation ditch was observed adjacent to the well location.
- In 2008, the northwest irrigation well, powered by a late-model Cummins engine with an associated diesel AST mounted on a flatbed trailer, was observed near the northwest corner of the Project site. A 2-gallon, capped plastic container of waste oil was observed on the south side of the pump turbine. By 2017, the engine, AST and 2-gallon plastic container had been removed. Well is now idle. No oil- or diesel-stained soil was observed within the vicinity of the idle irrigation well.
- Steel irrigation standpipes were observed along the west boundary.
- An unlined ditch was observed on the south side of the Di Giorgio Road unpaved alignment at the northeast corner of the proposed Project site. The ditch marks the boundary between the proposed Project and the adjacent off-site agricultural land to the north. In 2008, the ditch was identified to contain rip-rap.
- The proposed Project has an electrically operated domestic water well with associated pressure and a storage tank on the north side of the easternmost portion of the Project site. There is one pole mounted electrical transformer located off-site and to the north of the domestic water well (4) PMT.
- A PG&E Company marker indicating the presence of a natural gas pipeline no. L-300B was observed along the west boundary.
- An off-site PG&E, South Union Avenue natural gas meter and regulation Station 269.45-B, within the chain link fence and gravel surface located at the northwest corner of South Union Avenue and Mugsy Avenue, approximately 1,333 feet north of Houghton Road.
- In the easternmost portion of the Project site, an electrically-operated domestic well with associated pressure and storage tanks was observed at the north boundary. A steel shop building fixed to a concrete foundation with a floor area of 3,840 square feet was observed south of the domestic well. Two transformers, an inoperable electrical switch panel, and a cylinder-shaped, propane AST were observed near the northeast corner of the building in 2008. Propane service lines were observed on the east side of the building. An open canopied carport, out-of-service electrical panel/meter, and one pole mounted electrical transformer located on the north side at the easternmost portion of the proposed Project.

- At the Houghton Road / Chevalier Road intersection at the proposed Project, adjacent to the tail water booster pump, brushy retention basin, wooden beehives and one pole mounted electrical transformer. The wooden beehives were observed on the north side of a dry, brushy tailwater pit located in the south portion of the Project site. An irrigation riser was observed at the west end of the tailwater pit.
- A dry tailwater pit was observed in the southwest corner of the easternmost portion of the Project site.
- An out-of-service electrical turbine for a well booster pump was observed on the west slope of the dry, brushy tailwater pit.
- Two older transformers, with an associated out-of-service electrical panel and meter, were observed west of the tailwater pit.
- Higgins Auto Wrecking, Inc. is located at 12825 South Union Avenue, adjacent to the proposed Project at the southeast corner of the Project site at the intersection of South Union Avenue and Houghton Road.
- Old tire, debris and palm fronds, and row of palm trees are along the east edge of the Project site and South Union Avenue.
- The adjacent property along South Union Avenue and the east edge of the proposed Project site have rural residential units with corrals and equestrian facilities.

Off-Site Observations

The following are observations for the properties surrounding the proposed Project. Observations are from both the July 1, 2008 and June 15, 2017 site reconnaissance's. Photographs of these observations are available in the Hazardous Materials Evaluation (refer to Appendix F and Appendix N).

- Agricultural Land and rural residential with corrals and equestrian facilities, and mobile homes along South Union Avenue and on the northeast, east and southeast adjacent to the proposed project. There is an automobile wrecking yard (Higgins Auto Wrecking, 12825 South Union Avenue) located adjacent to the southeast portion of the proposed Project.
- Approximately ¼-mile southeast of the steel shop building, a fenced, off-site PG&E natural gas facility with a gravel surface was observed at South Union Avenue, adjacent to the southeast corner of the easternmost portion of the Project site.
- A fenced PG&E natural gas valve station no. 269B was observed within an unpaved road easement along the south boundary of the easternmost portion of the Project site.
- An off-site irrigation well was observed immediately east of the northeast corner of the Project site.

On-Site Hazards of Potential Concern

Pole Mounted Electrical Transformers

There are four pole mounted electrical transformer that are located on the proposed Project site, and two addition pole mounted electrical transformers are adjacent to the proposed project. The ground

surface below each pole mounted electrical transformer displayed no evidence of discoloration from fluid leakage.

PG&E is the owner of the PMTs. Mr. Mark Maytubby of PG&E reported that PMTs installed subsequent to 1990 likely did not contain polychlorinated biphenyl (PCB) insulating fluids. PMTs labeled with blue "non-PCB" stickers do not contain PCB fluids. Based on the visual absence of apparent unauthorized releases of insulating fluids from the on-site PMTs during the site reconnaissance activities, the on-site PMTs are not currently anticipated to pose adverse impacts. PG&E should be contacted regarding the disposition of these PMTs prior to development of the Project site. The electrical transformers located within the Project site are summarized in Table 4.9-3 *Electrical Transformers On-Site*.

Table 4.9-3. Electrical Transformers On-Site

Location	Number of *PMTs	*PG&E Power Rating	Year Installed
PMT– (1) - Southwest corner of the proposed project on the north side of the Houghton Road overpass.	1	15 *KvA [1]	1990
PMT– (2) - Along the west boundary adjacent to the overhead electric freeway message sign.	1	15 *KvA [1]	1994
PMT– (3) – Off–site - Adjacent to the Northeast corner of the proposed project. Blue label affixed to the transformer, indicating that it is free of electrolytic fluid containing *PCBs.	1	150 *KvA [3]	1999 [B]
PMT– (4) – Off-site – North of the electrically operated domestic water well and storage tank	1	15 *KvA [1]	2007 [B]
PMT– (5) - Located north of the Northeast corner of steel shop building on the proposed project	2	15 *KvA [1] 25 *KvA [1]	1991 1976
PMT– (6) - North of Houghton Road on the proposed project and adjacent to the tail water booster pump and brushy retention basin	1	10 *KvA [1] 10 *KvA [1]	1986 1986

Source: McIntosh & Associates, 2017.

[1] Single-Phase Transformer

[3] Three-Phase Transformer

[B] Blue sticker indicates transformer is confirmed PCB-free–*KvA - Kilovolt-Amperes

–PG&E - Pacific Gas and Electric Company

*PMTs – Pole Mounted Transformers

*PCBs – Polychlorinated Biphenyls

Pacific Gas and Electric Company Subsurface Pipelines

PG&E 34-inch diameter active natural gas transmission pipeline (Line 300-B) underlies the proposed project. The 34-inch diameter pipeline external coating includes primer, paint, two coats of asphalt, and two layers of felt. The depth of the pipeline is estimated at 36 inches to 60 inches below surface which allows the surface farmer to shallow plow and disc the soil above the pipeline a reasonable amount without endangering the pipeline. The natural gas transmission pipeline maximum operating pressure is approximately 700 pounds per square inch gauge (psig). The natural gas transmission pipeline traverses from SR-99 in the northwest to the south line bordering the easternmost portion of the proposed Project. The natural gas transmission pipeline then traverses due east for approximately 0.25 mile passing through the off-site PG&E (South Union Avenue natural gas meter and regulation Station 269.45-B), located at the northwest corner of South Union Avenue and Mugsy Avenue, which is located 1,333 feet north of Houghton Road.

PG&E operates a 6-inch diameter steel natural gas distribution pipeline operating at a maximum pressure of 60 psig parallels the west right-of-way of South Union Avenue, a 2-inch plastic distribution pipeline operating at a maximum pressure of 60 psig parallels the east right-of-way of South Union Avenue, and a 3-inch distribution pipeline operating at a maximum pressure of 60 psig parallels the north right-of-way of Houghton Road. Only the 6-inch pipeline has a segment adjacent to the proposed Project, which will require street improvements above the pipeline. The pipelines locate on-site are shown in Table 4.9-4, *Pipelines On-Site*.

Table 4.9-4. Pipelines On-Site

Pipeline Identifier	Diameter Pipeline	Year Installed	Operating Pressure Pounds Per Square Inch
(PG&E*) Natural Gas Transmission Pipeline (Line 300-B) underlies the proposed project	34 Inches	1950	700
(PG&E*) Natural Gas Distribution Pipeline traverses north to south along the west side of South Union Avenue right-a-way	6 Inches	Not available	60

Agricultural Activities

The Project site has been in agricultural production since the 1940s. The Agriculture Commissioner records revealed that herbicides, insecticides, pesticides and other chemicals were used on the proposed Project area. The years of agricultural activity conducted on the Project site has included the application of pesticides, herbicides and associated metals, which may be present in near surface soils at residual concentrations of concern. However, it is not known if environmentally-persistent pesticides and herbicides were applied to the proposed Project site.

Asbestos Containing Materials

It is possible that asbestos-containing materials could be present in subsurface concrete irrigation (transite) pipe on the site. Concrete pipe was documented in information obtained from the Kern County Assessor-Recorder's Office.

Oilfield Activities

DOGGR online website records and the Wildcat Map W4-1 identified that one exploration oil well was drilled near the north boundary of the proposed Project. The Big McKittrick Oil Company drilled one exploration well "Sea Cliff-Houghton", Well Number 1, and American Petroleum Institute (API) Number 02932362 on October 31, 1934, which was drilled to a depth of 6,756 feet. The well is east of present SR-99, along Di Giorgio Road and along the north portion of the proposed project. The well failed to produce oil or gas and was subsequently abandoned in October 9, 1935 (McIntosh & Associates 2017).

Water Wells

Two irrigation wells are located on-site. The first irrigation well is located in the western portion of the Project site and is identified as well no. 31S28E-7P1. The second irrigation well is located in the northwestern portion of the site and is identified as well no. 31S28E-7D1. These wells were confirmed during the site reconnaissance. Well no. 31S28E-7P1 is powered by late-model Cummins engine with

an associated diesel AST mounted on a flatbed trailer. Waste oil containers were observed between the AST and the pump turbine at this location in 2008, but removed since. The Cummins engine at well no. 31S28E-7D1 has been removed, and the well is now idle. Waste oil containers were observed on the south side of the pump turbine at this well location in 2008, but removed since.

As discussed previously, in the fall of 2006, petroleum-stained soil was removed from each well irrigation location and transported to the McKittrick Waste Site in western Kern County. No oil- or diesel-stained soil was observed at either well location. The wells would need to be properly abandoned per KCEHS standards prior to development. If the wells are not used in the planned development, they should be destroyed in accordance with California SWR and KCEHS requirements.

4.9.3 Regulatory Setting

Federal

U.S. Environmental Protection Agency (USEPA)

The USEPA was established in 1970 to consolidate in one agency a variety of Federal research, monitoring, standard-setting, and enforcement activities to ensure environmental protection. The USEPA's mission is to protect human health and to safeguard the natural environment - air, water, and land - upon which life depends. The USEPA works to develop and enforce regulations that implement environmental laws enacted by Congress, is responsible for researching and setting national standards for a variety of environmental programs, and delegates to states and tribes the responsibility for issuing permits and for monitoring and enforcing compliance. Where national standards are not met, the USEPA can issue sanctions and take other steps to assist the states and tribes in reaching the desired levels of environmental quality.

Federal Toxic Substances Control Act/Resource Conservation and Recovery Act (RCRA)/Hazardous and Solid Waste Act (HSWA)

The Federal Toxic Substances Control Act (1976) and the RCRA of 1976 established a program administered by the USEPA for the regulation of the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA was amended in 1984 by the HSWA, which affirmed and extended the “cradle to grave” system of regulating hazardous wastes.

Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA)

CERCLA, commonly known as Superfund, was enacted by Congress on December 11, 1980. This law (U.S. Code Title 42, Chapter 103) provides broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA establishes requirements concerning closed and abandoned hazardous waste sites; provides for liability of persons responsible for releases of hazardous waste at these sites; and, establishes a trust fund to provide for cleanup when no responsible party can be identified. CERCLA also enables

the revision of the National Contingency Plan (NCP). The NCP (Title 40, Code of Federal Regulation [CFR], Part 300) provides the guidelines and procedures needed to respond to releases and threatened releases of hazardous substances, pollutants, and/or contaminants. The NCP also established the National Priorities List (NPL). CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986.

Clean Water Act (CWA)/Spill, Prevention, Control, and Countermeasure (SPCC) Rule

The CWA (33 U.S.C. Section 1251 et seq., formally the Federal Water Pollution Control Act of 1972), was enacted with the intent of restoring and maintaining the chemical, physical, and biological integrity of the waters of the United States. As part of the CWA, the USEPA oversees and enforces the Oil Pollution Prevention regulation contained in Title 40 of the CFR, Part 112 (Title 40 CFR, Part 112), which is often referred to as the "SPCC rule" because the regulations describe the requirements for facilities to prepare, amend, and implement SPCC plans. A facility is subject to SPCC regulations if a single oil storage tank has a capacity greater than 660 gallons, or the total above ground oil storage capacity exceeds 1,320 gallons, or the underground oil storage capacity exceeds 42,000 gallons, and if, due to its location, the facility could reasonably be expected to discharge oil into or upon the "navigable waters" of the U.S.

Other Federal regulations overseen by the USEPA relevant to hazardous materials and environmental contamination include Title 40 CFR Chapter 1, Subchapter D – Water Programs and Subchapter I – Solid Wastes. Title 40 CFR Chapter 1, Subchapter D, Parts 116 and 117 designate hazardous substances under the CWA. Title 40 CFR Part 116 sets forth a determination of the reportable quantity for each substance that is designated as hazardous. Title 40 CFR Part 117 applies to quantities of designated substances equal to or greater than the reportable quantities that may be discharged into waters of the U.S.

Occupational Safety and Health Administration (OSHA)

OSHA's mission is to ensure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health. OSHA staff establishes and enforces protective standards and reaches out to employers and employees through technical assistance and consultation programs. OSHA standards are listed in Title 29 CFR Part 1910.

National Weather Service (NWS)

Under extreme fire weather conditions, the NWS issues Red Flag Warnings for all affected areas. A Red Flag Warning means that any ignition could result in a large-scale damaging wildfire. The NWS region encompassed by the project is the San Joaquin Valley/Hanford region. Red Flag Warning criteria for are as follows: the area contains dry fuels, the National Fire Danger Rating System is high to extreme, and the following forecast weather parameters are: 1) relative humidity is 25 percent or less; 2) a sustained wind average of 15 mph or greater; and 3) a temperature of more than 75 degrees Fahrenheit (°F) (NWS, 2014).

Transportation Emergency Preparedness Program

The U.S. Department of Energy (DOE) Office of Environmental Management implements the Transportation Emergency Preparedness Program (TEPP) through the Office of Transportation. TEPP integrates a basic approach to transportation emergency planning and preparedness activities under a single program with the goal to ensure DOE, its operating contractors, and state, tribal, and local emergency responders are prepared to respond promptly, efficiently, and effectively to accidents involving DOE shipments of radioactive material. The TEPP mission is to ensure that federal, state, tribal, and local responders have access to the plans, training, and technical assistance necessary to safely, efficiently, and effectively respond to transportation accidents involving DOE-owned radioactive materials. To accomplish this mission, a suite of tools has been developed to aid the response jurisdictions in their readiness activities.

State

Division of Oil, Gas and Geothermal Resources (DOGGR)

The DOGGR is the State agency responsible for supervising the drilling, operation, maintenance, plugging and abandonment of oil, gas and geothermal wells. DOGGR's regulatory program promotes the wise development of oil, natural gas and geothermal resources in California through sound engineering practices, prevention of pollution and ensurance of public safety. To implement this program, DOGGR recommends avoidance of building over or near plugged and abandoned wells, or the replugging of wells to current DOGGR standards.

Department of Toxic Substances Control (DTSC)

The Department of Toxic Substances Control (DTSC) is responsible for restoration, protection and enhancement of the environment; ensuring public health, environmental quality and economic vitality through regulating hazardous waste; conducting and overseeing cleanups; and developing and promoting pollution prevention. DTSC implements programs that oversee cleanups, prevent releases by ensuring waste is properly generated, handled, transported, stored and disposed of; enforcing laws; promoting pollution reduction; encouraging recycling and reuse; conducted toxicological evaluations; and involving the public in decisions. DTSC also oversees the siting and cleanup of schools.

DTSC maintains the CORTESE List for use by State and local agencies to provide information about hazardous release sites. This list includes the Site Mitigation and Brownfields Reuse Program Database (CalSites).

California Environmental Protection Agency (Cal/EPA)

The Cal/EPA was created in 1991, which unified California's environmental authority in a single cabinet-level agency and brought the California Air Resources Board (CARB), State Water Resources Control Board (SWRCB), Regional Water Quality Control Boards (RWQCBs), California Department of Resources Recycling and Recovery (CalRecycle) - formerly the Integrated Waste Management Board (IWMB), DTSC, Office of Environmental Health Hazard Assessment (OEHHA), and Department of Pesticide Regulation (DPR) under one agency. These agencies were

placed within the Cal/EPA "umbrella" for the protection of human health and the environment and to ensure the coordinated deployment of State resources. Their mission is to restore, protect, and enhance the environment, to ensure public health, environmental quality, and economic vitality.

DTSC is a department of Cal/EPA and is the primary agency in California that regulates hazardous waste, cleans up existing contamination, and looks for ways to reduce the hazardous waste produced in California. DTSC regulates hazardous waste in California primarily under the authority of RCRA and the California Health and Safety Code. Other laws that affect hazardous waste are specific to handling, storage, transportation, disposal, treatment, reduction, cleanup, and emergency planning.

California Office of Emergency Services (OES)

In order to protect the public health and safety and the environment, the California Office of Emergency Services (OES) is responsible for establishing and managing statewide standards for business and area plans relating to the handling and release or threatened release of hazardous materials. Basic information on hazardous materials handled, used, stored, or disposed of (including location, type, quantity, and the health risks) needs to be available to firefighters, public safety officers, and regulatory agencies and needs to be included in business plans in order to prevent or mitigate the damage to the health and safety of persons and the environment from the release or threatened release of these materials into the workplace and environment. These regulations are covered under Chapter 6.95 of the California Health and Safety Code Article 1–Hazardous Materials Release Response and Inventory Program (Sections 25500 to 25520) and Article 2–Hazardous Materials Management (Sections 25531 to 25543.3).

CCR Title 19, Public Safety, Division 2, Office of Emergency Services, Chapter 4–Hazardous Material Release Reporting, Inventory, and Response Plans, Article 4 (Minimum Standards for Business Plans) establishes minimum statewide standards for Hazardous Materials Business Plans (HMBPs). These plans shall include the following: (1) a hazardous material inventory in accordance with Sections 2729.2 to 2729.7; (2) emergency response plans and procedures in accordance with Section 2731; and, (3) training program information in accordance with Section 2732. Business plans contain basic information on the location, type, quantity, and health risks of hazardous materials stored, used, or disposed of in the State. Each business shall prepare a HMBP if that business uses, handles, or stores a hazardous material or an extremely hazardous material in quantities greater than or equal to the following:

- 500 pounds of a solid substance;
- 55 gallons of a liquid;
- 200 cubic feet of compressed gas;
- A hazardous compressed gas in any amount; or,
- Hazardous waste in any quantity.

California Occupational Safety and Health Administration (Cal/OSHA)

Cal/OSHA is the primary agency responsible for worker safety in the handling and use of chemicals in the workplace. Cal/OSHA standards are generally more stringent than Federal regulations. The

employer is required to monitor worker exposure to listed hazardous substances and notify workers of exposure (8 CCR Sections 337-340). The regulations specify requirements for employee training, availability of safety equipment, accident-prevention programs, and hazardous substance exposure warnings.

California Highway Patrol (CHP)

A valid Hazardous Materials Transportation License, issued by the CHP, is required by the laws and regulations of State of California Vehicle Code Section 3200.5 for transportation of either:

- Hazardous materials shipments for which the display of placards is required by State regulations; or,
- Hazardous materials shipments of more than 500 pounds, which would require placards if shipping greater amounts in the same manner.

Additional requirements on the transportation of explosives, inhalation hazards, and radioactive materials are enforced by the CHP under the authority of the State Vehicle Code. Transportation of explosives generally requires consistency with additional rules and regulations for routing, safe stopping distances, and inspection stops (Title 14, CCR, Chapter 6, Article 1, Sections 1150-1152.10). Inhalation hazards face similar, more restrictive rules and regulations (Title 13, CCR, Chapter 6, Article 2.5, Sections 1157-1157.8). Radioactive materials are restricted to specific safe routes for transportation of such materials.

Hazardous Material Business Plan

The State of California requires an owner or operator of a facility or business to complete and submit a Hazardous Material Business Plan (HMBP) to the Kern County Public Health Services Department if the facility or business handles a hazardous material or mixture containing a hazardous material that has a quantity at any one time during the reporting year equal to or greater than: 55 gallons; 500 pounds; 200 cubic feet at standard temperature and pressure for a compressed gas; any amount of hazardous waste; or amounts of radioactive materials requiring an emergency plan pursuant to Parts 30, 40, or 70 of Title 10, Code of Federal Regulations. Lower threshold quantities may be required for acutely hazardous substances. Pursuant to Health and Safety Code Section 25504 (a-c), an HMBP is required to contain detailed information on:

- Hazardous materials at the facility;
- Emergency response plans and procedures in the event of the reportable release or threatened release of a hazardous material; and
- Training for all new employees and annual training, including refresher courses, for all employees in safety procedures in the event of a release or threatened release of a hazardous material.

The intent of the HMBP is to provide basic information necessary for use by first responders in order to: prevent or mitigate damage to the public health and safety and to the environment from a release or threatened release of a hazardous material; and to satisfy federal and State Community Right-to-Know laws.

California Government Code

Government Code Section 65962.5 requires the DTSC, State Department of Health Services, the State Water Resources Control Board and the California Integrated Waste Management Board to assemble and annually update lists of hazardous waste sites and hazardous waste properties within California. The Secretary for Environmental Protection distributes these lists to each city and county where sites on the lists are located. Prior to approval of a development project by a lead agency the applicant shall consult these lists to determine that the project site is not listed.

California Public Resources Code

CEQA statute 21092.6 requires land agencies to consult with the compiled lists discussed above to determine whether a project or alternatives are located on a hazardous waste site.

California Education Code

The California Education Code Section 17213(a)(3) prohibits the approval of a school site if the site "contains one or more pipelines, situated underground or aboveground, which carries hazardous substances, acutely hazardous substances, or hazardous wastes, unless the pipeline is a natural gas line which is used only to supply natural gas to that school or neighborhood."

California Education Code Section 17213.1 requires DTSC to be involved in the environmental review process for the acquisition or construction of a school property utilizing state funding. The responsible school board is required to contract with an environmental assessor to supervise the preparation of a site evaluation to determine the potential for hazards or hazardous materials to exist on or near the site that could affect future staff and students, prior to acquiring a school site.

Petroleum and Natural Gas Pipelines

Pipelines that transport petroleum and natural gas are regulated by the following federal and state agencies:

- US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (OPS).
- California Department of Forestry and Fire Protection, Office of the State Fire Marshal (OSFM).

A setback is a minimum distance required by zoning to be maintained between structures, or between structures and property lines. Kern County has not passed a zoning ordinance specifically addressing the setback distance for petroleum and natural gas pipelines. The Kern County Fire Department has not established setbacks from hazardous liquid pipelines to structures (McIntosh & Associates 2017).

The OSFM restricts encroachments into or on hazardous liquid pipeline easements per Informational Bulletin 03-001 (revised March 13, 2017) as follows:

Section 51014.6 of the California Government Code states the following:

a) Effective January 1, 1987, no person, other than the pipeline operator shall do any of the following with respect to any pipeline easement:

   i. Build, erect or create a structure or improvement within the pipeline easement or permit the building, erection or creation thereof.

   ii. Build, erect or create a structure, fence, wall or obstruction adjacent to any pipeline easement which would prevent complete and impaired surface access to the easement, or permit the building, erection or creation thereof.

b) No shrubbery or shielding shall be installed on the pipeline easement which would impair aerial observation of the pipeline easement. This subdivision does not prevent the revegetation of any landscape disturbed within a pipeline easement as a result of construction of the pipeline and does not prevent the holder of the underlying fee interest or the holder's tenant from planting and harvesting seasonal agricultural crops on a pipeline easement.

c) This section does not prohibit a pipeline operator from performing any necessary activities within a pipeline easement, including, but not limited to the construction, replacement, relocation, repair or operation of the pipeline.

It is the position of the State Fire Marshal that nothing shall encroach into or upon the pipeline easement, which would not impede the pipeline operator from complete and unobstructed surface access along the pipeline ROW, nor shall there by any obstructions which would shield the pipeline ROW from observation. In the interest of public safety and the protection of the environment, it is imperative that the pipeline operator visually assess conditions along the easement to ensure the integrity of the pipeline.

It is the responsibility of the pipeline operator to ensure unimpeded surface access and retain the ability to physically observe all portions of their pipeline rights-of-way. In cases where this is not possible, the pipeline operator shall inform the State Fire Marshall. The State Fire Marshall shall, in conjunction with the pipeline operator, resolve the issue.

The pipeline corridor is the pathway through the jurisdiction (city or county) in which the pipelines and facilities of a pipeline operator are located, including public rights-of-way and easements over and through public or private property. The setback distance shall be measured from the nearest edge of the pipeline corridor.

Pipeline Marker Signs

Transmission and distribution pipelines located both on-site and off-site are recognized by marker signs installed along their respective routes. The signs indicate the approximate location of the pipeline corridor and provide the name of the pipeline company of ownership and toll-free telephone number where the company can be reached in the event of a suspected or witnessed pipeline emergency. It is against the law for any person to willfully and knowingly deface, damage, remove, or destroy any pipeline marker sign or ROW marker. It should be noted that markers placed near

pipelines may not directly overlie them, and a pipeline may not follow a straight line between each marker.

Truck Routes

Currently, Federal regulations allow transportation of hazardous radioactive materials on all interstate highways. Trucks traveling from the highway to sites that use such materials (such as hospitals or nuclear power plants) are allowed to use the most direct route. The California Highway Patrol (CHP) has adopted Interstate 5 (I-5) as a truck route for transporting hazardous radioactive materials.

The Circulation Element of the Metropolitan Bakersfield General Plan designates specific roadways on which trucks may travel within and through the Metropolitan Bakersfield area. These routes direct trucks away from streets that are inappropriate or inadequate to serve substantial truck traffic. Trucks are allowed to access locations on local streets for site deliveries (e.g., goods delivery or moving cars); however, they must take the most direct route to and from the designated truck routes. None of the streets surrounding the proposed Project site are identified as a truck route within the Metropolitan Bakersfield General Plan Circulation Element.

Local

Metropolitan Bakersfield General Plan (MBGP)

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals, policies and implementation measures in order to reduce impacts related to public safety. Applicable hazards/hazardous materials goals and policies relative to the proposed Project are listed in Table 4.9-5, *Metropolitan Bakersfield General Plan Goals and Policies for Hazards/Hazardous Materials*, below.

Table 4.9-5. Metropolitan Bakersfield General Plan Goals and Policies for Hazards/Hazardous Materials

Goals and Policies: Public Safety Element
Goal #1: Ensure that the Bakersfield metropolitan area maintains a high level of public safety for its citizenry.
Goal #2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development of metropolitan police and fire facilities and services.
Goal #3: Provide for the coordinated planning and development of service areas for police and fire protection to ensure an equitable burden of responsibility between County and City in Metropolitan Bakersfield.
Policy #4: Monitor, enforce and update as appropriate all emergency plans as needs and conditions in the Planning area change, including the California Earthquake Response Plan, the Kern County Evacuation Plan, and the City of Bakersfield Disaster Plan.
Policy #6: Promote fire prevention methods to reduce service protection costs and costs to the taxpayer.
Policy #7: Enforce ordinances regulating the use/manufacture/sale/transport/disposal of hazardous substances and require compliance with state and federal laws regulating such substances.

Table 4.9-5. Metropolitan Bakersfield General Plan Goals and Policies for Hazards/Hazardous Materials
Goals and Policies: Public Safety Element
Policy #8: The Kern County and Incorporated Cities Hazardous Waste Management Plan and Final Environmental Impact Report serves as the policy document guiding all facets of hazardous waste.
Policy #9: Restrict, after appropriate public hearings, the use of fire-prone building materials in areas defined by the fire services as presenting high-conflagration risk.

Kern County and Incorporated Cities Hazardous Waste Management Plan (HWMP)

In response to the growing concern regarding hazardous waste management, State Assembly Bill (AB) 2948 enacted legislation authorizing local government to develop comprehensive hazardous waste management plans (HWMP). The intent of each plan is to assure that adequate treatment and disposal capacity is available to manage the hazardous wastes generated within this jurisdiction. The Kern County and Incorporated Cities HWMP was first adopted by Kern County and each incorporated city before September 1988 and was subsequently approved by the State Department of Health Services. The HWMP is incorporated by reference into both the Metropolitan Bakersfield General Plan, as permitted by Health and Safety Code Section 25135.7(b), and thus must be consistent with all other aspects of both general plans.

The HWMP provides policy direction and action programs to address current and future hazardous waste management issues that require local responsibility and involvement in Kern County. In addition, the HWMP discusses hazardous waste issues and analyzes current and future waste generation in the incorporated cities, County and State and Federal lands.

The purpose of the HWMP is to coordinate local implementation of a regional action to effect comprehensive hazardous waste management throughout Kern County. The action program focuses on development of programs to equitably site needed hazardous waste management facilities; to promote on-site source reduction, treatment and recycling; and to provide for the collection and treatment of small quantity hazardous water generators.

Prior to or during construction, the remediation of hazardous materials within the proposed Project site will require the removal of hazardous materials from the Project site. Although none of the surrounding roads are identified as truck routes, pursuant to the Metropolitan Bakersfield General Plan Circulation Element, trucks hauling the hazardous materials away from the site are allowed to use the surrounding roads as long as they utilize the most direct route to designated truck routes.

Kern County Emergency Health and Safety Division

The Kern County Emergency Health and Safety Division (KCEHSD) provides oversight for locations within county jurisdiction that pose a threat to human health and safety.

Kern County Wildland Fire Management Plan

The Kern County Wildland Fire Management Plan documents the assessment of wildland fire situations throughout the SRAs within the County. The Kern County Fire Department Wildland Fire Management Plan provides for systematically assessing the existing levels of wildland protection services and identifying high-risk and high-value areas that are potential locations for costly and

damaging wildfires. The goal of the plan is to reduce costs and losses from wildfire by protecting assets at risk through focused pre-fire management prescriptions and increasing initial attack success. Based on this assessment, preventive measures are implemented, including the creation of wildfire protection zones.

Kern County Building and Construction Ordinance (Title 17 of the Ordinance Code of Kern County)

Chapter 17.32 Fire Code

> Kern County has adopted, by reference, portions of the California Building Standards Code and the International Fire Code, with modifications and amendments. The purpose of this code is to prescribe the minimum requirements necessary to establish a reasonable level of fire safety to protect life and property from hazards created by fire, explosion, and dangerous conditions.
>
> The Kern County Fire Code defines a hazardous fire area as any land that is covered with grass, grain, brush, or forest and situated (e.g., in an inaccessible location) so that a fire originating upon such land would present an abnormally difficult job of suppression and would result in great and unusual damage through fire or the resulting erosion.

Chapter 17.34 Wildland-Urban Interface Code

> Kern County has adopted, by reference the Urban Wildland Interface Code, published by the International Fire Code Institute, with modifications and amendments. The purpose of this code is to safeguard life and property and maintain public welfare to a reasonable degree by addressing hazards related to wildland fire exposures and fire exposures from adjacent structures, and to prevent structure fires from spreading to wildland fuels.

Kern County Operational Area Hazardous Materials Area Plan

The Hazardous Materials Area Plan identifies local, State, and Federal responsibilities during incidents involving the release or threatened release of hazardous substances. According to the Kern County Operational Area Hazardous Materials Area Plan (Kern County Public Health Services Department, 2011):

> [H]azardous materials emergencies are the result of threatened releases, highway accidents, clandestine drug laboratories, train derailments, pipeline transportation accidents, pesticide drift incidents, or related fire and/or spills at fixed facilities.

4.9.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative basis through a comparison of existing conditions within the proposed Project site and the anticipated Project effects. The potential for impacts to hazards/hazardous materials would occur if the effect described under the criteria below occurs. The evaluation of Project impacts is based on professional judgment, analysis of the County's hazards/hazardous materials policies, and the significance criteria established by Appendix G of the State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accidental conditions involving the release of hazardous materials into the environment;
- Emit hazardous emissions or handle hazardous or acutely hazardous, substances, or waste within one-quarter mile of an existing or proposed school;
- Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment;
- For a project located within the adopted Kern County Airport Land Use Compatibility Plan results in a safety hazard for people residing or working in the project area;
- For a project within the vicinity of a private airstrip, results in a safety hazard for people residing or working in the project area;
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan;
- Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

The analysis of the existing environment and the impact analysis indicate that this proposed Project could result in a significant environmental impact if it would result in a release of hazardous materials that would, if not mitigated, adversely affect the public health and safety of future residents, surrounding residents and workers.

Project Impacts

Impact 4.9-1: The Project Would Create in a Significant Hazard to the Public or the Environment Through the Routine Transport, Use or Disposal of Hazardous Materials.

The Kern County and Incorporated Cities Hazardous Waste Management Plan (HWMP) lists goals and policies regarding the transport of hazardous wastes. The HWMP recognizes that the transportation of hazardous waste on roads poses a short-term threat to public health; of prime concern is the safety of the transportation system for hazardous waste, especially extremely hazardous waste, in and throughout Kern County. The HWMP seeks to establish State and federally maintained roads as candidate Commercial Hazardous Waste Shipping Routes in and through the County (except those to collect locally generated hazardous wastes). The current Metropolitan Bakersfield General Plan does not identify designated hazardous material shipping routes. The Kern County General Plan shows the nearest hazardous materials shipping routes to the Project site as the following: SR-99 (adjacent to the western proposed Project boundary); Interstate (I) 5 (approximately 7.5 miles west), and SR-58 (approximately 7.5 miles north).

The proposed Project would introduce approximately 4,613,004 square feet of light and service industrial, and general commercial and highway commercial land uses, which could include warehousing, distribution, and retail showroom uses. Industrial uses often involve the transport of hazardous materials. Because the proposed Project is located adjacent to SR-99, potential delivery trucks would transport materials and chemicals along a County designated hazardous materials shipping route. In addition, the proposed Project is located in an area that is currently surrounded by agricultural and some industrial (i.e., automobile wrecking yard) land uses. The number of deliveries in the area would increase; however, there is already the presence of hazardous material transport within the vicinity of the proposed Project. While the risk of exposure to hazardous materials cannot be fully eliminated, measures can be implemented to maintain risks at acceptable levels. As described above, several federal, state, and local regulatory agencies oversee hazardous materials transportation. Oversight by the appropriate agencies and compliance with applicable regulations are considered adequate to offset the negative effects related to the transport of hazardous materials within the proposed Project area.

The proposed Project would include a private package sewer treatment plant to provide sewer services for the Project site. Sewer System for the proposed Project area has never been provided, and currently the neighboring residential and commercial properties are served by individual and privately owned septic systems. The developer would be required to construct a new wastewater plant facility for the proposed Project that could cause significant environmental effects. Based on wastewater generation rate for general commercial and industrial development uses utilized by the County of Kern, the proposed project would result in the generation of a normal, unpeaked flow of approximately 1.46 million gallons per day, with a peak flow maximum generation rate of 2.91 million gallons per day of wastewater. The new wastewater package plant facility would be constructed according to State specifications and would be operated in such a way as to not contaminate the underlying unconfined aquifer, and not cause a nuisance to existing agricultural land, neighboring residential and commercial properties.

In accordance with the California Health and Safety Code and Kern County regulations, the Project applicant would be required to prepare and submit a HMBP for any uses that would require the use

and storage of hazardous materials (such as a wastewater treatment facility, water treatment facility, maintenance facilities, emergency response services).

Compliance with state and federal law, and the Metropolitan Bakersfield General Plan, as well as the implementation of mitigation measures would ensure impacts associated with routine transport, use, or disposal of hazardous waste during construction or operation of the proposed Project are reduced to less than significant levels.

Mitigation Measures

MM 4.9-1: **Hazardous Materials Business Plan.** During the life of the project, including decommissioning, the project operator shall prepare and maintain a Hazardous Materials Business Plan (HMBP), as applicable, pursuant to Article 1 and Article 2 of California Health and Safety Code 6.95 and in accordance with Kern County Ordinance Code 8.04.030, by submitting all the required information to the California Environmental Reporting System (CERS) at http://cers.calepa.ca.gov/ for review and approval. The HMBP shall:

- Delineate hazardous material and hazardous waste storage areas
- Describe proper handling, storage, transport, and disposal techniques
- Describe methods to be used to avoid spills and minimize impacts in the event of a spill
- Describe procedures for handling and disposing of unanticipated hazardous materials encountered during construction
- Establish public and agency notification procedures for spills and other emergencies including fires.
- Include procedures to avoid or minimize dust from existing residual pesticides and herbicides that may be present on the site

The project proponent shall ensure that all contractors working on the project are familiar with the facility's HMBP as well as ensure that one copy is available at the project site at all times. In addition, a copy of the approved HMBP from CERS shall be submitted to the Kern County Planning and Natural Resources Department for inclusion in the projects permanent record.

MM 4.9-2: **Spill Prevention Control and Countermeasures (SPCC) Response Plan.** Prior to the issuance of a certificate of occupancy for an individual parcel project which exceeds any of the thresholds established by Title 40, Code of Federal Regulations, Part 112, related to facilities requiring a Spill Prevention Control and Countermeasures (SPCC) Response Plan, the individual parcel proponent shall prepare and submit an SPCC Response Plan to the Kern County Public Health Services Department/Environmental Health Division and the California Department of Water Resources. The individual parcel proponent shall ensure the project is

implemented in compliance with the approved Spill Prevention Control and Countermeasures Response Plan.

~~**MM 4.9-3: Hazardous Waste Exclusion/Business Plan.** The individual parcel proponent shall continuously comply with the following:~~

~~1. All hazardous wastes shall be stored and properly managed in accordance with the approved Kern County Waste Management Department Hazardous Waste Exclusion Plan and Hazardous Materials Business Plan, until transported for proper disposal.~~

~~2. A copy of the Hazardous Waste Exclusion Plan shall be submitted to the Kern County Planning and Natural Resources Department.~~

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-2: The Project Would Create a Significant Hazard to the Public or the Environment Through Reasonably Foreseeable Upset and Accidental Conditions Involving the Release of Hazardous Materials into the Environment.

Project construction activities are not anticipated to result in a significant release of hazardous materials into the environment. However, during construction, there is a possibility of accidental release of hazardous substances, such as spilling petroleum-based fuels used for construction equipment. The level of risk associated with the accidental release of hazardous substances is not considered significant because of the small volume and low concentration of hazardous materials utilized during the construction phases. The Project contractor would be required to use standard construction controls and safety procedures that would avoid and minimize the potential for accidental release of such substances into the environment. Standard construction practices would be observed such that any materials released would be appropriately contained and remediated as required by local, State, and Federal law.

Light and medium industrial uses may result in increased risks from hazardous materials. These types of uses may allow the installations of ASTs and USTs utilized for fueling vehicles and backup generators (this short list is not all-inclusive). These uses could potentially result in environmental impacts from hazardous materials and/or substances; however, various government entities require permits for the hazardous materials concerns. These various permits require controls that would reduce the potential impacts to a less than significant level. The proposed Project would comply with all applicable rules and regulations dealing with hazardous materials and/or substances from the following agencies: SJVAPCD, California Regional Water Quality Control Board (CRWQCB), California Integrated Waste Management Board, DTSC, California Office of Environmental Health Hazard Assessment, KCDEHS, and the Kern County Fire Department.

As noted above, a physical inspection of the proposed Project site, as part of the Hazardous Materials Evaluation, revealed evidence of hazardous materials and waste present within the proposed Project site. The evidence consists of abandoned petroleum prospect well, use of pesticides and herbicides,

PMTs, the potential for asbestos containing materials, high-pressure pipelines within and adjacent to the proposed Project site, and water wells.

Local regulatory agency records were reviewed to help determine whether hazardous materials have been handled, stored or generated on the proposed Project site and/or the adjacent properties and businesses. In the fall of 2006, petroleum-stained soil was removed from each irrigation well location and transported to the McKittrick Waste Site in western Kern County. The remediation report for the proposed Project site was approved by KCEHSD and a closure letter was issued on December 1, 1006. No other hazardous materials records related to the Project site were found.

As discussed above, four PMTs were observed within the proposed Project boundaries. The PMTs were observed to be in good condition and no apparent corrosion was noted. The ground surface below each PMT displayed no evidence of discoloration from fluid leakage. PG&E is the owner of the PMTs. According to PG&E, PMTs installed after 1990 likely did not contain PCB insulating fluids. PMTs labeled with blue "non-PCB" stickers do not contain PCB fluids. Based on the visual absence of apparent unauthorized releases of insulating fluids, the on-site PMTs are not currently anticipated to pose adverse impacts.

PG&E maintains two natural gas pipelines, a 34-inch pipeline and 6-inch pipeline within areas that would be improved as part of the proposed Project. The 34-inch pipeline is one of many pipelines monitored for leaks daily by aircraft. The rupture of natural gas pipelines would result in the release of petroleum products to the Project site. A pipeline rupture could result in environmental contamination and human health effects in the rural-residential areas adjacent to the proposed Project site. For safety reasons, State regulations prohibit the construction of any structures directly over the pipeline and a right-of-way (ROW) is usually established. The width of the ROW is negotiated between the property owner and the pipeline operator and usually ranges between 20 and 100 feet. Types of shrubs may be restricted; specifically, structures and large trees cannot be located over pipelines. With the compliance with Federal, State and applicable local regulations, and implementation of mitigation measures, impacts from potential health risks or damaging incidents associated with the pipelines would be reduced to a level of less than significant.

The potential impacts resulting from the operation of the existing pipeline are reduced with the use of pipeline markers, signs and underground warning tape and further reduced by enhanced safety features, including intrusion detection and leak monitoring system (central control room via supervisory control and data acquisition to detect third party dig-in), automatic and remote-controlled shut-off valves. Given the design of the pipeline, recently imposed integrity management protocol for all utility pipeline operators, and pipeline monitoring and reporting requirements, the potential impacts associated with reasonably foreseeable upset and accident conditions during the operation of the existing pipelines within the proposed project would be less than significant with the implementation of mitigation measures.

According to the Hazardous Materials Evaluation, one previously abandoned oil prospect well is present within the proposed Project site. Public Resources Code Section 3208.1 authorizes the State Oil and Gas Supervisor to order the reabandonment of a previously abandoned well when construction of any structure over or in the proximity of the well could result in a hazard. The well was filled only with drilling mud prior to abandonment in 1935, therefore, the DOGGR will require

that the well be reabandoned to current standards prior to grading and development of the proposed Project. DOGGR will furnish the necessary closure specifications. Adherence to closure provisions would serve to reduce impacts to less than significant levels.

One active diesel powered and one idle irrigation well are located within the proposed Project boundary. In 2006, petroleum stained soil was removed from each well irrigation location and transported to the McKittrick Waste Site in western Kern County. No diesel or waste-oil staining was observed on the ground surface at the time of the site reconnaissance. One well may be expected to supply water for dust suppression during construction of the proposed Project. If the wells are not to be used for irrigation or industrial purposes, they should be destroyed in accordance with California Well Standards as governed by the California Department of Water Resources, and permit requirements of the KCEHSD. The wells would have a less than significant impact on the proposed Project.

A domestic well is located north of the modular shop building and should be destroyed in accordance with California Well Standards as governed by the California Department of Water Resources, and permit requirements of the KCEHSD. If it is determined that the well be utilized as a water source, then the well does not need to be destroyed. The well would have a less than significant impact on the proposed Project.

Applications of pesticides and herbicides have been conducted according to RMPs obtained annually from the Kern County Agricultural Commissioner's Office. Agricultural chemicals are typically applied in dilute concentrations, and when used properly, degrade relatively quickly. However, it is not known if environmentally persistent pesticides and herbicides have been applied to the proposed Project in the past. Generally, sampling and analysis of surface soils from properties with similar pesticide and herbicide application histories has typically yielded non-detectable results for analyses of elevated concentrations of environmentally persistent pesticides and/or herbicides. The potential for elevated concentrations of environmentally-persistent pesticides and herbicides to exist in the near-surface soils of the proposed Project, which would require regulatory action, is low. Therefore, less than significant impacts would occur.

It is possible that asbestos-containing materials could be present in subsurface concrete irrigation (transite) pipe on-site. Concrete pipe was documented in information obtained from the Kern County Assessor-Recorder's Office. If subsurface concrete irrigation pipe is located on-site, the SJVAPCB shall be contacted for proper disposal procedures and requirements. If any subsurface concrete irrigation pipe is removed from the proposed Project site, it would be removed according to SJVAPCD regulations and would be considered to be a less than significant impact.

If Valley Fever spores occur within the boundaries of the proposed Project, with the absence of mitigation, there is potential for the infection of construction workers and surrounding residents, as well as within the proposed Project area. Mitigation measures designed to reduce the amount of fugitive dust during grading activities would reduce the likelihood of Valley Fever to a less than significant level; (refer to Section 4.3, *Air Quality*). Covering of portions of the Project site with landscaping material and/or with impervious roadway surfaces and buildings would reduce the long-term potential release of Valley Fever spores to a less than significant level.

Due to the scope and nature of the proposed Project, the level of risk associated with hazardous materials on the proposed Project site is considered significant. However, a less than significant impact would occur in this regard after compliance with State and applicable local regulations and the following mitigation measures.

Mitigation Measures

MM 4.9-34: Discovered/Spilled Hazardous Waste Materials. The Project proponent shall continuously comply with the following:

1. If suspect materials or wastes of unknown origin are discovered during construction on the project site, which is thought to include hazardous waste materials the following shall occur:

    a. All work shall immediately stop in the vicinity of the suspected contaminant;

    b. Project Construction Manager shall be notified;

    c. Area(s) shall be secured as directed by the Project Construction Manager;

    d. Notification shall be made to the Kern County Environmental Health Services Division/Hazardous Materials Section for consultation, assessment, and appropriate actions; and,

    e. Copies of all notifications and correspondence shall be submitted to the Kern County Planning and Natural Resources Department.

MM 4.9-45: Hazardous Materials Specialist. Prior to issuance of the grading permit, a qualified hazardous materials specialist shall inspect each power pole on-site with a transformer. Those containing polychlorinated biphenyls shall be removed by the hazardous specialist and disposed of at an appropriate hazardous materials disposal site to the satisfaction of Department of Toxic Substances Control. The hazardous materials specialist shall provide a short report to the Kern County Planning and Natural Resources Department and the Kern County Environmental Health Services Division/Hazardous Materials Section for review and approval.

Prior to construction, Pacific Gas and Electric Company (PG&E) shall be contacted regarding the disposition of pole-mounted transformers. In the event of a future release or leak of insulating fluids from any of the pole-mounted transformers, PG&E shall be contacted for their removal or replacement.

MM 4.9-56: Known/Discovered Well Remediation. Prior to start of construction, the abandoned petroleum prospect well shall be located, exposed, and re-abandoned, if required, to conform to the current abandonment requirements of the California

Department of Conservation, Division of Oil, Gas and Geothermal Resources and the Kern County Department of Environmental Health Services.

MM 4.9-6~~7~~: **Final Maps and Grading Plans, Notes.** The following note shall appear on all final maps and grading plans: "If during grading or construction, any plugged and abandoned or unrecorded wells are uncovered or damaged, the Department of Oil, Gas and Geothermal Resources will be contacted to inspect and approve any remediation required."

MM 4.9-7~~8~~: **Underground Service Alert One-call.** Prior to grading or excavating the Underground Service Alert One-call center shall be contacted at (800) 227-2600. The proposed excavation area shall be delineated with white marking paint or with other suitable markers such as flags or stakes at least two days prior to commencing any excavation work. A "Dig Alert" ticket number would be issued at the time Underground Service Alert is contacted. Excavating is not permitted without this ticket number and is valid for twenty-eight days. Underground Service Alert would notify its member utilities having underground facilities in the area. Underground Service Alert does not notify nonmember utilities or energy companies, or Caltrans.

MM 4.9-8~~9~~: **Ruptured Pipeline Safety.** If a rupturing of a pipeline should occur during excavation and construction activities the Kern County Fire Department and Pacific Gas and Electric Company should be contacted immediately. Natural gas transmission pipeline rupture most often indicates an emergency situation and 9-1-1 should be dialed. If an emergency is not indicated, the Kern County Fire Department-Greenfield Station 52, located at 312 Taft Highway, should be contacted at (661) 834-5144. Non-Emergency telephone numbers for the Kern County Fire Department number (661) 324-6551 and the project proponent shall follow all safety and cleanup regulations.

MM 4.9-9~~10~~: **On-site Water Wells.** If the on-site water wells are not to be used for irrigation or industrial purposes, they shall be destroyed in accordance with California Well Standards as governed by the California Department of Water Resources, and permit requirements of the Kern County Environmental Health Services Division.

MM 4.9-10~~11~~: **Herbicides.** Prior to the issuance of grading or building permits for the project, if herbicides are to be utilized, the contractor or personnel applying herbicides must have the appropriate State and local herbicide applicator licenses and comply with all State and local regulations regarding herbicide use.

1. Herbicides shall be mixed and applied in conformance with the product manufacturer's directions.

2. The herbicide applicator shall be equipped with splash protection clothing and gear, chemical resistant gloves, chemical spill/splash wash supplies, and material safety data sheets for all hazardous materials to be used.

3. To minimize harm to wildlife, vegetation, and waterbodies, herbicides shall not be applied directly to wildlife, products identified as non-toxic to birds and small mammals shall be used if nests or dens are observed.

4. Herbicides shall not be applied if it is raining at the site, rain is imminent, or the target area has puddles or standing water, and shall not be applied when wind velocity exceeds 10 miles per hour.

5. If spray is observed to be drifting to a non-target location, spraying shall be discontinued until conditions causing the drift have been abated.

MM 4.9-11~~12~~: **Asbestos Containing Materials.** If asbestos containing materials are identified during construction (particularly in the concrete irrigation (transite) pipe located on-site, then the San Joaquin Valley Air Pollution Control District shall be contacted for removal and disposal procedures. These procedures shall be followed in order to eliminate asbestos exposure to construction workers and surrounding workers and residents.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-3: The Project Would Emit Hazardous Emissions or Handle Hazardous or Acutely Hazardous, Substances, or Waste Within One-Quarter Mile of an Existing or Proposed School.

Due to the active agricultural uses of the proposed Project site, it is anticipated that pesticides have been used on-site, and that residues remain within the on-site soils. There are no existing schools located within one-quarter mile of the proposed Project. Currently, McKee Middle School and McKee Primary School are located approximately 1.5 miles north of the proposed Project and General Shafter Elementary School is located approximately 1.0 to the southwest. Additionally, the use, storage, and transportation of hazardous materials that would occur as part of construction and operation of the proposed Project would be more than 0.25 miles from these schools, thus potential impacts are considered less than significant in this regard.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-4: The Project Would Be Located on a Site That is Included on a List of Hazardous Materials Sites Compiled Pursuant to Government Code Section 65962.5 and, as a Result, Would Create a Significant Hazard to the Public or the Environment.

An EDR, Inc. radius search and written report for the proposed Project site and properties within one mile were completed in July 2008, in conjunction with the Hazardous Materials Evaluation (McIntosh and Associates 2008; refer to Appendix N). The search of Federal, State, and local agencies environmental records found no records for the proposed Project site. Three facilities were identified on one or more of the databases searched for the EDR report. These facilities are listed on the following databases: Solid Waste/Landfill-listed facility; CORTESE, LUST, HIST UST, CA FID UST; and SWEEPS UST. The facilities identified include Lamb Chops, YCT, and Limi Brothers Farm. In addition, five "orphan sites" were identified in the EDR report. "Orphan sites" are sites that the EDR report cannot map due to insufficient information. In addition, the Hazardous Materials Evaluation (McIntosh and Associates 2017; refer to Appendix F) included a more recent record search.

The proposed Project is not included on any hazardous materials sites lists. The proposed project would not create a hazard to the public or environment through the transport, disposal and/or use of hazardous materials, and it would not create a public hazard through emissions of hazardous materials, accidental or otherwise. Impacts are considered less than significant, and mitigation is not required.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-5: The Project Would Be Located Within an Within the Adopted Kern County Airport Land Use Compatibility Plan Resulting in a Safety Hazard for People Residing or Working in the Project Area.

The proposed Project site is not located within two miles of a public airport or public use airport as shown in the Kern County Airport Land Use Compatibility Plan (ALUCP).

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-6: The Project Would Result in a Safety Hazard for People Residing or Working in the Project Area from a Private Airstrip.

A private airstrip (Costerisan Farms Airport) was located two miles northwest of the proposed Project site; however, this private airstrip is no longer in use (pilotnav 2017). No other private airstrips are within two miles of the proposed Project site. Therefore, this airstrip is not expected to result in a safety hazard for the construction workers and future employees of the proposed Project site. Less than significant impacts are anticipated.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-7: The Project Would Impair Implementation of, or Physically Interfere with, an Adopted Emergency Response Plan or Emergency Evacuation Plan.

There is no information in the record to date that indicates the proposed Project would interfere with the operation of any roadway, facility, or area that would be used as part of an emergency response plan or emergency evacuation plan. Impacts would be less than significant, and mitigation is not required.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.9-8: The Project Would Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Wildland Fires, Including Where Wildlands are Adjacent to Urbanized Areas or Where Residences Are Intermixed with Wildlands.

As discussed in Impact 4.18-1, the proposed Project is not located adjacent to a wildland area. The proposed Project site is located in an area with a mixture of agricultural, industrial, and residential land uses, which are not considered susceptible to wildland fires. Therefore, wildland fires do not have the potential to affect the site and no impacts would occur.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Impacts related to hazardous materials and hazardous substances are considered site-specific and are generally mitigated to less than significant levels on a project-by-project basis. Compliance with Federal, State, and local regulations would ensure that contamination or exposure to hazardous substances is avoided or controlled to minimize the risk to the public on a project-by-project basis, as the cumulative projects are constructed. For the proposed Project, all potential hazards and potentially hazardous materials or situations that could result from release of hazardous substances would be mitigated to less than significant levels following compliance with Federal, State, and local regulations. Therefore, implementation of the proposed Project in conjunction with future projects would result in less than significant cumulative impacts for hazards or hazardous materials.

Mitigation Measures

Implement Mitigation Measures MM 4.9-1 through MM 4.9-12.

Level of Significance after Mitigation

Impacts would be less than significant.

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Section 4.10

Hydrology and Water Quality

Section 4.10
Hydrology and Water Quality

4.10.1 Introduction

The purpose of this section is to describe the hydrologic and water quality setting of the proposed Project and surrounding area. This section also evaluates the potential impacts the proposed Project will have on water resources. A Water Supply Assessment was prepared by Yarne & Associates in January 2019. See Appendix H, Water Supply Assessment.

4.10.2 Environmental Setting

Climate

The proposed Project lies within the southern Central Valley of California, which has rainy winters and dry summers, characteristic of a Mediterranean climate. The Central Valley has greater temperature extremes than the coastal areas because it is less affected by the moderating influence of the Pacific Ocean.

Ninety percent of annual rainfall in the southern Central Valley occurs during the period between November and April. Infrequent summer thunderstorms and showers from tropical depressions account for the remaining rainfall. Average annual precipitation is about 5.7 inches, which is a relatively small amount. By comparison, Los Angeles County receives an annual average of 14.8 inches, Sacramento receives an average of 17.5 inches per year, and Bishop, which is on the dry eastern side of the Sierra Nevada mountain range (near Death Valley), receives an annual average of 5.4 inches.

Hydrology

Metropolitan Bakersfield, located in a semi-arid region, relies on groundwater, the Kern River and two water importation projects for its water supply for agricultural and municipal usage. The region receives a normal annual precipitation of approximately 5 to 13 inches, which categorizes the area as a desert or steppe; most of the precipitation falls between November and April.

Regional Surface Water Resources

Kern River

The Kern River is the only significant stream in Metropolitan Bakersfield. From an elevation of 775 feet above mean sea level at the mouth of the Kern River Canyon, westward to an elevation of 325 feet at Interstate 5, the Kern River is a unique resource in a desert environment. The river begins on the western flank of Mount Whitney in the southern Sierra Nevada and flows in a southwest direction.

Several minor streams flow into the Kern River, which exists as a contained basin except during high runoff years. The Kern River Basin includes approximately 2,100 square miles of watershed area above Isabella Dam, about 300 square miles of foothill area below the dam, and about 600 square miles of alluvial fan below the mouth of the Kern River Canyon. The basin is fully diverted and used; however, during very wet years, the Kern River reaches the flood channel located on the west of the valley floor and carries water into the Tulare Lake bed. The river flows have been regulated since the completion of Isabella Dam in 1953.

Tulare Lake Basin

The proposed Project is located within the Central Valley's Tulare Lake Basin; the Diablo and Temblor Mountain Ranges are to the west, the San Emigdio and Tehachapi Mountains are to the south, and the Sierra Nevada Mountains are to the east and southeast. The Tulare Lake Basin encompasses approximately 10.5 million acres. The basin is approximately 170 miles long and 140 miles wide; the Central Valley floor comprises less than one-half of the total Basin area. The Tulare Lake Basin drains to the San Joaquin River Basin only during years of heavy rainfall. The Tulare Lake Basin is under the jurisdiction of the Central Valley Regional Water Quality Control Board (RWQCB), which is responsible for designing and implementing the Tulare Basin Plan.

Regional Surface Water Supply

There are three major sources of surface water available in the Metropolitan Bakersfield General Plan area: the Kern River, the Central Valley Project (CVP), and the State Water Project (SWP). Historically, the Kern River has been the primary source of surface water to Kern County. It originates in the southern Sierra Nevada and flows in a south and southwesterly direction to the Central Valley northeast of Bakersfield. SWP water is supplied from the Sacramento/San Joaquin Delta area and is delivered through the California Aqueduct to Kern County and other areas. CVP water is delivered to the Kern County area through the Friant-Kent Canal. This canal begins at Friant Dam and Millerton Lake and flows southerly to its terminus at the Kern River upstream of the Project area.

Of the three principal sources of water, Kern River and Friant-Kern Canal water are higher quality water producers than SWP water. The quality of Kern River water near Bakersfield is excellent, as is the water quality of the Friant-Kern Canal.

Local Surface Water Setting

The proposed Project is relatively level, sloping southwesterly at an average rate of approximately 7.5 feet per mile. Precipitation is rarely enough to cause flowing water from the site, as most of the water percolates into the soil. The proposed Project overlies the Kern County sub-basin of the San Joaquin Valley Groundwater basin within the Tulare Lake Hydrologic Region.

Physical Characteristics of Surface Water Quality

Standard parameters used to assess the quality of stormwater provide a method of measuring impairment. The backgrounds of these typical characteristics assist in understanding water quality requirements. The quantity of a material in the environment and its characteristics determine the

degree of availability as a pollutant in surface runoff. In an urban environment, the quantity of certain pollutants in the environment is a function of the intensity of the land use. For instance, high density of automobile traffic makes a number of potential pollutants (such as lead and hydrocarbons) more available. The availability of a material, such as a fertilizer, is a function of the quantity and the manner in which it is applied. Applying fertilizer in quantities that exceed plant needs leaves the excess nutrients available for loss to surface or ground water.

The physical properties and chemical constituents of water have traditionally served as the means for monitoring and evaluating water quality. Evaluating the condition of water through a water quality standard refers to its physical, chemical or biological characteristics. Water quality parameters for stormwater make up a long list and are classified in many ways. In many cases, the concentration of an urban pollutant, rather than the annual load of that pollutant, is needed to assess a water quality problem.

Flooding

The Kern River has been subject to severe flooding from storms and snowmelt in the upper portion of its watershed. According to the Kern River Floodway Draft Environmental Impact Report dated June 1988, a worst-case maximum precipitation possible storm for the climate of the Kern River area would have produced an estimated peak discharge above Bakersfield of 204,000 cubic feet per second (cfs). In 1867, levees were first constructed in Bakersfield to protect from flood damage. The annual average runoff for the Kern River is estimated at 700,000 acre-feet per year, of which most is diverted to agricultural uses. The flood of November 1950 had a peak flow of 36,000 cfs and led to the construction of the Isabella Dam and Reservoir in 1953, which significantly reduced flood hazards in the southern San Joaquin Valley and the greater Metropolitan Bakersfield area.

Flooding of the Kern River has resulted from high-intensity winter rainstorms which generally occur from November through April. Flooding can also be caused by snowmelt, which occurs in the late spring and early summer months. However, snowmelt is less damaging because it has a longer period of runoff and a lower peak than rain floods.

Within the past 40 years, seven major floods have occurred including, the 1998 flood caused by the El Niño weather pattern. These floods have been investigated by the Kern County Water Agency (KCWA) and the U.S. Army Corp of Engineers (USACE). Since 1971, the United States Department of Housing and Urban Development (HUD) has designated the unincorporated portions of Kern County as a special flood hazard area. In compliance with the Federal Flood Insurance Program, HUD has provided Kern County with a series of eighty-three Flood Hazard Boundary Maps. These maps delineate major areas of flooding throughout the County.

The proposed Project site is located within the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Zone X. According to FEMA, Zone X consists of: areas within and outside the 0.2 percent annual chance floodplain, areas of 1-percent annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1-percent annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1-percent annual chance flood by levees. Flood insurance purchase is not required in these zones.

Dam Inundation

Isabella Dam is located approximately 40 miles northeast of the City of Bakersfield, near a major fault line. Isabella Dam is earth-filled and is approximately 185 feet high, 1,725 feet long, and can hold 570,000-acre feet of water.

Because Isabella Dam is near an active fault line, the potential for seismic activity to cause dam failure exists. If the dam fails, the entire lake storage would be released and approximately 60 square miles of the Metropolitan Bakersfield area would be flooded. Flood levels have the potential to reach 30 feet, with peak inundation at the Project site having the potential to be 5 to 10 feet depending on the water level in the lake. The proposed Project is expected to be inundated within ten to twelve hours after dam failure. This lag time would provide adequate time for warning and would substantially decrease the number of deaths and injury; however, property damage would occur. The chance of dam failure occurring is approximately one day in 10,000 years when the lake is at maximum capacity.

Groundwater

Groundwater is subsurface water that occurs beneath the ground surface in fully saturated zones within soils and other geologic formations. Groundwater in a saturated geologic unit with sufficient permeability and thickness to store sufficient water to sustain a well or spring is defined as an aquifer. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers.

Metropolitan Bakersfield rests above a series of water aquifers that form part of a larger groundwater basin called the San Joaquin Groundwater Basin. The primary aquifer below Metropolitan Bakersfield is made up of unconsolidated sediments bordered by faults or mountain ranges to the east, west and south. Groundwater within the Basin occurs under unconfined, confined and semi-confined conditions.

Groundwater recharge in the basin consists primarily of the percolation of excess irrigation applications, with lesser contributions supplied by river and canal seepage, artificial recharge programs of water agencies, and municipal and industrial wastewater. Direct recharge from precipitation is only a minor source of supply.

Historically, water quality degradation has been noticed in many wells in Kern County. Groundwater contamination in the area includes nitrates, ethylene dibromide (EDB), and dibromochloropropane (DBCP). As a result of the historical use of the area as cultivated agriculture, a number of groundwater contaminants have been introduced over a period of years. In many cases, recent efforts to limit such discharge have led to a reduction or complete cessation of new sources of contamination. Many uses, however, continue to contribute significant quantities of contaminants to the groundwater.

Three principal sources for ongoing groundwater contamination exist in the area: septic systems, cultivated agriculture, and the petroleum industry. By design, septic systems discharge nitrified effluent into soils surrounding the systems. Cultivated agriculture contributes pollutants through nitrogen fertilizer application resulting in a measurable increase in groundwater nitrates throughout

the area. A past source of groundwater contamination was the application of EDB and DBCP to control crop damage.

Petroleum production and refining contributes contamination through direct application of spilled or leaked crude oil and petroleum products to the ground surface and through the use of corrosion inhibitors in the well development process. Pollutants resulting from this activity typically include hydrocarbons and phenols that have entered the subsurface soils through injection or by percolation.

Groundwater recharge in the Basin is currently obtained through the following sources:

Natural Recharge. Natural recharge of groundwater is provided by precipitation runoff, which is defined as the amount of melted snow and rainwater measured after evaporation, evapotranspiration, and percolation.

River and Canal Seepage. Canal seepage is defined as the amount of water that percolates into the ground from earthen canals.

Spreading and Banking. Percolation of water spread in open basins has been used to replenish the groundwater system. Fifteen agencies operate groundwater banking programs in Kern County, which can store up to 5.7 million-acre-feet of water during wet years. The largest is the Kern Water Bank (KWB), a 7,000-acre groundwater recharge facility located in and along the Kern River channel, in response to concerns regarding groundwater supplies. The City of Bakersfield operates the "2800 Acres" groundwater recharge facility, a 2,800-acre groundwater recharge facility located in and along the Kern River channel, in response to concerns regarding groundwater supplies. The facility receives water from the Kern River, the Central Valley Project, and the State Water Project when they have water surpluses. The six-mile long site is made up of river channels, overflow lands and constructed spreading basins. The groundwater is recharged in this facility by spreading water onto spreading basins, then allowing it to percolate. The recharge facility improves groundwater quality by recharging low- salinity water from the Kern River into the aquifers, which dilutes the high-salinity irrigation water that reaches the groundwater from adjacent farming operations.

To eliminate potential overdraft conditions in which more groundwater is used than is replenished, surface water was made available to former groundwater users via the Friant-Kern Canal and the State Water Project. These supplemental surface water supplies, in conjunction with the recharge facilities, have generated inflow into the groundwater basin that exceeds the outflow, as is indicated by the steady rise in groundwater levels since 1992.

Water Quality

Surface water quality is subject to Federal, State, and local water quality requirements that are administered and enforced by the U.S. Environmental Protection Agency (EPA), the California State Water Resources Control Board (SWRCB), and the California Regional Water Quality Control Board (RWQCB), with cooperation from each county.

The principal law governing pollution of the nation's surface waters is the Federal Water Pollution Control Act (Clean Water Act [CWA]). Originally enacted in 1948, it was amended in 1972 and has remained substantially the same since. The CWA consists of two major parts: provisions that

authorize federal financial assistance for municipal sewage treatment plant construction and regulatory requirements that apply to industrial and municipal dischargers. The CWA authorizes the establishment of effluent standards on an industry basis. The CWA also requires states to adopt water quality standards that "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses".

To achieve its objectives, the CWA is based on the concept that all discharges into the nation's waters are unlawful, unless specifically authorized by a permit. The National Pollutant Discharge Elimination System (NPDES) is the permitting program for discharge of pollutants into surface waters of the United States under Section 402 of the CWA. Thus, industrial and municipal dischargers (point source discharges) must obtain NPDES permits from the Central Valley RWQCB. The existing NPDES (Phase I) stormwater program requires municipalities serving more than 100,000 persons to obtain a NPDES stormwater permit for any construction project larger than five acres. Proposed NPDES stormwater regulations (Phase II) expand this existing national program to smaller municipalities with populations of 10,000 persons or more and construction sites that disturb greater than one acre. For other dischargers, such as those affecting groundwater or from non-point sources, a Report of Waste Discharge must be filed with the RWQCB. For specified situations, some permits may be waived and some discharge activities may be handled through being included in an existing general permit.

While the EPA has two permitting options to meet NPDES requirements (individual permits and general permits), the SWRCB has elected to adopt one statewide General Permit for California that applies to all construction-related stormwater discharges, except for those on tribal lands, in the Lake Tahoe Hydrologic Unit, and under the control of the California Department of Transportation (Caltrans).

Construction activity subject to this General Permit includes any clearing, grading, stockpiling, or excavation that results in soil disturbances of at least one acre of total land area. Construction activities disturbing less than one acre are still subject to this permit if the activity is part of a large common plan of development or if significant water quality impairment will result from the activity.

The General Permit requires all dischargers whose construction activity disturbs one acre or more to:

- Develop and implement a Stormwater Pollution Prevention Plan (SWPPP) that specifies Best Management Practices (BMPs) to prevent all construction pollutants from contacting stormwater and with the intent of keeping all products of erosion from moving off-site into receiving waters;
- Eliminate or reduce non-stormwater discharge to storm sewer systems and other waters of the United States; and
- Inspect all BMPs.

Construction activities disturbing less than one acre are required to prevent the pollution of stormwater runoff from the construction activities with the usage of erosion and sediment control BMP's as specified in the site development sections of the California Green Code.

4.10.3 Regulatory Setting

Federal Regulations

Clean Water Act (CWA)

The CWA is a federal law that protects the nation's water quality for surface waters, including lakes, rivers, coastal wetlands, and "waters of the United States". The CWA specifies that discharges to waters are illegal, unless authorized by an appropriate permit. The permits regulate the discharge of dredged and fill materials, construction-related stormwater discharges, and activities that may result in discharges of pollutants to waters of the United States. If waters of the U.S. are located on a project site, a proposed project is likely to discharge to them, and if impacts on them are anticipated, the project must obtain a CWA Section 401 Water Quality Certification from the appropriate RWQCB.

National Pollutant Discharge Elimination System (NPDES)

The NPDES program is administered by the EPA, which delegates oversight in California to the Regional Water Quality Control Boards.

The NPDES program provides general permits and individual permits. The general permits are for construction projects that disturb more than one acre of land. The general permit requires the applicant to file a public notice of intent to discharge stormwater and to prepare and implement a SWPPP. The SWPPP includes a site map, description of proposed activities, demonstration of compliance with applicable ordinances and regulations, and a description of BMPs that would be implemented to reduce erosion and discharge of construction-related pollutants.

Stormwater Pollution Prevention Plan (SWPPP)

The SWPPP has two major objectives: to help identify the sources of sediment and other pollutants that affect the quality of stormwater discharges, and to describe and ensure the implementation of BMPs to reduce or eliminate sediment and other pollutants in both stormwater and in non-stormwater discharges.

BMPs include activities, practices, maintenance procedures, and other management practices that reduce or eliminate pollutants in stormwater discharges and authorized non-stormwater discharges. BMPs include treatment requirements, operation procedures, and practices to control site runoff, spillage, leaks, waste disposal and drainage from raw materials storage. BMP implementation must take into account changing weather conditions and construction activities, and various combinations of BMPs may be used over the life of the project to maintain compliance with the CWA. The General NPDES Permit gives the owner the discretion to determine the most economical, effective and innovative BMPs to achieve the performance-based goals of the General NPDES Permit.

There are two types of BMPs: structural and nonstructural. Structural BMPs are the specific construction, modification, operation, maintenance, or monitoring of facilities that would minimize the introduction of pollutants into the drainage system or would remove pollutants from the drainage system. Nonstructural BMPs are activities, programs and other nonphysical measures that help reduce

pollutants from nonpoint sources to the drainage system. In general, nonstructural BMPs are source control measures.

The issue of pollution in stormwater and urban runoff has been recognized by both Federal and State agencies, and there has been a growing concern regarding activities that discharge water affecting California's surface water, coastal waters, and groundwater. Discharges of water are classified as either point source or non-point source discharges. A point source discharge usually refers to waste emanating from a single, identifiable point. Regulated point sources include municipal wastewater, oil field wastewater, winery discharges, solid waste sites and other industrial discharges. Point source discharge must be actively managed to protect the state's waters. A nonpoint source discharge usually is a waste emanating from diffused locations. As a result, specific sources of nonpoint source pollution may be difficult to identify, treat, or regulate. The goal is to reduce the adverse impact of nonpoint source discharges on water resources through better management of these activities. Nonpoint sources include drainage and percolation from a variety of activities such as agriculture, forestry, recreation, and storm runoff.

Impaired Waterbodies

The CWA Section 303(d) and the California's Porter-Cologne Water Quality Control Act (described below) require the State to establish the beneficial uses of its State waters and to adopt water quality standards to protect those beneficial uses. Section 303(d) establishes a Total Maximum Daily Load (TMDL), which is the maximum quantity of a particular contaminant that a water body can maintain without experiencing adverse effects, to guide the application of State water quality standards. Section 303(d) also requires the State to identify "impaired" streams (water bodies affected by the presence of pollutants or contaminants) and to establish the TMDL for each stream.

State Regulations

Department of Water Resources

The California Department of Water Resources' (DWR's) major responsibilities include preparing and updating the California Water Plan to guide development and management of the State's water resources; planning, designing, constructing, operating, and maintaining the State Water Resources Development System; regulating dams; providing flood protection; assisting in emergency management to safeguard life and property; educating the public; and serving local water needs by providing technical assistance. In addition, DWR cooperates with local agencies on water resources investigations; supports watershed and river restoration programs; encourages water conservation; explores conjunctive use of ground and surface water; facilitates voluntary water transfers; and, when needed, operates a State drought water bank.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act acts in cooperation with the CWA to establish the State Water Resources Control Board (SWRCB). The SWRCB is divided into nine regions, each overseen by a RWQCB. The SWRCB, and thus each RWQCB, is responsible for protecting California's surface waters and groundwater supplies.

The Porter-Cologne Water Quality Control Act develops Basin Plans that designate the beneficial uses of California's rivers and groundwater basins. The Basin Plans also establish narrative and numerical water quality objectives for those waters. Basin Plans are updated every three years and provide the basis of determining waste discharge requirements, taking enforcement actions, and evaluating clean water grant proposals. The Porter-Cologne Water Quality Control Act is also responsible for implementing CWA Sections 401-402 and 303(d) to SWRCB and RWQCBs.

Senate Bills 610 (Chapter 643, Statutes of 2001) and 221 (Chapter 642, Statutes of 2001)

SB 610 and SB 221 are companion measures that seek to promote more collaborative planning among local water suppliers and cities and counties. They require that water supply assessments occur early in the land use planning process for all large-scale development projects. If groundwater is the supply source, the required assessments must include detailed analyses of historic, current, and projected groundwater pumping and an evaluation of the sufficiency of the groundwater basin to sustain a new project's demands. They also require an identification of existing water entitlements, rights, and contracts and a quantification of the prior year's water deliveries. In addition, the supply and demand analysis must address water supplies during single and multiple dry years presented in 5-year increments for a 20-year projection. Under SB 221, approval by a county of a subdivision of more than 500 homes requires an affirmative written verification of a sufficient water supply.

Sustainable Groundwater Management Act

In 2014, California enacted the Sustainable Groundwater Management Act (SGMA; Water Code Section 10720 et seq.). SGMA, and related amendments to California law, require that all groundwater basins designated as high or medium priority in the DWR California Statewide Groundwater Elevation Monitoring (CASGEM) Program, and that are subject to critical overdraft conditions, must be managed under a new Groundwater Sustainability Plan (GSP) or a coordinated set of GSPs, by January 31, 2020. High or medium priority basins that are not subject to a critical overdraft must be regulated under one or more GSPs by 2022. Where GSPs are required, one or more local Groundwater Sustainability Agencies (GSAs) must be formed to implement applicable GSPs. A GSA has the authority to require registration of groundwater wells, measure and manage extractions, require reports and assess fees, and to request revisions of basin boundaries, including establishing new subbasins. GSAs must have been formed for high and medium priority basins by June 2017. All of the Kern County Subbasin has been included in exclusive GSA's as mandated by SGMA.

The 2.8 million acres of valley portion of Kern County has been designated a high priority and the 250,000 acres of the Indian Wells Valley sub-basin which includes the City of Ridgecrest and China Lake Naval Weapons Station has been classified a medium priority basin. Both are under mandatory requirements to form a GSA and create a GSP that achieves sustainability in 20 years.

Each GSP must include a physical description of the covered basin, such as groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on historical and projected water demands and supplies, monitoring and management provisions, and a description of how the plan will affect other plans, including city and county general plans. Under the

Act, the GSA is authorized to restrict pumping, levy assessments and fees and undertake water quality and quantity projects to rebalance the basin. The DWR must adopt regulations for the preparation of a GSP by January 2016. Emergency regulations for the preparation of the GSP's were approved by the California Water Commission on May 18, 2016. As defined by the Act, "sustainable groundwater management" means that groundwater use within basins managed by a GSP will not cause any of the following "undesirable results:" (a) chronic lowering of groundwater levels (not including overdraft during a drought, if a basin is otherwise managed); (b) significant and unreasonable reductions in groundwater storage; (c) significant and unreasonable seawater intrusion; (d) significant and unreasonable degradation of water quality; (e) significant and unreasonable land subsidence; and (f) surface water depletions that have significant and unreasonable adverse impacts on beneficial uses (Water Code Section 10721(w)).

Kern County is a member of the following GSA's: Cuyama Basin Groundwater Sustainability Agency, Indian Wells Valley Groundwater Authority and Kern Groundwater Authority which manages a portion of the valley sub-basin. The Valley portion of Kern County also is managed by the Kern River Groundwater Sustainability Agency which is comprised of the City of Bakersfield, Kern Delta Water District and Improvement District No. 4 of the Kern County Water Agency. An additional nine GSA's have also been formed to sustainably manage their respective portions of the Kern County subbasin.

Note: Effective December 11, 2018, the County of Kern withdrew from the Kern Groundwater Authority. The Kern County Water Agency (KCWA) was brought in as a cooperative member of Joint Powers Agreement to manage the white spaces. Five GSA's are preparing GSP's to manage the Kern subbasin per a Kern County Subbasin Coordination Agreement.

Municipal Recycled Water Landscape Irrigation Use Permit

The General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water (Water Quality Order No. 2009-0006-DWQ) (Landscape Irrigation General Permit) regulates landscape irrigation with recycled water. Specified uses of recycled water considered to be "landscape irrigation" include any of the following: (i) parks, greenbelts, and playgrounds; (ii) school yards; (iii) athletic fields; (iv) golf courses; (v) cemeteries; (vi) residential landscaping and common areas (not including individually owned residential areas); (vii) commercial landscaping, except eating areas; (viii) industrial landscaping, except eating areas; and (ix) freeway, highway, and street landscaping. Producers or distributors of recycled water must submit a Notice of Intent for coverage under the Landscape Irrigation General Permit. This permit is not required for individual recycled water users and does not cover use of harvested stormwater for irrigation.

Producer and Distributor Responsibilities

Producers must deliver disinfected tertiary recycled water as defined by California Code of Regulations (CCR) Title 22, sections 60301.230 and 60301.320, which address disinfection requirements and "filtered wastewater" requirements, respectively. Producers are responsible for ensuring that recycled water meets the quality standards for disinfected tertiary recycled water as described in Title 22 and any associated waste discharge requirement order for the water reclamation plant. Distributors are responsible for drafting and submitting an operations and maintenance plan to

the SWRCB. The operations and maintenance plan contents are contained in a permit, and include operation and maintenance/management of transport facilities and associated infrastructure necessary to convey and distribute recycled water from the point of production to the point of use. Additionally, distributors must designate a Recycled Water Use Supervisor for each use area. A permit also addresses best management practices, including general operations and maintenance, which producers and distributors must apply to manage recycled water and prevent water quality impacts.

Usage

A permit establishes terms and conditions of discharge to ensure that the discharge does not unreasonably affect beneficial uses of groundwater and surface water. This includes minimum setback distances, signage, application control, and use restrictions, along with other preventative measures, such as backflow prevention and cross-contamination programs.

California Green Building Standards Code (CALGreen Code)

The State of California enacted The California Green Building Standards Code (CALGreen Code) as part 11 of The California Building Standards Code (Title 24). The 2016 CALGreen Code, effective on January 1, 2017, contains measures that are designed to improve public health, safety, and general welfare by utilizing design and construction methods that reduce the negative environmental impact of development and encourage sustainable construction practices.

The CALGreen Code provides mandatory direction to developers of all new construction and renovations of residential and non-residential structures with regard to all aspects of design and construction, including but not limited to site drainage design, stormwater management, and water use efficiency. Required measures are accompanied by a set of voluntary standards that are designed to encourage developers and cities to aim for a higher standard of development.

Under the CALGreen Code, all residential and non-residential sites are required to be planned and developed to keep surface water from entering buildings and to incorporate efficient outdoor water use measures. Construction plans are required to show appropriate grading and surface water management methods, such as swales, water collection and disposal systems, French drains, and rain gardens. Plans should also include outdoor water use plans that utilize weather or soil moisture-controlled irrigation systems. In addition to the above-mentioned requirements, non-residential developments are also required to develop:

- A Stormwater soil loss prevention plan[1];
- An irrigation budget for landscapes greater than 2,500 square feet, and
- A quantified plan to reduce waste water by 20 percent through use of water-efficient fixtures or non-potable water systems, such as use of harvested rainwater, grey water, and/or recycled water.

CALGreen also offers a tiered set of voluntary measures to encourage residential and non-residential development that goes beyond the mandatory standards to reduce soil erosion, rainwater capture and infiltration, and use of recycled and/or grey water systems. Non-residential developers are further encouraged to integrate treatment BMPs that result in zero net increase in runoff due to development

[1] Kern County, 2016 Cal Green Stormwater BMP (January 2017).

and can treat runoff from the 85th percentile storms. Furthermore, by meeting overall environmental performance goals for the specified categories (e.g., planning and design, energy efficiency, water efficiency and conservation, etc.), buildings can be designated as CALGreen Tier 1 or Tier 2, with the Tier 2 designation having more stringent goals than the Tier 1 designation.

Assembly Bill (AB) 1750 (Rainwater Capture Act of 2012)

Assembly Bill (AB) 1750 (AB 1750), also known as the Rainwater Capture Act of 2012, allows residential, commercial, and government land owners to install, operate, and maintain rainwater collection systems that would not otherwise directly enter a saltwater body through a constructed conveyance and treatment system. Under AB 1750, rainwater is defined as precipitation on any public or private parcel that has not entered an off-site storm drain system or channel, a flood control channel, or any other stream channel, and has not previously been put to beneficial use. AB 1750 permits the following uses for rooftop runoff: rain barrel system for outdoor non-potable use, rain collection system for outdoor non-potable use or infiltration into groundwater, and rain collection system for indoor non-potable use. Additional requirements are included for indoor non-potable use. Compliance with any local rainwater or stormwater capture programs continues to be required under AB 1750.

California Water Conservation Executive Orders

Beginning in January 2014, Governor Jerry Brown issued three Executive Orders (EOs), B-26-14, B-28-14, B-29-15, B-37-16, and B-40-17 regarding water supply, water demand, and water use within the State during severe drought conditions. EO B-29-15, issued April 1, 2015, sets limitations not only for existing land uses and water supply systems, but also for new construction. Some of these restrictions include:

- The Water Board shall prohibit irrigation with potable water of ornamental turf on public street medians. (EO B-29-15, Save Water, Action #6)
- The Water Board shall prohibit irrigation with potable water outside of newly constructed homes and buildings that is not delivered by drip or microspray systems. (EO B-29-15, Save Water, Action #7)
- The California Energy Commission shall adopt emergency regulations establishing standards that improve the efficiency of water appliances, including toilets, urinals, and faucets available for sale and installation in new and existing buildings. (EO B-29-15, Increase Enforcement Against Water Waste, Action #16)

In addition, EO B-29-15 requires that DWR update the State Model Water Efficient Landscape Ordinance through expedited regulation by the end of 2015. This ordinance will increase water efficiency standards for new and existing landscapes through more efficient irrigation systems, greywater usage, onsite stormwater capture, and by limiting the portion of landscapes that can be covered in turf (EO B-29-15, Increase Enforcement Against Water Waste, Action #11).

On November 13, 2015, Governor Brown issued EO B-36-15, which upheld the previous EOs, and directs the SWRCB to extend of urban water use restrictions through October 31, 2016 based on drought conditions known through January 2016. The SWRCB issued Emergency Regulations on

February 2, 2016, in compliance with EO B-36-15. These emergency regulations maintain the current tiers of required water reductions; however, additional adjustments in response to stakeholders; equity concerns were included in the Emergency Regulations.

In addition, DWR and the U.S. Bureau of Reclamation have finalized the 2016 Drought Contingency Plan that outlines State Water Project and Central Valley Project operations from February through November 2016. The 2016 Drought Contingency Plan was developed in coordination with staff from State and federal agencies. The 2016 Drought Contingency Plan communicates overarching goals for 2016 water management and the potential operations needed to achieve those goals.

In May 2016, Governor Brown issued EO B-37-16, which upheld the previous EOs, and directs local agencies to provide new permanent water use targets for each urban water supplier and concrete improvements to drought preparedness. The order bolstered the State's drought resilience and preparedness by establishing longer-term water conservation measures that include permanent monthly water use reporting, new urban water use targets, reducing system leaks and eliminating clearly wasteful practices, strengthening urban drought contingency plans and improving agricultural water management and drought plans. Local agencies are required to publicly disclose the projections and calculations used to determine their conservation standards, and to continue monthly water conservation reporting. EO B-37-16 calls for wise water use and less water waste to become permanent changes to prepare for more frequent and persistent periods of limited water supply. On April 7, 2017, EO B-40-17 lifted the drought emergency in all California counties except Fresno, Kings, Tulare, and Tuolumne counties. EO B-40-17 builds on EO B-37-16, which continues to remain in effect, to continue to make water conservation a way of life in California.

Biosolids Regulations

Biosolids generated during wastewater treatment are regulated by the State under SWRCB Water Quality Order No. 2004-0012-DWQ, Final General Waste Discharge Requirements for Land Application of Biosolids for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities. This order, implemented under the federal biosolids rules (40 CFR Part 503), applies to all land application of Class A and Class B biosolids and "exceptional quality" biosolids-derived mixtures consisting of 50 percent or more biosolids. The order establishes permitting, monitoring, and reporting requirements. Local ordinances, described below, also regulate the disposal of biosolids in Kern County.

Local

Metropolitan Bakersfield General Plan

The goals and policies of the Metropolitan Bakersfield General Plan relating to water and water quality include water conservation, balancing competing demands for water, and protecting the quality of groundwater and surface water resources. The goals and policies that apply to the proposed Project are listed in Table 4.10-1, *Metropolitan Bakersfield General Plan Goals and Policies for Hydrology and Water Quality*, below.

Table 4.10-1. Metropolitan Bakersfield General Plan Goals and Policies for Hydrology and Water Quality
Goals and Policies: Hydrology and Water Quality
Goal #2: Assure that adequate groundwater resources remain available to the planning area.
Goal #3: Assure that adequate surface water supplies remain available to the planning area.
Goal #4: Continue cooperative planning for and implementation of programs and projects which will resolve water resource deficiencies and water quality problems.
Goal #5: Achieve a continuing balance between competing demands for water resource usage.
Goal #6: Maintain effective cooperative planning programs for water resource conservation and utilization in the planning area by involving all responsible water agencies in the planning process.

4.10.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative basis through a comparison of the anticipated Project effects with the existing hydrologic environment. The change in the hydrologic environment is significant if the effect described under the criteria below occurs. The evaluation of Project impacts is based on professional judgment, analysis of the County's hydrology and water quality policies and the significance criteria established by Appendix G of the California Environmental Quality Act (CEQA) Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

- The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:
- Violate any water quality standards or waste discharge requirements;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

- Substantially degrade water quality;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; and/or
- Be subject to inundation by seiche, tsunami, or mudflow.

Project Impacts

Impact 4.10-1: The Project Would Violate Any Water Quality Standards or Waste Discharge Requirements.

With future urban development of the site, the proposed Project would increase urban pollutant discharge, especially during short-term construction phases. The discharge of materials other than stormwater from a particular site is prohibited. With urban development projects, the pollutants of concern include silt and sediment, oil and grease, floatable trash, nutrients (including fertilizers), heavy metals, pathogens (such as coliform bacteria) and other substances. Discharge of these substances, referred to as "controlled pollutants," into waters of the United States is prohibited.

Future proposed developments that involve grading and construction would contribute to an increase in pollution discharge. Individual development projects would be required to mitigate short-term construction impacts pursuant to the NPDES criteria and standards on a project-by-project basis. The purpose of the NPDES permit is to ensure that the proposed Project area would eliminate or reduce construction-related sediments and pollutants during stormwater runoff. Construction sediment erosion can be adequately controlled through the application of standard construction BMPs. The goal of BMPs is to capture and treat "first flush" stormwater run-off generated by surrounding and on-site watersheds. Water quality management BMPs for grading and construction scenarios may include the use of sand bags and straw bales for run-off diversion and velocity reduction, mulch topping, hydro-seeding and siltation fencing to prevent soil loss and measures to minimize vehicular leaking and spilling. Additionally, within Kern County, post-development compliance with NPDES is regulated by the Kern County Standard Urban Water Mitigation Plan (SUSMP). Projects within the City are required to comply with the SUSMP through the implementation of the City's Drainage Manual. Implementation of the following mitigation measures, in addition to compliance with the NPDES requirements, would reduce construction-related impacts on water quality to a less than significant level. Implementation and compliance with the SUSMP would reduce post development impacts to less than significant levels.

Mitigation Measures

Implement Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geologic and Seismic Hazards.*

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-2: The Project Would Substantially Deplete Groundwater Supplies or Interfere Substantially With Groundwater Recharge Such That There Would be a Net Deficit in Aquifer Volume or a Lowering of the Local Groundwater Table Level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted).

The agricultural uses on the Project site are irrigated using two existing on-site wells that supply groundwater to the existing agricultural uses. It is estimated that 50% of the irrigation supply is from the wells and the other 50% from Kern Delta Water District (KDWD) surface waters. The average annual irritation rate is 977.2-acre feet/year (AFY) and based on this volume, the existing agricultural uses would use approximately 488.6 AFY of groundwater.

Groundwater recharge from irrigated agricultural is a function of many variables which include weather, hydrologic conditions, irrigation practices, crops, soils, geologic conditions, etc. Recharge for the existing Project site was calculated using the total volume of irrigation and precipitation minus water losses associated with other factors. For the proposed Project a general estimate of agricultural recharge to groundwater was made by estimating that groundwater recharge at the existing site is on average 25% of the irrigated amount. Based on this percentage, the existing irrigated agricultural operations would result in approximately 122.15 AFY (25% of 488.6) of the pumped groundwater being returned to the water table with the balance, approximately 366.15 AFY of the pumped groundwater being lost through evapotranspiration.

The estimated water use for the proposed Project at build out in 2025 is approximately 544.5 AFY, which is approximately 432.7 AFY less than the existing agricultural operations and 187.5 AFY less than the water lost through evapotranspiration alone. The initial irrigation water requirement for landscaped areas of the proposed Project is estimated to be 39 AFY and 86.7 AFY at project build out. Water for on-site irrigation of Project landscaping will be provided by recycled water from the on-site wastewater treatment plant. The WSA conservatively estimated that total demand for landscape irrigation at 47.4 AFY. Considering this savings added to the overall reduction in demand as a result of the proposed Project, this results in a total reduction in water demand of approximately 480.12 AFY. This is illustrated in Table 4.10-2, *Different Between Existing and Proposed Water Usage*, below.

Table 4.10-2. Difference Between Existing and Proposed Water Usage

Type	Without Reclaimed Water (AFY)	With Reclaimed Water (AFY)
Avg. Existing Agricultural Use	977.2	977.22
Proposed Project Use	544.5	497.1
Difference	432.7	480.12

AFY = Acre-Feet Per Year
Source: Yarne & Associates, 2019.

Water for the proposed Project would be supplied by CalWater from the Bakersfield District. On average from 2011-2015 water to the District is 58% from groundwater, 16% from the Kern River purchased from the City of Bakersfield and treated by CalWater's North East Bakersfield Water Treatment Plant (NEBWTP); 5% from the Kern River purchased from the City treated at the North West Treatment Plant (NWWTP); and 21% from the Kern River or State Water Project (SWP) water from Improvement District No. 4 (ID-4) of the Kern County Water Agency (KCWA).

The groundwater sub-basin is not anticipated to be affected by the proposed Project, primarily due to the substantial reduction of water required between existing agricultural uses and proposed industrial and commercial uses. Additionally, the use of groundwater will be reduced because the on-site groundwater wells would no longer be used for water for the proposed Project. CalWater and other water suppliers including KDWD, KCWA and the City of Bakersfield also have ongoing and increasing programs to replenish the groundwater aquifers in normal and wet years with water banking programs to be used in future drought years and use of recharge basins. Additionally, groundwater sustainability plans and water conservation programs and best management practices continue to reduce overall water use including groundwater and increase efficiency and recharge. Lastly, according to the Water Supply Assessment, there would be an adequate supply of groundwater over the next 20 years, and there is a surplus groundwater production capacity. Therefore, impacts in this regard would be less than significant.

Because groundwater would no longer be pumped from under the Project site, adjacent water wells would not experience a drawdown effect of their existing supplies from the proposed Project. In addition, infiltration of surface water and lateral transfer of groundwater across the movement gradient would continue to replenish the aquifers beneath the proposed Project site. Please see Section 4.17, *Utilities*, Impact 4.17-4 for additional discussion regarding the proposed Project's impacts to groundwater supplies.

Mitigation Measures

Implementation of Mitigation Measure MM 4.17-1 through MM 4.17-5, as described in Section 4.17, *Utilities*.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-3: The Project Would Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream Or River, in a Manner Which Would Result in Substantial Erosion or Siltation On- or Off-Site.

The proposed Project site is relatively flat, with a low potential for runoff. Additionally, the topography of the Project site would remain similar to the existing conditions during site grading and construction. The development of industrial uses, landscaping, and roadways would alter the drainage pattern within the proposed Project through the introduction of impervious surfaces. Any water that is anticipated to drain off-site would be required by the County to drain into storm drain structures. The use of storm drain infrastructure reduces the amount of surface runoff and would potentially

reduce flooding impacts. Implementation of the following mitigation measures would reduce erosion or siltation impacts to less than significant levels.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geology and Seismic Hazards*.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-4: The Project Would Substantially Alter the Existing Drainage Pattern of the Site or Area, Including Through the Alteration of the Course of a Stream or River, or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.

The development of industrial uses, landscaping, and roadways would alter the drainage pattern within the proposed Project through the introduction of impervious surfaces. Any water that is anticipated to drain off-site would be required by the County to drain into an approved storm drain structure or be retained on site. The use of storm drain infrastructure reduces the amount of surface runoff and would potentially reduce flooding impacts.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geologic and Seismic Hazards.*

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-5: The Project Would Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff.

The proposed Project would add impervious surfaces to the Project site with the development of industrial uses and associated landscaping and roadways and potentially increase the amount of stormwater exiting the site. Surface runoff velocities, volumes and peak flow rates would increase as well and could flow off-site if not properly contained. Water that is anticipated to drain off-site would be required by the County to drain to storm drain structures, including detention or retention basins. Drainage collection facilities within the proposed Project would be constructed as development occurs and would be designed in accordance with local improvement standards and specifications. In addition, the Metropolitan Bakersfield General Plan has goals and policies to ensure that adequate storm drainage facilities are constructed to maintain a comprehensive storm drainage system to serve all urban development within Metropolitan Bakersfield. Pursuant to Kern County requirements, new

developments are required to provide their own on-site retention or illustrate that existing facilities have sufficient capacity to carry the additional runoff. If a stormwater drainage study is needed, the study would determine the size of retention basin(s) and optimal pipeline sizes that are needed to accommodate stormwater from the proposed project. These stormwater facility designs would be reviewed and approved by Kern County. Site improvement standards for drainage areas would be determined by the County of Kern as a function of the Precise Development Plan, Conditional Use Permit, or land division procedure. This would ensure that all drainage facilities are designed to accommodate runoff stormwater. With implementation and compliance with legal and regulatory requirements and the goals and policies of the Metropolitan Bakersfield General Plan and Kern County Ordinance Code, drainage impacts would be reduced to a less than significant level.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geologic and Seismic Hazards*.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-6: The Project Would Otherwise Substantially Degrade Water Quality.

With the future urban development of the site, the proposed Project would result in an increase in urban pollutant discharge, especially during short-term construction phases. The discharge of materials other than stormwater from a particular site is prohibited. With urban development projects, the pollutants of concern include silt and sediment, oil and grease, floatable trash, nutrients (including fertilizers), heavy metals, pathogens (such as coliform bacteria), and other substances. Referred to as "controlled pollutants", discharge of these substances into waters of the United States is prohibited.

During construction of the proposed Project, pollutants from the site could potentially increase substantially as a result of soil disturbance and construction operations. Initial clearing and grading operations during construction would expose much of the surface soils and may release pollutants into runoff from the site that would result in an adverse water quality impact.

Erosion and sedimentation caused by construction activities are dependent upon climatic and site conditions, as well as the degree of disturbance and type of construction project. As indicated above sedimentation resulting from the excessive erosion of disturbed soils, is the primary pollutant of concern. Other pollutants of concern include phosphorous and nitrogen from fertilizers, pesticides, petroleum products, construction chemicals, soil additives and solid waste are often generated by construction projects. The following is a brief discussion of typical pollutants related to construction activities:

- Nutrients – Heavy use of commercial fertilizers can result in discharge of nutrients to water bodies where they may cause excessive algae growth. Nitrogen, phosphorous, and potassium are the major nutrients used for fertilizing new landscape and constriction sites.

- Trace Metals – Over half of the metal load carried in stormwater is associated with sediments as metals both absorb to solid particulate matter (total suspended solids) and are washed off in dissolved forms. Galvanized metals, paint, or preserved wood may contain metals which may, if uncontrolled, enter the stormwater and impact downstream receiving waters.
- Pesticides – The three most commonly used forms of pesticides at construction sites are herbicides, insecticides and rodenticides. Unnecessary or improper application of pesticides may directly or indirectly contaminate surface water bodies.
- Other Toxic Chemicals – If improperly stored and/or disposed of, synthetic organic compounds that may be used at construction sites (such as adhesives, cleaners, sealants, and solvents) may have an adverse impact on receiving waters.
- Miscellaneous Wastes – Miscellaneous wastes may include water from concrete mixers, paints and painting equipment cleaning activities, solid wastes from land clearing activities, wood and paper material from packaging of building material, and sanitary wastes. Improper disposal of construction wastes may directly or indirectly pollute runoff and receiving water bodies.

The proposed Project would be required to include a drainage system. Additionally, future proposed developments that involve grading and construction would contribute to an increase in pollution discharge. Individual development projects would be required to mitigate short-term construction impacts pursuant to the NPDES criteria and standards on a project-by-project basis. The purpose of the NPDES permit is to ensure the proposed Project area would eliminate or reduce construction related sediments and pollutants during stormwater runoff. Construction sediment erosion can be adequately controlled through the application of standard construction BMPs. The goal of BMPs is to capture and treat "first flush" stormwater run-off generated by surrounding and on-site watersheds. Water quality management BMPs for grading and construction scenarios may include the use of sand bags and straw bales for run-off diversion and velocity reduction, mulch topping, hydro-seeding and siltation fencing to prevent soil loss and measures to minimize vehicular leaking and spilling. Implementation and compliance with mitigation measures and the NPDES requirements would reduce construction-related impacts to water quality to a less than significant level.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geology and Seismic Hazards.*

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-7: The Project Would Place Housing Within a 100-Year Flood Hazard Area as Mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or Other Flood Hazard Delineation Map.

No residences would be constructed in association with this proposed Project, and the Project is not located within a 100-year flood hazard area. The proposed Project is located within the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Zone X. According to FEMA,

Zone X consists of: areas within and outside the 0.2 percent annual chance floodplain, areas of 1-percent annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1-percent annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1-percent annual chance flood by levees. Flood insurance purchase is not required in these zones. Due to this small percentage, it is not anticipated that flooding hazards would occur within the Project site.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-8: The Project Would Place Within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows.

The proposed Project is not located within a 100-year flood hazard area. Refer to Impact 4.10-7, above.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-9: The Project Would Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding as a Result of the Failure of a Levee or Dam.

The closest dam to the proposed Project is the Isabella Dam. Isabella Dam is located approximately forty miles northeast of the proposed Project site and has a capacity to hold 570,000 acre-feet of water. If an earthquake were to occur in the vicinity, it could potentially result in a break in the dam. This could, under certain conditions, cause the entire lake storage to be released, which would result in flooding 60 square miles of the Metropolitan Bakersfield area (Kern County 2008). It would take approximately 10- 12 hours from the time the dam breaks for the water from Isabella Dam to reach the Project site, allowing adequate time for warning and to evacuate the area. The chance of the Isabella Dam failing entirely, with the lake at capacity, is approximately one day out of 10,000 years. The impacts to the proposed Project from dam failure are considered less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.10-10: The Project Would Be Subject to Inundation By Seiche, Tsunami, or Mudflow.

The proposed Project is located far enough from a large body of water that the site would not be impacted by seiche or tsunami. Additionally, as the Project site and surrounding area is relatively flat, the potential for a mudflow to occur is very low.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Cumulative effects related to hydrology resulting from implementation of the proposed Project and development in the vicinity and surrounding areas may expose more persons and property to potential water hazards. Cumulative development may also adversely affect downstream water quality, impacting surface and groundwater supplies. The potential cumulative impact is mitigated through required drainage studies to identify potential impacts, relationship to City and County drainage master plans, and implementation of appropriate on-site and off-site drainage improvements. Projects are also required to implement NPDES and BMP measures on a project basis to reduce potential water quality impacts. In addition, projects may require drainage improvements to be in compliance with the Metropolitan Bakersfield General Plan and Kern County Ordinance Code standards in addition to local and regional agency requirements, as part of the discretionary review process. There are no cumulative impacts associated with the proposed Project.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geology and Seismic Hazards*, and Mitigation Measure MM 4.17-1 through MM 4.17-5, as described in Section 4.17, *Utilities*.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.11

Land Use and Relevant Planning

Section 4.11
Land Use and Relevant Planning

4.11.1 Introduction

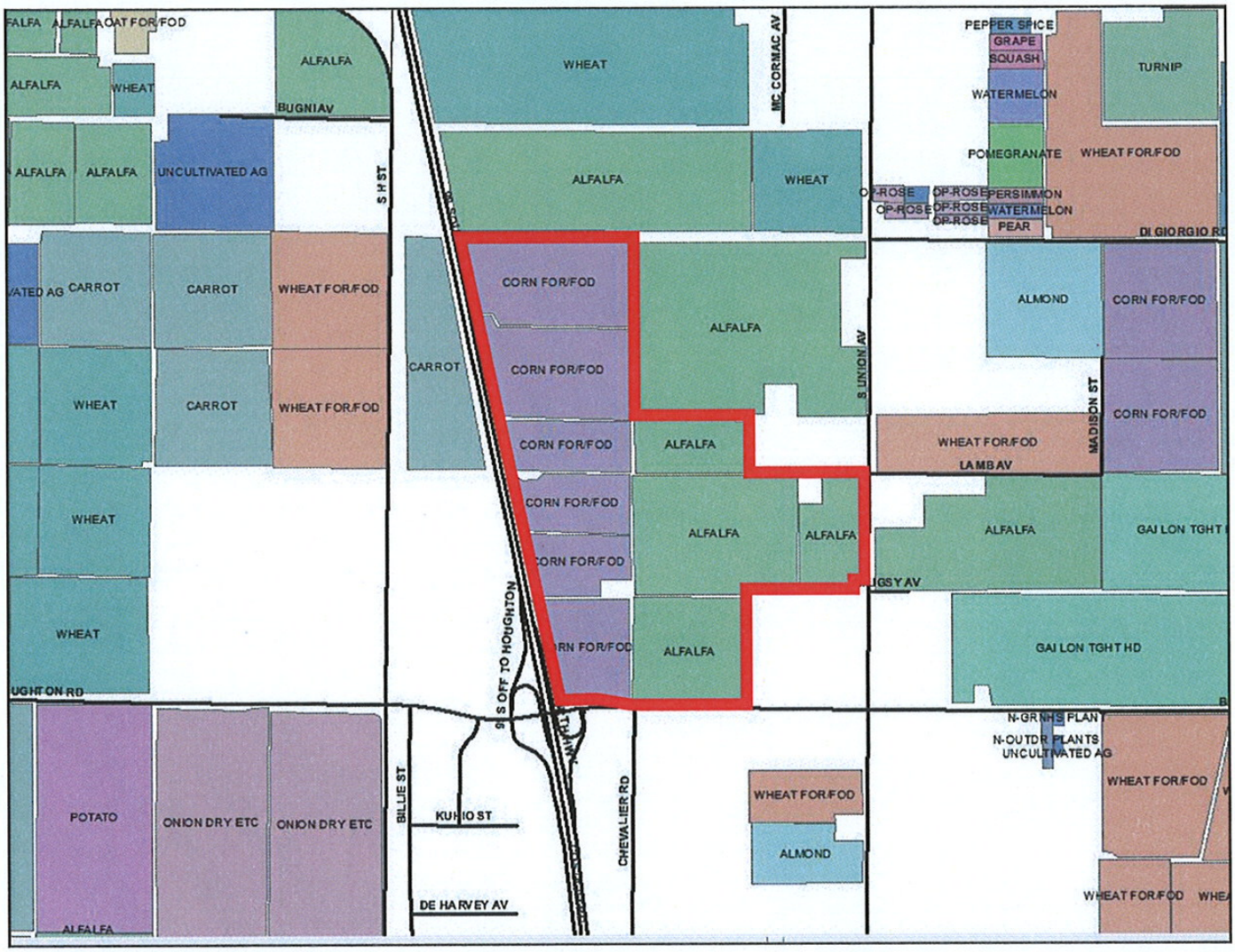
This section describes the environmental setting for land use and planning. Information in this section is based on information provided in the technical studies (refer to Appendices A through N). Ground and aerial photographs for the on-site and surrounding land use analysis as well as the following reference documents: Final Environmental Impact Report (EIR) for the Metropolitan Bakersfield General Plan, Metropolitan Bakersfield General Plan, Kern County General Plan, Title 16 of the Bakersfield Municipal Code, and the Kern County Ordinance Code. The purpose of this section is to identify the existing land use conditions, to analyze proposed Project compatibility with existing uses and consistency with relevant planning policies and to recommend mitigation measures to eliminate or reduce the significance of potential impacts.

4.11.2 Environmental Setting

The following section discusses the existing land uses in the Project area and land use conditions, such as type of use and densities adjacent to the Project site that would influence land use compatibility (refer to Figure 4.11-1, *On-Site and Surrounding Uses*). The environmental setting of the Project site consists of the physical conditions or existing land uses on the Project site and in the surrounding areas.

On-Site Land Use

The proposed Project site consists of disked land and has been utilized for agricultural purposes; primarily row-crop agriculture consisting of alfalfa, corn, wheat, and grain. A steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue (SR-204). There is one plugged and abandoned oil well located within the proposed Project boundaries (Big McKittrick Oil Company "Sea Cliff-Houghton" 1). In addition, two active, diesel-powered irrigation wells and one domestic well are located on-site.



Source: Kern County Geographic Information System Reported Crops

PROPOSED PROJECT

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

On-Site and Surrounding Land Uses

Figure 4.11-1

Surrounding Land Use

Existing adjacent land uses include vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard located south/southeast of proposed Project site. The following table, Table 4.11-1, *Surrounding Land Use*, provides a detailed description of the land uses for the properties adjacent to the site:

Table 4.11-1. Surrounding Land Use

Location	Land Use / Metropolitan Bakersfield General Plan Land Use Designations
North	Vacant / Agriculture: R-IA (Resource-Intensive Agriculture), LMR (Low Medium Density Residential, 4 to 10 units per acre), HMR (High Medium Density Residential, 7.26 to 17.42 units per acre), SR (Suburban, 4 units per acre), and GC (General Commercial)
East	Agriculture / Single-Family Residential / State Route 204: R-IA (Resource-Intensive Agriculture), RR (Rural Residential), and SI (Service Industrial)
South	Agriculture / Automobile Wrecking Yard: RI-A (Resource-Intensive Agriculture), RR (Rural Residential, 2½ acres per unit), and HC (Highway Commercial)
West	State Route 99 / Agriculture: PT (Public Transportation) and R-IA (Resource-Intensive Agriculture)

The area surrounding the proposed Project is undergoing various types of land use entitlements and development that will be consistent with the proposed Project.

4.11.3 Regulatory Setting

The proposed Project's relationships with the Metropolitan Bakersfield General Plan, the Kern County Zoning Ordinance, and other related policy planning documents are described below.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan is a policy document designed to give long-range guidance for decision-making affecting the future character of the Metropolitan Bakersfield planning area. The Metropolitan Bakersfield General Plan is a joint effort between the Kern County Planning Department and the City of Bakersfield Planning Division. It was last adopted on December 11, 2007, includes both City and unincorporated County lands, and is currently undergoing an update. It represents the official statement of the community's physical development as well as its economic, social and environmental goals. The Metropolitan Bakersfield General Plan contains goals and policies regarding the following Elements: Land Use, Circulation, Housing, Conservation, Open Space, Noise, Safety, Public Services and Facilities and Parks. An additional element includes the Kern River Plan, which helps to define goals and policies for issues unique to the Metropolitan Bakersfield area. The Metropolitan Bakersfield General Plan was utilized throughout this RDEIR as the fundamental planning document governing development on the Project site. Background information and policy information from the Metropolitan Bakersfield General Plan are cited in several sections of the RDEIR. Table 4.11-2, *Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies*, below, provides a list of policies applicable to the proposed Project.

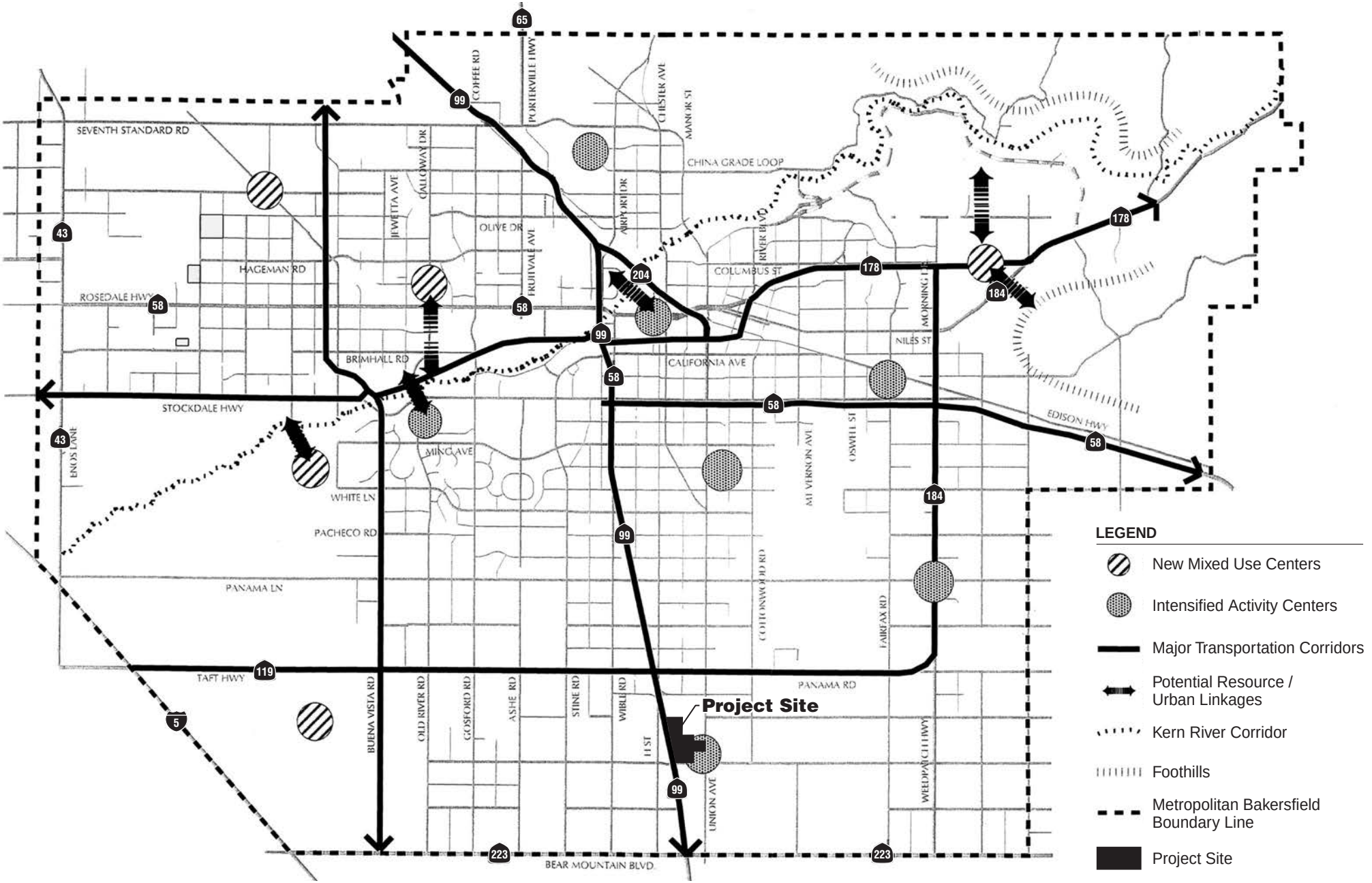
The proposed Project site and surrounding area are within the City of Bakersfield Sphere of Influence (SOI), defined as a plan for the probable physical boundary and service area of the City. This is the boundary in which all goals, policies and programs in the Metropolitan Bakersfield General Plan are applicable.

The Metropolitan Bakersfield General Plan has separated the City into four quadrants with State Route 99 (SR-99) serving as the north-south axis and Stockdale Highway (SR-58) serving as the east-west axis. These four quadrants are further subdivided into developed urban and rural-undeveloped areas. As a general rule, the City's SOI boundaries were utilized to help define the boundaries of planned urban growth. However, Pages II-2 through II-5 of the Metropolitan Bakersfield General Plan provide an overview of the basic principles for new urban areas and development in peripheral areas. The development concepts are referred to as "mixed-use activity centers." The following is an excerpt from Pages II-2 through II-5. Figure 4.11-2 *General Plan Land Use Policy Concept* Figure II-2 of the General Plan.

Overview of the General Plan Basic Principles for New Urban Areas

The Metropolitan Bakersfield General Plan Land Use Map is depicted in Figure II-1, located in the back of this document. The plan map provides a graphic depiction of the general plan's development policies and indicated that land use designations for which pertinent policies and standards have been established. Two basic principles govern the plan: the focusing of new development into distinctive centers which are separated by low land use densities and the siting of development to take advantage of the environmental setting. These principles are defined as the "centers" and "resource" concepts respectively. Figure II-2 conceptually illustrates these land use principles.

The "centers" concept provide for a land use pattern consisting of several concentrated mixed-use commercial and high density residential centers surrounded by medium density residential uses. Centers may be differentiated by functional activity, density/intensity, and physical character. Single-family residential uses are located between these mixed-use commercial/residential centers primarily.



Source: Metropolitan Bakersfield General Plan

0 15,000'
APPROXIMATE

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07 • AGRICULTURAL PRESERVE #13 EXCLUSION

General Plan Land Use Policy Concept

Figure 4.11-2

This concept encourages people to live and work in the same area, thus, serves to minimize sprawl, reduce traffic, travel time, infrastructure costs, and air pollution. In addition to promoting the formation of several large concentrated mixed-use centers, the plan attempts to consolidate smaller, neighborhood-serving commercial development by prescribing minimum distances between commercial parcels and by discouraging strip commercial development.

The "resources" concept emphasizes the siting of development to reflect the planning area's natural and visual resources; its river, canals, and foothills. The "resources" concept uses as a point of departure, the 1984 Kern River Plan Element (as amended), which takes advantage of the recreational potential of the river while respecting the river's sensitive natural habitats and aesthetic resources. It is proposed that linkages to unique resources be encouraged. Policies have been included in the plan to promote utilization and sensitivity of natural and visual resources.

Basic Principles for Development of Peripheral Areas

New development on the periphery of urban Bakersfield will be focused in ten new mixed-use activity centers located in the southwest, northwest and northeast. It is expected that the southwest center would include a mix of professional office and retail uses, moderate density residential, and would filter outwards to lower suburban-type densities. Although depicted in Figure II-2 in policy concept form, actual land use designations for the southwest center and the area around it will be determined through a more detailed land use and environmental analysis. In depth analysis of the southwest center is warranted due to its growth potential and its related impacts, impact on prime agricultural lands, and potential to impact the Kern River corridor resource. The northwest center will contain retail commercial, light industrial, moderate and high density residential, and will be surrounded by low and estate residential densities. The center in the northeast will include retail commercial, professional office, moderate and high density residential, and will filter outwards to lower densities.

The plan encourages that each center: (a) focus on a major open space amenity, such as a park or water body; (b) link land uses to the Kern River where possible; and (c) exhibit pedestrian sensitivity with appropriate design applied to encourage pedestrian activity. In addition to these three activity centers, peripheral development will be focused in smaller community centers, such as in the Greenfield and Lamont areas, with local-serving commercial services and residential uses.

As a general rule, the sphere of influence boundary was utilized to help define the boundaries of planned urban growth. However, there are two exceptions to this. The most obvious exception is the southwest center. Here, while the commercial center lies within the sphere of influence, the single-family residential densities extend beyond the western boundary of the present sphere of influence. Justification for extending beyond the sphere of influence boundary includes the following: (a) rapid growth has already taken place in this direction in recent years and show no signs of slowing; (b) the area presents an opportunity to capitalize on the Kern River as a visual and aesthetic resource; and (c) the ease with which services may be extended. The second exception occurs in Oildale. In particular, a major new airport terminal with supporting commercial and industrial uses are master planned just north of the existing terminal at Meadows Field."

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Circulation Element - Streets	
Streets Policy #36: Prevent streets and intersections from degrading below Level of Service "C" where possible due to physical constraints (as defined in a Level of Service Ordinance) or when the existing Level of Service is below "C" prevent where possible further degradation due to new development with a three-part mitigation program: adjacent right-of-way dedication, access improvements and/or on area-wide impact fee. The area-wide impact fee would be used where the physical changes for mitigation are not possible due to existing development and/or the mitigation measures is part of a larger Project, such as freeways, which will be built at a later date.	Appropriate fees would be applied to the future development of the proposed Project in order to accommodate the expansion of required utilities, facilities, and infrastructure.
Streets Policy #37: Require new development and expansion of existing development to pay for necessary access improvements, such as street extensions, widenings, turn lanes, signals, etc., as identified in the transportation impact report as may be required for a Project.	Refer to analysis for Circulation/Streets Goal #3 and Policy #36.
Streets Policy #39: Require new development and expansion of existing development to pay or participate in its pro rata share of the costs of expansions in area-wide transportation facilities and services which it necessitates.	Refer to analysis for Circulation/Streets Goal #3 and Policy #36.
Streets Policy #40: Provide new local street systems that are logical and comprehensible and systems of street names and addresses that are simple, consistent, and understandable.	Future roadway extensions and improvements shall be implemented in accordance with Kern County Ordinance Code requirements.
Streets Policy #41: Plan alignments for local streets to permit economical and practical patterns, shapes, and sizes of development parcels.	Future roadway extensions and improvements shall be implemented in accordance with Kern County Ordinance Code requirements.
Circulation Element - Transit	
Transit Goal #2: Provide a street system and land development policies that support public transportation"	Refer to this section for a detailed description of available public transportation.
Transit Goal #3: Provide cost effective public transportation services.	Refer to analysis in Circulation/Transit Goal #2.
Transit Goal #4: Reduce traffic congestion and parking requirements and improve air quality through improved transportation services.	Refer to analysis in Circulation/Transit Goal #2.
Transit Policy #1: Consider transit service issues in the design of the arterial and collector street system.	Future roadway extensions and improvements shall be implemented in accordance with Kern County Ordinance Code requirements.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Transit Policy #4: Coordinate with GET [Golden Empire Transit] to locate bus stops as close as possible to the facilities they serve.	The Project Applicant shall work with the GET to locate bus stops as close as possible to the proposed Project site in an effort to provide residents with sufficient access to public transit service.
Circulation Element - Bikeways	
Bikeways Goal #1: Provide a circulation system which recognizes and responds to the needs of bicycle travel.	Future roadway extensions and improvements shall be implemented in accordance with Kern County Ordinance Code requirements.
Bikeways Goal #2: Provide a circulation system that minimizes cyclist/motorist conflicts.	Refer to analysis in Bikeways Goal #1.
Bikeways Policy #5: Consider bicycle safety when implementing improvements for automobile traffic operations.	Refer to analysis in Bikeways Goal #1.
Bikeways Policy #7: Provide bicycle parking facilities at activity centers such as shopping centers, employment sites, and public buildings.	Refer to analysis in Bikeways Goal #1.
Circulation/Bikeways Policy #9: Require new subdivisions to provide bike lanes on collector and arterial streets in accordance with the Bikeway Master Plan.	Refer to analysis in Bikeways Goal #1.
Circulation Element - Parking	
Circulation/Parking Goal #1: Provide an efficient parking system to respond to the needs of motorists.	Future parking improvements shall be implemented in accordance with Kern County Ordinance Code requirements.
Circulation/Parking Goal #2: Satisfy parking requirements in all new developments (residential, commercial, industrial, etc.) through off-street facilities.	Refer to analysis in Circulation/Parking Goal #1.
Circulation/Pedestrian Ways Element Goals	
Circulation/Pedestrian Ways Goal #2: Provide adequate sidewalks throughout the planning area.	Development on-site shall be subject to County design review, Kern County Ordinance Code, and Metropolitan Bakersfield General Plan requirements.
Circulation/Pedestrian Ways Element Policies	
Safety Element Goal #2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development of metropolitan police and fire facilities and services.	The proposed Project site is within fire and sheriff/police service areas and is not anticipated to create and additional need for police and fire services. Any potential increase in the cost to maintain and staff additional fire or sheriff/police protection services would be paid for by property tax revenues generated by the proposed Project.
PSF School Policy #1: New development will be required to pay its proportional share of the cost of school impact fees within the Plan area.	The Project Applicant/Developer is required to pay developer fees to mitigate impacts to elementary and middle schools.
PSF Park Policy #3: "Require developers to dedicate land, provide improvements and/or in lieu fees to serve the needs of the population in newly developing areas."	Appropriate fees would be applied to the future development of the proposed Project.
Conservation Element – Biological Resources	

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Biological Resources Goal #1: "Conserve and enhance Bakersfield's biological resources in a manner which facilitates orderly development and reflects the sensitivities and constraints of these resources."	A Biota Report was performed for the proposed Project. Due to the site's location within the Metropolitan Bakersfield Habitat Conservation Plan (MBHCP) boundary, the proposed Project would be required to pay biological impact mitigation fees. Additional mitigation measures are also required.
Biological Resources Goal #2: "To conserve and enhance habitat areas for designated 'sensitive' animal and plant species."	Refer to analysis for Biological Resources Goal #1.
Biological Resources Policy #1: "Direct development away from 'sensitive biological resource' areas, unless effective mitigation measures can be implemented."	Refer to analysis for Conservation/Biological Resources Goal #1.
Biological Resources Policy #2: "Preserve areas of riparian vegetation and wildlife habitat within floodways along rivers and streams, in accordance with the Kern River Plan Element and channel maintenance programs designed to maintain flood flow discharge capacity."	No riparian habitat is located within the proposed Project site.
Biological Resources Policy #3: "Discourage, where appropriate, the use of off-road vehicles to protect designated sensitive biological and natural resources."	Upon construction of the proposed Project, the Project site would not be vacant nor available for off-road vehicle use.
Biological Resources Policy #4: "Determine the feasibility of enhancing sensitive biological habitat and establishing additional wildlife habitat in the study area with State and/or Federal assistance."	Refer to the analysis for Conservation/Biological Resources Goal #1.
Biological Resources Policy #5: "Determine the locations and extent of suitable habitat areas required for the effective conservation management of designated "sensitive" plant and animal species."	No sensitive plant species occur on-site. Refer to the analysis for Conservation/Biological Resources Goal #1.
Biological Resources Policy #6: "Investigate the feasibility of including natural areas selected for the habitat conservation plan as a component of the regional park system."	Refer to the analysis for Conservation/Biological Resources Goal #1.
Conservation Element - Mineral Resources	
Mineral Goal #1: Protect areas of significant resources potential for future use.	The proposed Project site is not located within an oil or gas administrative boundary. The prospect well on the northwest portion of the site had no oil shows and one natural gas show and was abandoned in 1935. One natural gas pipeline traverses the proposed Project area. The proposed Project would be required to comply with appropriate setbacks for the on-site abandoned wells and natural gas pipelines in accordance with the Kern County Ordinance Code, Chapter 19.98, Oil and Gas Production, and Kern County Fire Department Pipeline Development Policies.
Mineral Goal #2: Document areas of current mineral and energy resource extraction, as a basis for land use and conservation policies and programs.	No mineral and energy resource extraction areas occur on-site.
Mineral Goal #3: Avoid conflicts between the productive use of mineral and energy resource lands and urban growth.	The proposed Project would be required to comply with the Kern County Ordinance Code, Chapter 19.98, Oil and Gas Production. No productive mineral and energy resource lands are within, or adjacent to, the proposed Project site. Therefore, development of

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
	the proposed Project would avoid conflicts between the productive use of mineral and energy resource lands and urban growth.
Mineral Goal #4: Protect land, water, air and visual resources from environmental damage resulting from mineral and energy resource development.	Mineral and energy resource development would not occur as part of the proposed Project. Because the site is outside any oil or gas administrative boundary, future development of mineral and energy resources would be unlikely; however, should future development occur, it shall be evaluated for environmental impacts at the time the development is proposed.
Mineral Policy #1: Maintain maps and descriptions of potential mineral and energy resources as a basis for policy and program implementation.	This RDEIR provides information, including maps, on mineral and energy resources for the proposed Project and adjacent properties. Refer to the analysis for Mineral Goal #1, above.
Mineral Policy #2: Document the location, status and long-term viability of sand and gravel quarries and petroleum drilling sites for purposes of avoiding near and long-term land use conflicts and provide a basis of compliance monitoring.	The proposed Project does not contain sand and gravel extraction areas or petroleum drilling sites.
Mineral Policy #3: Encourage and support the exchange of information on mineral and energy resources between private industry, City of Bakersfield and Kern County.	This RDEIR provides information on mineral and energy resources for the proposed Project site and adjacent properties.
Mineral Policy #4: Land use decisions shall recognize the importance of identified mineral resources and need for conservation of resources identified by the State Mining and Geology Board.	The proposed Project will undergo discretionary review by Kern County. This RDEIR evaluates the presence and absence of mineral resources on the Project site and any potential impacts the proposed Project may have on the proposed mineral resources. This RDEIR will be utilized by decision makers to help them make an educated decision on the proposed Project.
Mineral Policy #5: Protect significant mineral and petroleum resource areas, including potential sand and gravel extraction areas.	Refer to the analysis for Mineral Goals #2 and #3 and Mineral Policy #2, above.
Mineral Policy #6: Continue implementation of the Kern River Channel Maintenance Program for extraction of river sand and gravel.	The proposed Project is not located within the Kern River Channel Maintenance Program.
Mineral Policy #7: Promote development of compatible uses adjacent to mineral extraction areas.	Refer to the analysis for Mineral Goal #3, above.
Mineral Policy #8: Allow development of resource extraction sites subject to the conditional use permit procedure in zones where such uses are not prohibited by right and where it can be shown that the proposed extraction uses are compatible with surrounding areas.	Resource extraction sites are not proposed as part of this Project. Any future development of mineral and energy resources shall be evaluated for environmental impacts at the time the development is proposed.
Mineral Policy #9: Encourage preservation of any known deposits of gemstones and fossils.	The proposed Project has not been identified as a potential quarry. Additionally, according to the Phase I Cultural Resources Survey prepared for the proposed Project, fossils are not anticipated to be encountered within the Project site.
Mineral Policy #10: Implement, as appropriate, the California Environmental Quality Act to minimize land use conflicts and reduce extraction operations.	Refer to the analysis for Mineral Goal #3 and Mineral Policies #1 and #3, above.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Mineral Policy #11: Prohibit incompatible development in areas, which have a significant potential to harm public health, safety and welfare due to mineral and petroleum extraction and processing.	Refer to the analysis for Mineral Goal #3, Mineral Policies #1 and #3, above, and Section 4.9, *Hazards/Hazardous Materials*.
Mineral Policy #12: Design resource extraction operations subject to discretionary permits to maintain the integrity of areas of "high environmental quality" and unique scenic value.	Resource extraction operations are not proposed as part of the proposed Project; therefore, discretionary permits would not be required. Any future development of mineral and energy resources shall be evaluated for environmental impacts at the time the development is proposed.
Mineral Policy #13: Require surface mineral resource extraction sites to have plans and procedures for land reclamation, conforming with the requirements of the State Mining and Geology Board, to be implemented upon completion of extraction operations at each site or portion thereof.	Refer to the analysis for Mineral Resource Goals #2 and 3, above and Mineral Policy #12, above.
Mineral Policy #14: Review all discretionary mineral or petroleum development including renewal of existing authorizations, under the policies and procedures of the California Environmental Quality Act.	Mineral or petroleum development is not proposed as part of this proposed Project. Refer to the analysis for Mineral Goal #3 and Mineral Policies #1 and #3, above.
Mineral Policy #15: Require petroleum production sites in urban areas, which are subject to discretionary permits to install peripheral landscaping to help reduce the noise, dust and visual impacts to adjacent sensitive receptors and public ways.	Resource extraction operations are not proposed as part of this Project. The proposed Project would be subject to the appropriate setbacks and landscaping for the abandoned well and the natural gas pipelines as required by the Kern County Ordinance Code, Chapter 19.98, Oil and Gas Production, and Kern County Fire Department Pipeline Development Policies.
Mineral Policy #16: Require all mineral development to be predicated on appropriate reclamation plans that meet the standards of the State Surface Mining and Reclamation Act and the implementing guidelines of the State Mines and Geology Board, and/or the standards of the State Division of Oil and Gas. Reclamation/ restoration of the sites shall be done at each phase of development or as extraction is completed.	Refer to the analysis for Mineral Goal #4, above. It is unlikely that mineral development would occur on-site. Any mineral development shall be required to comply with the standards of the State Surface Mining and Reclamation Act and the implementing guidelines of the State Mines and Geology Board, and/or the standards of the DOGGR.
Conservation Element – Soils and Agriculture	
Soils and Agriculture Goal #1: "Provide for the planned management, conservation, and wise utilization of agricultural land in the planning area."	The proposed Project is not consistent with this goal and will result in an unavoidable adverse impact.
Soils and Agriculture Goal #2: "Promote soil conservation and minimize development of prime agricultural land as defined by the following criteria: Capability Class I and/or II irrigated soils, 80-100 Storie Index rating, Gross crop return of $200 or more per acre per year, and Annual carrying capacity of one animal per acre per year."	As defined by the California Land Conservation Act (G.C. Section 51202) and the Metropolitan Bakersfield General Plan, prime agricultural soils comprise Class I and Class II soils, Storie index 80-100 soils, vineyards and orchards and soil that yields a minimum of $200 an acre per year. According to these standards, the proposed Project consists of prime soils.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Soils and Agriculture Goal #3: "Establish urban development patterns and practices that promote soil conservation and that protect areas of agricultural production of food and fiber crops, and nursery products."	Refer to analysis for Soils and Agriculture Element Goal #1.
Soils and Agriculture Policy #1: "Determine the extent and location of all prime agricultural land within the study area."	Approximately 314.30 acres of the proposed Project are located within an area designated prime agricultural land. Additionally, approximately 257.57 acres of the proposed Project are included in Agricultural Preserve No. 13. Therefore, implementation of the proposed Project would result in a significant and unavoidable impact. A Farmland Conversion Study has been prepared for the RDEIR and is included as Appendix B.
Soils and Agriculture Policy #2: "Review projects that propose subdividing or urbanizing prime agricultural land to ascertain how continued commercial agricultural production in the project vicinity would be affected."	Phased development of the proposed Project would allow for the continued use of prime agricultural land until buildout of the Project site occurs.
Soils and Agriculture Policy #3: "Protect areas designated for agricultural use, which includes Class I and II agricultural soils having surface delivery water systems, from the encroachment of residential and commercial subdivision development activities."	The proposed Project has Class II and III agricultural soils. Based on the California Land Conservation Act and the Metropolitan Bakersfield General Plan criteria for prime farmland, the proposed Project consists of 314.30 acres of prime agricultural lands. However, the proposed Project was identified for urbanization within the Metropolitan Bakersfield General Plan. Therefore, the proposed Project would not be considered an encroachment of commercial uses.
Soils and Agriculture Policy #4: "Monitor the amount of prime agricultural land taken out of production for urban uses or added within the plan area."	A Farmland Conversion Study has been prepared for the RDEIR and is included as Appendix B.
Soils and Agriculture Policy #6: "Continue implementing land grading ordinances that reduce soil erosion/siltation commonly associated with land development."	Project grading shall be conducted in accordance with applicable local grading ordinances, standards, and practices to minimize soil erosion and siltation.
Soils and Agriculture Policy #7: "Land use patterns, grading, and landscaping practices shall be designed to prevent soil erosion while retaining natural watercourses when possible."	Natural watercourses are not present within the proposed Project site. However, with implementation of mitigation measures in Section 4.7, *Geologic and Seismic Hazards*, and Section 4.10, *Hydrology and Water Quality*, impacts would be reduced to less than significant levels.
Soils and Agriculture Policy #9: "Protect prime agricultural lands against unplanned urban development by adopting agricultural zoning, general plan agriculture designation, and by encouraging use of the Williamson Act and supporting programs and policies that provide tax and economic incentives to ensure the long-term retention of agricultural lands."	The proposed Project is not situated on land under an existing Williamson Act Contract; however, it is identified as prime farmland. In addition, approximately 257.57 acres of the proposed Project are located in Agricultural Preserve No. 13. Approval and implementation of the proposed Project would result in a significant impact from the conversion of approximately 314.30 acres of soil that meet the requirements for prime farmland if water for irrigation were available.
Soils and Agriculture Policy #10: "Encourage landowners to retain their lands in agricultural production."	The proposed Project will remain under agricultural production as the various phases of the Project are constructed.
Soils and Agriculture Policy #12: "Prohibit premature removal of ground cover in advance of development and require measures to prevent soil erosion during and immediately after construction."	Refer to analysis for Soils and Agriculture Policy #6.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Soils and Agriculture Policy #13: "Minimize the alteration of natural drainage and require development plans to include necessary construction to stabilize runoff and silt deposition through enforcement of grading and flood protection ordinances."	Refer to analysis for Soils and Agricultural Policy #7.
Soils and Agriculture Policy #14: "When considering proposal to convert designated agricultural lands to non-agricultural use, the decision-making body of the city and County shall evaluate the following factors to determine the appropriateness of the proposal: Soil quality; Availability of irrigation water; Proximity to non-agricultural uses; Proximity to intensive parcelization; Effect on properties subject to "Williamson Act" land use contracts; Ability to be provided with urban services (sewer, water, roads, etc.); Ability to effect the application of agricultural chemicals on nearby agricultural properties; Ability to create a precedent-setting situation that leads to the premature conversion of prime agricultural lands; Demonstrated project need; and Necessity of buffers such as lower densities, setbacks, etc.	Refer to analysis for Soils and Agricultural Policy #3 and #9.
Conservation Element – Water Resources	
Water Quality Goal #2: Assure that adequate groundwater resources remain available to the planning area.	Based on the Water Supply Assessment, the proposed Project will withdraw 287.11 acre-feet of groundwater annually regardless of single or sequential dry years. The groundwater sub-basin will not be affected by the proposed Project primarily due to a large reduction of water required between existing agricultural uses and proposed industrial uses.
Water Quality Goal #3: Assure that adequate surface water supplies remain available to the planning area.	No surface water sources will be utilized for the proposed Project except as groundwater recharge.
Conservation Element - Air Quality	
Air Quality Goal #1: "Promote air quality that is compatible with health, well-being, and enjoyment of life by controlling point sources and minimizing vehicular trips to reduce air pollutants."	Stationary point sources (i.e., mechanical equipment) would be subject to applicable regulatory requirements. With regard to mobile emissions, the proposed Project would strive to reduce the number of vehicular trips to the site by the provisions of sidewalks, bicycle lanes and bicycle racks.
Air Quality Goal #2: Continue working toward attainment of Federal, State and Local standards as enforced by the San Joaquin Valley Air Pollution Control District."	Refer to analysis for Conservation/Air Quality Goal #1.
Air Quality Goal #3: "Reduce the amount of vehicular emissions in the planning area."	Refer to analysis for Conservation/Air Quality Goal #1.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Air Quality Policy #1: "Comply with and promote San Joaquin Valley Unified Air Pollution Control District (SJVAPCD) control measures regarding Reactive Organic Gases (ROG). Such measures are focused on: (a) steam driven well vents, (b) Pseudo-cyclic wells, (c) natural gas processing plant fugitives, (d) heavy oil test stations, (e) light oil production fugitives, (f) refinery pumps and compressors, and (g) vehicle inspection and maintenance."	Air Quality impacts have been analyzed and concluded to be significant and unavoidable since operational and cumulative ROG emissions would exceed San Joaquin Valle Air Pollution Control District (SJVAPCD) thresholds.
Air Quality Policy #2: "Encourage land uses and land use practices which do not contribute significantly to air quality degradation."	The proposed Project would provide development consistent with existing and approved development on nearby parcels, and would be located in an area of relatively lesser environmental sensitivity accommodating growth while balancing environmental considerations.
Air Quality Policy #3: "Require dust abatement measures during significant grading and construction operations."	As discussed in Section 4.3, *Air Quality*, the proposed Project would implement dust control techniques during construction activities in conformance with SJVAPCD Regulation VIII, the Kern County Ordinance Code, and required Mitigation Measures.
Air Quality Policy #4: Consider air pollution impacts when evaluating discretionary permits for land use proposals. Considerations should include: a) Alternative access routes to reduce traffic congestion, b) Development phasing to match road capacities, c) Buffers including increase vegetation to increase emission dispersion and reduce impacts of gaseous or particulate matter on sensitive uses."	The rate of development would proceed based largely on economic considerations, infrastructure improvements, market demands and other planning considerations. All plans are subject to review and approval by the Planning Department as part of the final Development Plan review process.
Air Quality Policy #11: "Improve the capacity of the existing road system through improved signalization and traffic control systems."	Refer to analysis for Circulation/Streets Policy #1 and #3.
Air Quality Policy #12: "Encourage the use of mass transit, carpooling and other transportation options to reduce vehicle miles traveled."	Refer to analysis for Circulation/Streets Policy #4.
Air Quality Policy #13: "Consider establishing priority parking areas for carpoolers in projects with relatively large numbers of employees to reduce vehicle miles traveled and improve air quality."	Refer to analysis for Circulation/Parking Element Goal #1 and #4.
Air Quality Policy #14: "Establish park and ride facilities to encourage carpooling and the use of mass transit."	Refer to analysis for Circulation/Streets Policy #4.
Air Quality Policy #16: "Cooperate with Golden Empire Transit [GET] and Kern Regional Transit to provide a comprehensive mass transit system for Bakersfield; require large-scale new development to provide related improvements, such as bus stop shelters and turnouts."	Refer to analysis for Circulation/Streets Policy #4.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Air Quality Policy #18: "Encourage walking for short distance trips through the creation of pedestrian friendly sidewalks and street crossings."	Refer to analysis for Circulation/Pedestrian Ways Goal #1 and #2.
Air Quality Policy #19: "Promote a pattern of land uses which locates residential uses in close proximity to employment and commercial services to minimize vehicular travel."	Refer to analysis for Circulation/Pedestrian Ways Goal #1.
Land Use Element - Aesthetics	
Land Use Goal #3: Accommodate new development which is compatible with and complements existing land uses.	The proposed Project has been evaluated with respect to potential impacts pertaining to the degradation of existing visual character/quality. The Project site is located in close proximity to agricultural farms, orchards, light industrial activities, and single-family residences. However, the Project area is slated for development, which would be subject to County design review standards and regulations that would ensure functional and visual compatibility of both the Project and surrounding projects.
Land Use Goal #7: Establish a built environment which achieves a compatible functional and visual relationship among individual buildings and sites.	Development on-site shall be subject to County design review, Kern County Ordinance Code, and Metropolitan Bakersfield General Plan requirements.
Land Use Policy #26: Encourage adjacent commercial uses to be of compatible height, setback, color and materials.	The Project would be designed with unified materials and colors and would be compatible with the surrounding land uses. Future uses are subject to the development standards of the Kern County Ordinance Code, which regulates all aspects of development including building heights, building massing, setbacks, parking, landscaping, lighting, and signage.
Land Use Policy #28: Require that commercial development provide design features such as screen walls, landscaping and height, setback and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to noise, traffic, parking, and differences in scale.	Refer to the analysis for Land Use Policy #26. The proposed Project's lighting plans would also be reviewed by Kern County on a project-by-project basis to ensure uniformity and adequate public lighting without adding to the light and glare in the proposed Project area.
Land Use Policy #30: Street frontages along all new commercial development shall be landscaped.	Refer to the analysis for Land Use Policy #26.
Land Use Policy #34: Provide for the clustering of new industrial development adjacent to existing industrial uses and along major transportation corridors.	The proposed Project would provide approximately 314.30 acres of industrial development within the southern Metropolitan Bakersfield area, at the Houghton Road and SR-99 interchange.
Land Use Policy #36: Require that industrial uses provide design features, such as screen walls, landscaping and height, setback and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to light, noise, sound and vibration.	Development on-site shall be subject to County design review, Kern County Ordinance Code, and Metropolitan Bakersfield General Plan requirements.
Land Use Policy #37: Street frontages along all new industrial development shall be landscaped.	Refer to the analysis for Land Use Policy #26.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Land Use Policy #63: Encourage the use of creative and distinctive signage which establishes a distinctive image for the planning area and identifies principal entries to the metropolitan area, unique districts, neighborhoods and locations.	Signage plans have not been submitted for the proposed Project. Should signage be proposed in the future, signage plans shall be reviewed and approved by the County's Planning Department as part of the final Development Plan review process.
Land Use Policy #72: Promote the establishment of attractive entrances into communities, major districts, and transportation terminals, centers, and corridors within the planning area.	Refer to analysis for Land Use Policy #26.
Land Use Policy #74: Encourage the establishment of design programs which may include signage, street furniture, landscape, lighting, pavement treatments, public art, and architectural design.	Refer to analysis for Land Use Policy #26.
Land Use Element – Cultural Resources	
Land Use Element Goal #6: Accommodate new development that is sensitive to the natural environment, and accounts for environmental hazards.	According to the Phase I Cultural Resource Survey, the proposed Project is not located within an area of significant cultural resources.
Land Use Element Policy #105: Development on land containing known archaeological resources (i.e., high sensitivity areas) shall utilize methodology set forth as described necessary by a qualified archaeologist to locate proposed structures, paving, landscaping and fill dirt in such a way as to preserve these resources undamaged for future generations when it is the recommendation of a qualified archaeologist that said resources be preserved in situ.	Refer to Goal #6.
Land Use Element Policy #107: The preservation of historical resources shall be promoted, and other public agencies or private organizations shall be encouraged to assist in the purchase and/or relocation of sites, buildings, and structures deemed to be of historical significance.	Refer to Goal #6.
Land Use Element - Land Use and Planning	
Land Use Goal #1: Accommodate new development which captures the economic demands generated by the marketplace and establishes Bakersfield's role as the capital of the southern San Joaquin Valley.	The proposed Project would provide industrial and commercial uses that would meet the substantial and unmet service demands of the residents within the southern portion of the City.
Land Use Goal #2: Accommodate new development which provides a full mix of uses to support its population.	Refer to the analysis for Land Use Goal #1.
Land Use Goal #3: Accommodate new development which is compatible with and complements existing land uses.	The proposed Project is located in close proximity to agricultural farms, orchards, light industrial activities, and single-family residences. Development of the proposed Project would be subject to Metropolitan Bakersfield and County requirements, to ensure functional and visual compatibility both internally within the proposed Project and with surrounding uses.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Land Use Goal #4: Accommodate new development which channels land uses in phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.	The Project site is adjacent to other proposed projects, and the proposed Project is located within the logical pathway of continued urbanization, south of the City of Bakersfield. The rate of on-site development would correspond with the availability of appropriate infrastructure.
Land Use Goal #6: Accommodate new development that is sensitive to the natural environment, and accounts for environmental hazards.	The Project site is located within the adopted MBHCP and will be subject to the payment of HCP fees. Upon payment of this fee, a development permit application would become a sub-permittee and would be allowed the "incidental take" of species in accordance with state and federal endangered species laws. Pesticide contamination was deemed not to be a major concern at the site.
Land Use Goal #7: Establish a built environment which achieves a compatible functional and visual relationship among individual buildings and sites.	Development on-site shall be subject to County design review and Kern County Ordinance Code and Metropolitan Bakersfield General Plan requirements.
Land Use Policy #15: Allow for the development of a variety of commercial centers/corridors which are differentiated by their function, intended users and level of intensity, including convenience centers service local residential neighborhoods, subregional centers which serve groupings of neighborhoods, and major regional centers which serve the planning area and surrounding areas.	The proposed Project is located in an urbanizing area and is near existing residential and industrial development. The proposed Project would provide industrial uses that would capture the economic demands generated by the marketplace.
Land Use Policy #16: Allow for development of a variety of commercial uses, including those which serve residents (groceries, clothing, etc.), highway users, and tourists-visitors.	Refer to the analysis for Land Use Policy #15.
Land Use Policy #26: Encourage adjacent commercial uses to be of compatible height, setback, color and materials.	The Project would be designed with unified materials and colors and would be compatible with the surrounding land uses. Future uses are subject to the development standards of the Kern County Ordinance Code, which regulates all aspects of development including building heights, building massing, setbacks, parking, landscaping, lighting, and signage.
Land Use Policy #28: Require that commercial development provide design features such as screen walls, landscaping and height, setback, and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to noise, traffic, parking, and differences in scale.	Refer to the analysis for Land Use Policy #26.
Land Use Policy #30: Street frontages along all new commercial development shall be landscaped (I-1).	Refer to the analysis for Land Use Policy #26.
Land Use Policy #30B: Require perimeter street(s) around new commercial office, retail, mixed-use, and industrial business park land uses where they will enhance pedestrian and vehicular access from adjacent residential neighborhoods or promote convenient access to public transit services, and where anticipated traffic will	Perimeter street(s) will be considered during the development review process upon receipt of definitive site plans.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
not detrimentally impact local streets. Exceptions may be allowed if natural or artificial barriers such as, but not limited to, railroads, utility corridors, canals, or other watercourses, or topographic features exist that create a logical separation between the uses, or to encourage infill development.	
Land Use Policy #31: Allow for a variety of industrial uses, including land-extensive mineral extraction and processing, heavy manufacturing, light manufacturing, warehousing and distribution, transportation-related, and research and development uses (I-1).	Approximately 107.72 acres of LI (Light Industrial), 159 acres of SI (Service Industrial), 22 acres of GC (General Commercial), and 9.01 acres if HC (Highway Commercial) uses are proposed.
Land Use Policy #34: Provide for the clustering of new industrial development adjacent to existing industrial uses and along major transportation corridors.	SR-99 is adjacent to the west and SR-204 is adjacent to the east of the proposed Project.
Land Use Policy #36: Require that industrial uses provide design features, such as screen walls, landscaping and height, setback, and lighting restrictions between the boundaries of adjacent residential land use designations so as to reduce impacts on residences due to light, noise, sound and vibration.	Refer to the analysis for Land Use Policy #26.
Land Use Policy #37: Street frontages along all new industrial development shall be landscaped.	Refer to the analysis for Land Use Policy #26.
Land Use Policy #38: Minimize impacts of industrial traffic on adjacent residential parcels through the use of site plan review and improvement standards.	Refer to the analysis for Land Use Policy #26.
Land Use Policy #52: Locate new development where infrastructure is available or can be expanded to serve the proposed development.	As discussed in Section 4.17, *Utilities*, utility infrastructure is either currently, or will be available for the Project site at build-out, or improvements to the existing infrastructure are planned in order to provide the Project site and other future developments with adequate utilities.
Land Use Policy #53: Ensure that land use and infrastructure development are coordinated.	The development of the Project site will be coordinated with infrastructure improvements.
Land Use Policy #54: The developer shall be responsible for all on-site costs incurred as a result of the proposed project, in addition to a proportional share of off-site costs incurred in service extension or improvements. The availability of public or private services or resources shall be evaluated during discretionary project consideration. Availability may affect project approval or result in a reduction in size, density, or intensity otherwise indicated in the general plan's map provisions.	Refer to analysis for Land Use Policy #52.
Land Use Policy #55: Provide for the mitigation of significant noise impacts on adjacent sensitive uses from transportation corridor improvements.	An Acoustical Analysis was conducted for the proposed Project. Refer to Section 4.13, *Noise*, for impacts and mitigation measures associated with noise impacts of the Project.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Land Use Policy #61: Coordinate a consistent design vocabulary between city and county for all public signage, including fixture type, lettering, colors, symbols, and logos.	Signage plans have not been submitted for the proposed Project. Should signage be proposed in the future, signage plans shall be reviewed and approved by the County's Planning Department as part of the final Development Plan review process.
Land Use Policy #62: Provide signage which is adequately spaced and clearly visible during the day and night to control vehicular traffic, bicycles, and pedestrians.	Refer to the analysis for Land Use Policy #61.
Land Use Policy #63: "Encourage the use of creative and distinctive signage which establishes a distinctive image for the Planning area and identifies principal entries to the metropolitan area, unique districts, neighborhoods and locations."	Refer to the analysis for Land Use Policy #61.
Land Use Policy #65: Encourage that signs be designed and placed on buildings to be visible to pedestrians in areas designated for pedestrian activity.	Refer to the analysis for Land Use Policy #61.
Land Use Policy #72: Promote the establishment of attractive entrances into communities, major districts, and transportation terminals, centers, and corridors within the Planning area.	Refer to analysis for Land Use Policy #26.
Land Use Policy #74: Encourage the establishment of design programs which may include signage, street furniture, landscape, lighting, pavement treatments, public art, and architectural design.	Refer to analysis for Land Use Policy #26.
Land Use Policy #75: Provide adequate land area for the expansion of existing uses and development of new uses consistent with the policies of the general plan.	The proposed Project will be constructed consistent with the policies of the Metropolitan Bakersfield General Plan.
Land Use Policy #76: Provide for a mix of land uses which meets the diverse needs of residents; offers a variety of employment opportunities; capitalizes, enhances, and expands upon existing physical and economic assets; and allows for the capture of regional growth.	The proposed Project will provide light and medium industrial uses at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City of Bakersfield. The proposed Project will provide a broad range of goods and services to serve the regional market area.
Land Use Policy #77: Allow for the continuance of agricultural uses in areas designated for future urban growth.	Currently, the Project site consists of active agricultural land and fallow land. The proposed Project involves a GPA and zone change to allow for the phased development of the entire property with industrial and commercial uses. Portions of the Project site not under development will remain agricultural land until such time development is approved.
Land Use Policy #79: "Provide for an orderly outward expansion of new "urban" development (any commercial, industrial, and residential development having a density greater than one unit per acre) so that it maintains continuity of existing development, allows for the incremental expansion of infrastructure and public services, minimizes impacts on natural environmental	Refer to analysis for Land Use Goals #1, #3, #4, #6, and #7.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
resources, and provides a high quality environment for living and business."	
Land Use Policy #80: Assure that General Plan Amendment proposals for the conversion of designated agricultural lands to urban development occur in an orderly and logical manner giving full consideration to the effect on existing agricultural uses.	A Farmland Conversion Study was prepared for the proposed Project to evaluate the conversion for the existing on-site farmland to industrial uses. Refer to Section 4.2, *Agriculture*, for a detailed analysis of compatibility of the proposed Project and surrounding land uses.
Land Use Policy #82: "Preserve existing significant sound residential neighborhoods, commercial districts, and industrial areas."	Refer to the analysis for Land Use Goals #1, #3, #4, #6, and #7.
Land Use Policy #99: Develop a plan to ensure that all parking lots are 40 percent shaded at maturity to help alleviate "heat island effect."	Future development phases would be subject to the Kern County Ordinance Code and design review requirements. Final development plans will be reviewed by the County Planning Department on a project-by-project basis.
Land Use Policy #100: "Encourage the use of reflective roofing material and other measures that reduce the "heat island effect."	Refer to the analysis for Land Use Policy #99.
Noise Element	
Noise Goal #1: "Ensure that residents of the Bakersfield Metropolitan Area are protected from excessive noise and existing moderate levels of noise are maintained."	As stated in Section 4.13, *Noise*, the proposed Project would be subject to compliance with the Metropolitan Bakersfield General Plan and County's noise standards during construction and Project operation.
Noise Goal #2: "Protect the citizens of the Planning area from the harmful effects of exposure to excessive noise and protect the economic base of the area by preventing the encroachment of incompatible land uses near known noise-producing roadways, industries, railroads, airports and other sources."	As stated in Section 4.13, *Noise*, the proposed Project would be subject to compliance with the Metropolitan Bakersfield General Plan and County's noise standards during short-term construction and Project operation. Construction activities would adhere to the Kern County Noise Ordinance with respect to hours of operation and all equipment would be fitted with factory equipped mufflers and be in good working order; refer to Mitigation Measures 4.13-1 through 4.13-5.
Noise Policy #1: "Identify noise-impact areas exposed to existing or projected noise levels exceeding 65 dB CNEL (exterior) or the performance standards described in Table VII-4. The noise exposure contour maps on file at the City of Bakersfield and County of Kern indicate areas where existing and projected noise exposures exceed 65 dB CNEL (exterior) for the major noise sources identified."	The proposed Project would not exceed the Kern County's 65-dBA-CNEL (exterior) criterion for long-term vehicular-related noise.
Noise Policy #2: "Prohibit new noise-sensitive land uses in noise-impacted areas unless effective mitigation measures are incorporated into project design to acceptable levels."	As indicated within the Noise Impact Assessment, on-site noise levels would be below the 65 dBA exterior noise standards. Therefore, implementation of the proposed Project would comply with the Goals and Policies of the Metropolitan Bakersfield General Plan.
Noise Policy #3: Review discretionary industrial, commercial or other noise generating land use projects for compatibility with nearby noise-sensitive land uses. Additionally, the development of new noise generating	Not applicable. The proposed Project would not be located adjacent to incompatible land uses such as industries, railroads, and airports, that generate high levels of noise.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
land uses which are not preempted from local noise regulation will be reviewed if resulting noise levels will exceed the performance standards contained within Table VII-4 in areas containing residential or other noise-sensitive land uses.	
Noise Policy #4: Require noise level criteria applied to land uses other than residential or other noise-sensitive uses to be consistent with the recommendations of the California Office of Noise Control (see Figure VII-3)	Refer to Noise Policy #2.
Noise Policy #5: Encourage vegetation and landscaping along roadways and adjacent to other noise sources in order to increase absorption of noise.	Future development would comply with County Ordinances requiring setbacks from roadways and landscaping along arterial and collector roads.
Noise Policy #6: Encourage interjurisdictional coordination and cooperation with regard to noise impact issues.	Refer to Noise Goals #1 and #2, and Noise Policy #1, #2, and #5. As stated in Section 4.13, *Noise*, the proposed Project was evaluated against thresholds based on standards set forth by federal, State, and local agencies. In addition, the Project applicant will work with Kern County to implement Mitigation Measures 4.13-1 through 4.13-5.
Noise Policy #7: Establish threshold standards for the determination of the existence of cumulative noise impacts that are significant and will therefore require mitigation to achieve acceptable noise standards that do not exceed the standards contained in this element.	Refer to the consistency analysis for Noise Policy #6.
Safety Element – Public - Hazards/Hazardous Materials	
Safety Goal #1: Ensure that the Bakersfield metropolitan area maintains a high level of public safety for its citizenry.	The proposed Project would be required to adhere to the Metropolitan Bakersfield General Plan Safety Element, compliance with the County of Kern Department Codes, the Kern County Ordinance Code, DOGGR regulations, and compliance with the CBC and UBC to ensure safety for citizens.
Safety Goal #3: Provide for the coordinated planning and development of service areas for police and fire protection to ensure an equitable burden of responsibility between County and City in Metropolitan Bakersfield.	The proposed Project would be serviced by the Kern County Fire and Sheriff's Departments. Refer to Section 4.15, *Public Services* and Section 4.17, *Utilities*, for additional information.
Safety Policy #4: Monitor, enforce and update as appropriate all emergency plans as needs and conditions in the Planning area change, including the California Earthquake Response Plan, the Kern County Evacuation Plan, and the City of Bakersfield Disaster Plan.	Section 4.15, *Public Services* and Section 4.17, *Utilities*, addresses the potential impacts of the proposed Project on fire and emergency response. Additionally, all emergency plans applicable to the proposed Project would be updated as needed.
Safety Policy #6: Promote fire prevention methods to reduce service protection costs and costs to the taxpayer.	The proposed Project would be reviewed by the Kern County Fire Department. The proposed Project would be designed to comply and/or incorporate the Kern County Fire Department fire prevention requirements.
Safety Policy #7: Enforce ordinances regulating the use/manufacture/sale/transport/disposal of hazardous substances and require compliance with state and federal laws regulating such substances.	The proposed Project is subject to discretionary approval and would be required to comply with and/or adhere to all applicable State, Federal and local laws and regulations related to the use, manufacture, sale, transport and/or disposal of hazardous substances. A Hazardous Materials Evaluation was prepared for

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
	the Project to identify potential hazardous materials present within the proposed Project site and provide mitigation measures to reduce impacts. If hazardous materials are used during site construction, the materials shall be properly handled and disposed.
Safety Policy #8: The Kern County and Incorporated Cities Hazardous Waste Management Plan and Final Environmental Impact Report serves as the policy document guiding all facets of hazardous waste.	The proposed Project would be required to adhere to all applicable standards and requirements of the Kern County and Incorporated Cities Hazardous Waste Management Plan (HWMP). Any hazardous waste created during construction of the proposed Project will be disposed in accordance with the HWMP.
Safety Policy #9: Restrict, after appropriate public hearings, the use of fire-prone building materials in areas defined by the fire services as presenting high-conflagration risk.	As stated in Section 4.15, *Public Services* and Section 4.17, *Utilities* of this DREIR, future development of the proposed Project will be serviced by the Kern County Fire Department. The proposed Project would be reviewed by the Kern County Fire Department and would be required to comply with Kern County Fire Department requirements that prohibit the use of fire-prone building materials, where appropriate.
Safety Element - Seismic	
Seismic Goal #1: Substantially reduce the level of death, injury, property damage, economic and social dislocation and disruption of vital services that would result from earthquake damage.	The proposed Project design would be required to undergo review by the County of Kern. Adherence to and incorporation of the goals and policies of the Metropolitan Bakersfield General Plan Safety Element, compliance with the Kern County Ordinance Code, and compliance with the CBC and UBC would reduce impacts of earthquakes.
Seismic Goal #2: Ensure the availability and effective response of emergency services following an earthquake.	Refer to the analysis for Seismic Goal #1.
Seismic Goal #3: Prepare the Planning area for effective response to, and rapid, services following an earthquake.	Refer to the analysis for Seismic Goal #1.
Seismic Goal #7: Protect land uses from the risk of dam failure inundation including the assurances that: the functional capabilities of essential facilities are available in the event of a flood; hazardous materials are not released; effective measures for mitigation of dam failure inundation are incorporated into the design of critical facilities; and the rapid and orderly evacuation of populations in the inundation area will occur.	Isabella Dam is located approximately 40 miles northeast of Bakersfield, approximately 45 miles from the proposed Project site. The Safety Element of the Metropolitan Bakersfield General Plan has identified policies including a response plan for dam failure as well as the maintenance of disaster response plans and development of discretionary approval procedures for critical facilities for compatibility with evacuation plans. The proposed Project design would be required to undergo review by the County of Kern. The Project would be designed and constructed in strict adherence and incorporation with the goals and policies of the Metropolitan Bakersfield General Plan Safety Element, compliance with the Kern County Ordinance Code, and compliance with the CBC and UBC would reduce impacts related to dam failure.
Seismic Policy #7: Continue to address seismically hazardous buildings pursuant to Chapter 12.2 (8875 et. Seq.), Division 1 of Title 2 of the Government Code.	The proposed Project would be required to comply with the most current seismic standards of the UBC.
Seismic Policy #8: Require seismic review of other potentially hazardous buildings upon any change in their use or occupancy status.	The proposed Project design would be required to undergo review by the County of Kern.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Seismic Policy #9: Adopt and maintain high standards for seismic performance of buildings, through prompt adoption and careful enforcement of the most current seismic standards of the Uniform Building Code.	Refer to the analysis for Seismic Safety Policy #7.
Seismic Policy #10: Prohibit development designed for human occupancy within 50 feet of a known active fault and prohibit any building from being placed astride an active fault.	The proposed Project is not located within 50 feet of a known active fault. Additionally, implementation of the proposed Project would result in light to medium industrial land uses. Buildings associated with the proposed Project would not be intended for human occupancy. Adherence to and incorporation with the goals and policies of the Metropolitan Bakersfield General Plan Safety Element, compliance with the Kern County Ordinance Code, and compliance with the CBC and UBC would reduce impacts of fault rupture.
Seismic Policy #11: Require site-specific studies to locate and characterize specific fault traces within an Alquist-Priolo Earthquake Fault Zone for all construction designed for human occupancy.	The proposed Project is not located within an Alquist-Priolo Earthquake Fault Zone. Therefore, no site-specific study is required.
Seismic Policy #12: Design significant lifeline installations such as highway, utilities and petrochemical pipelines which cross an active fault, to accommodate potential fault movement without prolonged disruption of an essential service or creating threat to health and safety.	No active faults traverse the proposed Project and it is not located within an Alquist-Priolo Earthquake Fault Zone.
Seismic Policy #13: Determine the liquefaction potential at sites in areas of high groundwater prior to development and determine specific mitigation to be incorporated into the foundation design, as necessary to prevent or reduce damage from liquefaction in an earthquake.	The proposed Project is not located within an area of high groundwater. Therefore, the Project site is not susceptible to liquefaction. However, conformance with standard construction and design parameters set forth in the CBC would reduce potential impacts.
Seismic Policy #14: Route major lifeline installations around potential liquefaction areas or otherwise protect them against significant damage from liquefaction in an earthquake.	Refer to the analysis for Seismic Policy #13.
Seismic Policy #15: Compile information on areas of potential hazards and field information developed as part of CEQA investigations and geologic reports and keep geologic reviews and policy development current and accessible for use in report preparation.	The County of Kern will review the proposed Project and will be able to obtain information regarding seismic and geologic hazards on-site from this RDEIR.
Seismic Policy #18: Design discretionary critical facilities located within the potential inundation area for dam failure in order to: mitigate the effects of inundation on the facility; promote orderly shut-down and evacuation (as appropriate); and, prevent on-site hazards from affecting building occupants and the surrounding communities in the event of dam failure.	Isabella Dam is located approximately 40 miles northeast of Bakersfield, approximately 45 miles from the proposed Project. The Safety Element of the Metropolitan Bakersfield General Plan has identified policies including a response plan for dam failure as well as the maintenance of disaster response plans and development of discretionary approval procedures for critical facilities for compatibility with evacuation plans. The proposed Project design would be required to undergo review by the County of Kern. The Project would be designed and constructed in strict adherence and incorporation with the goals and policies of the Metropolitan Bakersfield General Plan Safety Element, compliance with the Kern County Ordinance Code, and compliance with the

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
	CBC and UBC would reduce impacts related to dam failure.
Seismic Policy #19: Design discretionary facilities in the potential dam inundation area used for the manufacture, storage or use of hazardous materials to prevent on-site hazards from affecting surrounding communities in the event of inundation.	Refer to the analysis for Seismic Policy #18.
Seismic Policy #20: Require emergency response plans for the Planning area to include specific procedures for the sequential and orderly evacuation of the potential dam inundation area.	Refer to the analysis for Seismic Policy #18.
Seismic Policy #21: Encourage critical and high-occupancy facilities as well as facilities for elderly, handicapped and other special care occupants located in the potential inundation area below the dam to develop and maintain plans for the orderly evacuation of their occupants.	Refer to the analysis for Seismic Policy #18.
Safety Element - Flooding	
Flooding Goal #1: Minimize hazards to planning area residents resulting from flooding.	The proposed Project would result in light and medium industrial facilities, and commercial uses. No residential land uses would be provided by the proposed Project. Future employees of the Project site are not likely to be impacted as a result of flooding within the proposed Project. The 8 to 12-hour lag time between failure of the Isabella Dam and inundation of the Project site reduces the risks to residents. Additionally, the proposed Project is located within Flood Zone X, which indicates that no flooding would be expected.
Flooding Goal #2: Reduce the risk of flooding to land uses.	Refer to the analysis for Flooding Safety Goal #1.
Flooding Policy #1: Ensure that the Bakersfield metropolitan area maintains a high level of public safety for its citizenry.	The proposed Project would be required to adhere to and incorporate the goals and policies of the Metropolitan Bakersfield General Plan Safety Element, comply with the Kern County Ordinance Code, and comply with the CBC and UBC to ensure safety for citizens. Refer to Sections 4.9, *Hazards and Hazardous Materials*, of this RDEIR.
Flooding Policy #2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development or metropolitan police and fire facilities and services.	The proposed Project would be required to comply with the provisions of the Uniform Fire Code and local amendment; Title 19, 22, and 27 of the California Safety Code Regulation; the Kern County Ordinance Code; and the National Fire Prevention Association Standards. Implementation of the recommended mitigation measures identified in Section 4.15, *Public Services*, of this RDEIR, would serve to ensure adequate levels of police and fire services are provided to meet existing and future demands associated with implementation of the proposed Project.
Public Services and Facilities Element - Aesthetics	
Street Lighting Goal #2: Develop uniform Planning area street light location and design standards.	The proposed Project includes the installation of streetlights and entry lighting that would conform to the intent of the Kern County Ordinance Code and Development Standards.

Table 4.11-2. Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies

GOALS AND POLICIES	PROJECT CONSISTENCY
Street Lighting Policy #4: Require developers to install street lighting in all new developments in accord with adopted city standards and county policies.	The proposed Project includes the installation of streetlights in conformance with adopted County standards and regulations.
Public Services and Facilities Element – General Utilities	
General Utilities Policy #5: Require all new development to pay its pro rata share of the cost of necessary expansion in municipal utilities, facilities and infrastructure for which it generates demand and upon which it is dependent.	Appropriate fees would be applied to the future development of the Project site in order to accommodate the expansion of required utilities, facilities, and infrastructure.
Public Services and Facilities Element - Water Distribution	
Water Distribution Goal #1: Ensure the provision of adequate water service to all developed and developing portions of the planning area.	The existing water purveyor, who provides irrigation water solely for agricultural purposes, will not service the proposed Project with domestic water. Instead, the domestic water will be provided by an on-site private well with water treatment and distribution facilities.
Water Distribution Policy #3: Require that all new development proposals have an adequate water supply available.	Refer to Public Services and Facilities - Water Distribution Goal #1, above.
Public Services and Facilities Element – Sewers	
Sewer Services Goal #3: Provide trunk sewer availability to and treatment/disposal capacity for all metropolitan urban areas, to enable cessation or prevention of the use of septic tanks where such usage crates potential public health hazards or may impair groundwater quality, and to assist in the consolidation of sewerage systems. Provide sewer service for urban development regardless of jurisdiction.	The proposed Project site has never been served by a sewer system. A new private package sewer treatment plant is proposed to provide services for the Project site.
Public Services and Facilities Element - Storm Drainage	
Storm Drainage Goal #1: "Ensure the provision of adequate storm drainage facilities to protect Planning area residents from flooding resulting from stormwater excess."	Stormwater facilities would be incorporated into the design of the infrastructure of the Project site. Additionally, future development phases would be subject to the Kern County Ordinance Code and design review requirements. Final development plans would be reviewed by the Kern County Planning Commission on a project-by-project basis.
Public Services and Facilities Element - Street Lighting	
Street Lighting Goal #1: "Provide uniform and adequate public lighting for all developed and developing portions of the Planning area."	Future development phases would be subject to the Kern County Ordinance Code and design review requirements. Final development plans would be reviewed by the Kern County Planning Commission on a project-by-project basis.
Street Lighting Policy #4: "Require developers to install street lighting in all new development in accord with adopted city standards and county policies."	Refer to analysis for PSF Street Lighting Goal #1.
Public Services and Facilities Element - Solid Waste	
Solid Waste Goal #1: "Ensure the provision of adequate solid waste disposal services to meet the demand for these services in the Planning area."	The County has adequate capacity in the Bena Landfill and the Shafter-Wasco Landfill to support the proposed Project.

Zoning Designations

Title 19 of the Kern County Ordinance Code provides a description of permitted uses, building height, yard and distance between buildings for the various zoning designations within the County. The Ordinance consists of two primary parts: a map that delineates the boundaries of zoning districts; and text that explains the purpose of the district, specifies permitted and conditional uses and establishes development and performance standards.

On- and Off-Site Zoning Designations

The proposed Project site is zoned A (Exclusive Agriculture). Zoning designations for properties surrounding the proposed Project include: A (Exclusive Agriculture), A-1 (Limited Agriculture), CH (Highway Commercial), C-2 PD (General Commercial, Precise Development Combining), E(1) RS MH (Estate 1 Acre, Residential Suburban Combining, Mobile Home Combining), E(2 ½) RS (Estate 2.5 Acres, Residential Suburban Combining), E(1/2) RS (Estate 0.5 Acres, Residential Suburban Combining), E(10) RS (Estate 10 Acres, Residential Suburban Combining), R-2 (Medium Density Residential, 16 units per acre), and M-2 PD (Medium Industrial, Precise Development Combining).

Metropolitan Bakersfield Habitat Conservation Plan

The Metropolitan Bakersfield Habitat Conservation Plan (MBHCP), adopted in March 1990, and its implementing agreements and ordinances provide a method of collecting funds for the acquisition and perpetual management of habitat land for the purpose of creating preserves. The MBHCP provides descriptions of species of concern and habitat areas within the Metropolitan Bakersfield General Plan Area. Development projects within Metropolitan Bakersfield pay mitigation fees, which are used to buy habitat lands. These lands are managed by wildlife agencies or entities they approve. Take avoidance measures are also listed in the MBHCP. Implementation of habitat preservation must always occur before project development. The boundaries of the MBHCP study area match the boundaries of the Metropolitan Bakersfield General Plan, which consists of 408 square miles. Refer to Section 4.4, *Biological Resources*, for a detailed discussion and Project consistency with the MBHCP.

Air Quality Attainment Plan

The Air Quality Attainment Plan (AQAP) prepared for the San Joaquin Valley Air Basin (Basin) calls for overall reduction in air quality emissions in the Valley to comply with California Ambient Air Quality Standards (CAAQS) for ozone and carbon monoxide (CO). Stationary and mobile source emission control recommendations and regulations have been developed by the San Joaquin Valley Air Pollution Control District (SJVAPCD) to implement the AQAP.

Metropolitan Bakersfield General Plan Bikeway Master Plan

This Plan includes the location and extent of bikeways within the greater Bakersfield Metropolitan area. The Metropolitan Bakersfield General Plan Bikeway Master Plan, included in the Circulation Element of the General Plan, was prepared by the City of Bakersfield and Kern County.

Emergency Response Plan

This Plan, prepared by the City of Bakersfield, indicates emergency evacuation routes that would be used in emergency situations, as well as other specific measures related to emergency preparedness.

Regional Transportation Plan

The Regional Transportation Plan (RTP) for Kern County identifies future transportation improvements needed to serve the projected transportation needs of the County. The RTP details the existing transportation systems, sets goals, policies, and projects, and identifies funding mechanisms for these projects. Transportation projects identified in the RTP include highway, street, and roadway projects; mass transportation; railroad; and other programs and projects related to the transportation needs of the County.

Solid Waste Management Plan

This plan is a comprehensive guide for all solid waste management activities in the County. The plan identifies the existing solid waste generation and disposal facilities in Kern County, estimates future solid waste disposal demand and identifies programs to meet this future need.

Hazardous Waste Management Plan (HWMP)

This Plan focuses on the siting of hazardous waste disposal facilities, the transport of hazardous waste in the County, protection of water resources from hazardous waste contamination and public education concerning the use and disposal of hazardous waste.

4.11.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a qualitative basis through a comparison of the existing land use and the proposed land uses. The change in the land use on the Project site is significant if the effect described under the Thresholds of Significance below occurs as a result of the proposed actions. The evaluation of Project impacts is based on professional judgment, analysis of the County's visual resources policies and the significance criteria established in Appendix G of the State CEQA Guidelines, which the County has determined appropriate for this RDEIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Physically divide an existing community or contribute to the decline of an existing community (a physical change that interrupts the cohesiveness of the neighborhood);

- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; and/or

- Conflict with any applicable habitat conservation plan or natural community conservation plan.

The analysis of the existing environmental and impact analysis indicate that this proposed Project could not result in a significant environmental impact to land use.

Project Impacts

Impact 4.11-1: The Project Would Physically Divide an Existing Community or Contribute to the Decline of an Existing Community.

The proposed Project currently consists of land under agricultural production or fallow agricultural land. A steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue. The majority of the Project site is currently designated R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial), with the HC (Highway Commercial) designation located in the southwestern area of the Project site. The proposed Project has a zoning classification of A (Exclusive Agriculture).

Existing land uses surrounding the proposed Project site include agricultural, residential, and industrial uses. The residential uses consist of a small cluster of single-family homes located to the east of the proposed Project. However, areas south and east of the proposed Project are designated for service industrial and highway commercial uses. Given that the proposed Project would develop industrial and commercial facilities in an area with an existing land use mix of industrial and residential, the proposed Project would not physically divide an already established community or neighborhood. Implementation of the proposed Project would not drastically alter the community characteristics in such a manner that would physically divide or contribute to the decline of an established community or neighborhood.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.11-2: The Project Would Conflict with Applicable Land Use Plan, Policy or Regulation of an Agency with Jurisdiction Over the Project.

The proposed Project would require an amendment to the Metropolitan Bakersfield General Plan and a concurrent change to the County of Kern zoning classification. This would result in a conversion of approximately 314.30 acres of agricultural uses and vacant land to industrial uses. The proposed Project has been reviewed for consistency with goals and policies as set forth in the Metropolitan Bakersfield General Plan.

As described in Section 3.0, *Project Description*, the proposed Project includes an amendment to the Land Use Element of the Metropolitan Bakersfield General Plan, amending the existing land use designation from R-IA (Resource – Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), GC (General Commercial), and HC (Highway Commercial). The subsequent zone change would consist of the removal of the existing A (Exclusive Agriculture) zoning classification and rezone the Project site M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), CH PD (Highway Commercial, Precise Development Combining), and C-2 PD (General Commercial, Precise Development Combining). The General Plan Amendment (GPA) and zone change (ZCC) would permit development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. In addition, two conditional use permits (CUPs) would permit the development of a sewer treatment plant and a water treatment plant.

Table 4.11-2, *Consistency Analysis with Metropolitan Bakersfield General Plan Goals and Policies for Land Use* (above), assesses the proposed Project's relationship to pertinent goals and policies of the Metropolitan Bakersfield General Plan. Note that goals and policies not included in the assessment are omitted because they have either a negligible relationship or no relationship to the proposed Project or surrounding area. The analysis contained in Table 4.11-2 concludes that there would be no significant consistency impacts of the proposed Project associated with the Metropolitan Bakersfield General Plan goals and policies.

The proposed Project was reviewed and determined to be consistent with the following regional plans: Air Quality Attainment Plan, Metropolitan Bakersfield General Plan Bikeway Master Plan, Regional Transportation Plan, Solid Waste Management Plan, Metropolitan Bakersfield Habitat Conservation Plan and Hazardous Waste Management Plan.

Air Quality Attainment Plan

As the Project proposes to amend the Metropolitan Bakersfield General Plan land use designation to allow industrial uses as opposed to agricultural uses (the current land use and zoning designations), the AQAP anticipated growth of the population and economy within the Basin. The AQAP predicted the workforce in Kern County to increase along with a 2.2 percent population increase between 2002 and 2030. Thus, the proposed Project is viewed as continued growth anticipated by the AQAP (refer to Section 4.3, *Air Quality*, for further discussion). The proposed Project's consistency with the San Joaquin Valley Air Pollution Control District (SJVAPCD) AQAP is also addressed in this Recirculated Draft EIR in Section 4.3, *Air Quality*.

Metropolitan Bakersfield General Plan Bikeway Master Plan

The proposed Project would not affect the City's Metropolitan Bakersfield General Plan Bikeway Master Plan. Bike lanes would be implemented as appropriate along roadways when full improvements are completed.

Regional Transportation Plan

The proposed Project would implement roadway improvements, such as installation of traffic signals and the widening of roadway segments and/or improve intersections on a fair-share basis. These improvements would be consistent with the policies or planned projects of the RTP (refer to Section 4.16, *Transportation and Traffic*, for further information).

Solid Waste Management Plan

Solid waste disposal would be in accordance with the County's Solid Waste Management Plan. Refer to Section 4.15, *Public Services*, and Section 4.17, *Utilities*.

Hazardous Waste Management Plan

Due to the previous oil drilling and gas production activities on-site, the proposed Project would be required to properly dispose of any contaminated soil within the Project site prior to construction. The proposed Project is located on a site that has been historically used for agricultural uses. Therefore, there is potential for contaminated soil to be encountered during construction. In addition, although the Project site has not been identified as being located in an area that has been designated as a candidate site or facility for hazardous materials disposal, removal of hazardous materials on the Project site is required prior to construction. In addition, the proposed Project may result in increased risks from hazardous materials and appropriate rules and regulations would adhere to the completed Project. Therefore, the proposed Project is subject to the Kern County and Incorporated Cities Hazardous Waste Management Plan as discussed in detail in Section 4.9, *Hazards and Hazardous Materials*.

Mitigation Measures

MM 4.11-1: **Master Precise Development Plan.** Prior to the issuance of any grading or building permit issued on the proposed project site, the project proponent shall process through the Kern County Planning and Natural Resources Department a Master Precise Development Plan in accordance with the requirements identified in Chapter 19.56 of the Kern County Zoning Ordinance.

1. All future changes to the physical environment of the site and or the specific characteristics of the existing uses of the site, either by a Master Developer or subsequent future land owners shall require revision and/or modification of the Master Precise Development Plan in accordance with Chapter 19.56 of the Kern County Zoning Ordinance.

2. The following thresholds have been established for the project site.

a. The proposed uses on the site shall not exceed a maximum of 4,613,0045~~,134,253~~ square feet of industrial and/or commercial use as determined by the Kern County Planning Director.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.11-3: The Project Would Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plans.

The Project site is located within the permitted area of the MBHCP. The MBHCP addresses mitigation and compensation for the loss of endangered species habitat and impacts on endangered species within the Metropolitan Bakersfield area. The development of the site would require the payment of mitigation fees for the preservation of natural habitat areas in the area (refer to Section 4.4, *Biological Resources*).

Mitigation Measures

No mitigation measures beyond compliance with the Metropolitan Bakersfield Habitat Conservation Plan is required. No additional mitigation measures are proposed.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

The area influenced by cumulative land use effects related to adjacent parcels and the surrounding planned development areas is described in Table 3-5, *Cumulative Projects List* (refer to Chapter 3, *Project Description*). Related land use projects in the surrounding areas have been: (1) submitted for plan processing; (2) approved by the County of Kern and City of Bakersfield; and/or (3) engaged in active construction programs. While the surrounding area is not at buildout, and as yet is relatively rural in nature, the proposed Project would contribute to a cumulative influence on proposed land uses in and around the Project area.

The anticipated proposed Project impacts in conjunction with cumulative development in the site vicinity would increase industrial uses and result in the loss of open space and mineral petroleum uses in the local vicinity. Potential land use impacts are site-specific and require evaluation on a case-by-case basis. This is true with regard to land use compatibility impacts, which are generally a function of the relationship between the interactive effects of a specific development site and those of its immediate environment. Development of the proposed Project site and surrounding planning area is anticipated to occur in accordance with the Metropolitan Bakersfield General Plan, and in accordance with zoning classifications. Potential cumulative effects upon land use and planning are not anticipated to be significant.

Mitigation Measures

No mitigation beyond compliance with the goals, policies, and implementation measures of the Metropolitan Bakersfield General Plan and the Metropolitan Bakersfield Habitat Conservation Plan is required. No additional mitigation measures are proposed.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.12

Mineral Resources

Section 4.12
Mineral Resources

4.12.1 Introduction

The purpose of this section is to evaluate existing mineral resources and the potential impacts on mineral resources, oil and gas, sand and gravel, and any other mineral resources of the proposed Project. This section also describes the environmental and regulatory settings. Mitigation measures are recommended to avoid or lessen impacts, as necessary. Information within this section is based on California Geological Survey (CGS, formerly the Department of Conservation Division of Mines and Geology [DMG]), California Division of Oil, Gas & Geothermal Resources (DOGGR) and Kern County publications and maps, in addition to the Hazardous Materials Evaluation prepared for the proposed Project. A Hazardous Materials Evaluation (2008 HME) was prepared by McIntosh & Associates in November 2008 (refer to Appendix N). A second HME (2017 HME) was prepared by McIntosh & Associates in July 2017. See Appendix F, *Hazardous Materials Evaluation*, and Appendix N, *Original Technical Studies*.

4.12.2 Environmental Setting

Local Character

Metropolitan Bakersfield General Plan

There are approximately 25 oil fields either partially or completely within the Metropolitan Bakersfield General Plan area. The closest oil fields to the proposed Project include Stockdale and Mountain View oil fields. In addition, there are three sand and gravel extraction areas within the Metropolitan Bakersfield General Plan area, primarily along the floodplain and alluvial fan of the Kern River.

Project Site

According to the State Division of Oil, Gas, and Geothermal Resources (DOGGR), the proposed Project is not located within an oil or gas field. One abandoned well, "Sea Cliff-Houghton" 1, is located in the northwest portion of the proposed Project. This well was drilled by Big McKittrick Oil Company of California between November 1934 and June 1935. No oils shows were reported during the drilling period; one gas show was reported at a depth interval from 2,077 feet to 2,079 feet. The well was abandoned in October 1935.

Regional Character

Kern County

Kern County is one of the largest producers of mineral products in California with a production value of almost one-quarter of the State's total. The principal County mineral product is petroleum (an organic derivative material) and related products, which contribute about 75 percent of the total valuation of all County mineral products. The remainder is comprised of sand and gravel, borax, cement products and other construction and gem-like minerals including gold. The majority of the proposed Project is currently designated as Map Code R-IA (Resource - Intensive Agriculture) and a small portion of the southwest corner of the site as Map Code HC (Highway Commercial) by the Metropolitan Bakersfield General Plan.

Kern County produces more oil than any other county in California and is one of the nation's leading petroleum-producing counties. Mineral and petroleum resources are basic to Kern County's economy. As new recovery technologies come into use, petroleum extraction should continue in economic importance. And as long as new urbanization is restricted in areas having important mineral and petroleum resources, the future production of these resources remains promising.

The history of the oil industry in Kern County dates back to the 19th century. The Lakeview Gusher near Taft (of the Midway-Sunset Oil Field) was literally a lake of oil held back by check dams, resulting in the accumulation of nine million barrels of oil in the ground. The Kern River Oil Field was established in 1899 when a 43-foot well dug by hand, by Tom Means, resulted in another sudden stream flow of oil. By 1903, 796 wells produced almost 17 million barrels of oil from the Kern River field. Over the next decade, the Kern River and West Side oil fields set production records and pioneered improvements in oil extraction. In the mid-1930s, several valley oil fields were found in large anticlines in Miocene oil sands beneath the valley floor. These discoveries were made following the advent of the reflection seismograph. Discoveries included the Ten Section, Greeley, Rio Bravo North, Coles Levee, South Coles Levee and Strand oil fields. Today, 71 active fields still continue to produce from the originally established 98 oilfields.

Oil Resources

In order to locate oil, companies drill through the earth to the deposits deep below the surface. The oil is then pumped from below the ground by oilrigs. Typically, oil then travels through pipelines and is stored in large tanks until it is sent to various places to be used for the production of thousands of products. Oil must be changed or refined into other products before it can be used. At oil refineries, crude oil is split into various types of products by heating the thick black oil (crude). Some of the products include gasoline, diesel fuel, aviation fuel, home heating oil, oil for ships and oil to burn in power plants to make electricity. In California, approximately 74 percent of our oil is used for transportation (i.e., cars, planes, trucks, etc.). Oil is found in 18 of the 58 counties in California.

Kern County crude oil is known as "heavy" oil. It is very thick and is difficult to pump from the ground. One of the innovations of the industry is to inject steam into the well, heating up the crude and making it easier to pump. This extends the life of the oil field but is also expensive. Drilling

activity in Kern County hit its peak in the 1950's, and the number of new wells being drilled has since stabilized.

The vast majority of the state's oil activity occurs in the County of Kern where four of the nation's seven most productive oil fields are located. Several of the County's "giant" oil fields are located entirely or partially within the City of Bakersfield. According to the 2016 Annual Report of the State Oil and Gas Supervisor, Kern County produced approximately 134,114,693 oil barrels (bbl) from 42,045 active producing wells (DOGGR 2017). Mineral resources in Kern County include numerous mining operations that extract a variety of materials, including sand and gravel, stone, gold, dimensional stone, limestone, clay, shale, gypsum, pumice, decorative rock, silica, and specialty sand. The State Geologist has classified 2,971 square miles of land in Kern County as Mineral Resource Zones (MRZs) of varying significance.

Natural Gas

Natural gas is lighter than air and is produced in two basic forms, associated gas and non-associated gas. Associated gas is produced along with crude oil while non-associated gas is produced from gas fields that do not produce any crude oil. Natural gas is found underground and then pumped from below ground and transported in large pipelines. Because natural gas usually has no odor and can't be seen, it is mixed with a chemical that gives it an easy to detect smell in the event of an accidental leak. From the storage tanks, natural gas is sent through underground pipelines to its destination (consumer) to be used for cooking, heating, manufacturing and to power plants to make electricity. California's net natural gas production in the year 2016 totaled 156,005,114 million cubic feet (including Outer Continental Shelf). Kern County accounted for 113,014,940 million cubic feet of this natural gas, representing approximately 72 percent of the total natural gas produced statewide.

Project Site

Pacific Gas and Electric Company (PG&E) natural-gas transmission pipeline *No. L-300B*, is located within the proposed Project boundaries. This pipeline was installed in 1954, is 34 inches in diameter, and operates at 700 pounds per square inch (psi). It traverses southeasterly across the property from SR-99 in the northwest to the south line bordering the easternmost portion of the site. The pipeline then traverses due east for one-quarter-mile, passing through PG&E valve station 269B and the original PG&E station situated at South Union Avenue. Refer to Figure 4.12-1, *Natural Gas Pipeline Map*, for an illustration of the location of the on-site pipeline. A 4-inch-diameter, steel, subsurface natural gas distribution line operating at 60 psi was also identified that traverses the west side of South Union Avenue.

Sand and Gravel

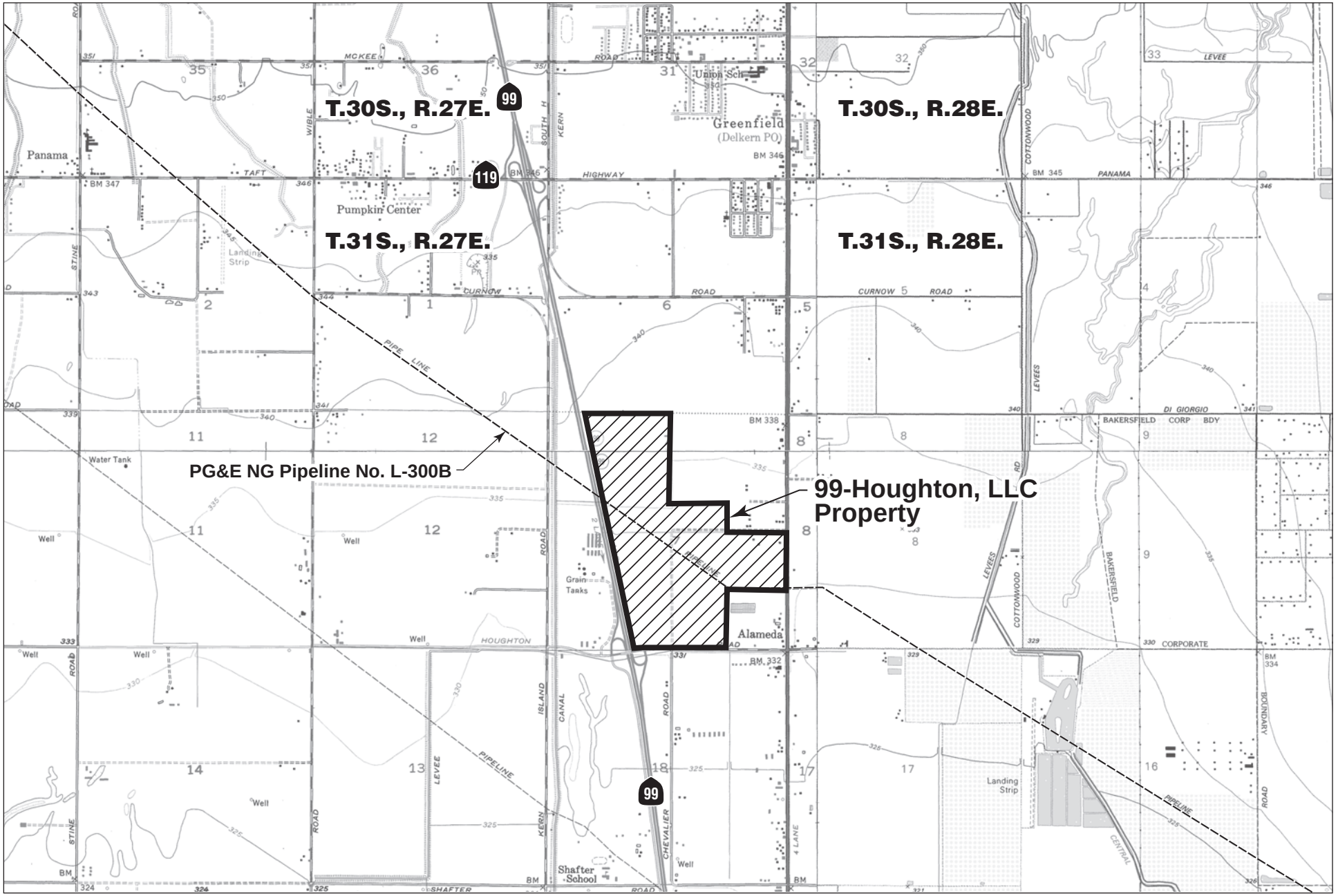
Sand and gravel have been determined to be important resources for construction, development and physical maintenance, from highways and bridges to swimming pools and playgrounds. The availability of sand and gravel affects construction costs, tax rates and affordability of housing and commodities. The State of California has statutorily required the protection of sand and gravel operations. Because transportation costs are a significant portion of the cost of sand and gravel, the

long-term availability of local sources of this resource is an important factor in maintaining the economic attractiveness of a community to residents, business, and industry.

Project Site

The proposed Project does not contain sand and gravel resources. There is no evidence of past or current sand and gravel extraction operations occurring within the site or immediate Project vicinity.

The major resources of sand and gravel in Kern County are in stream deposits along the eastern side of the San Joaquin Valley and in the Sierra Nevada foothills, and in alluvial fan deposits along the north flank of the San Emigdio and Tehachapi Mountains at the southern end of the County. Most of the recent alluvium in the San Joaquin Valley floor is composed of sand used as a source of road base material. According to the Metropolitan Bakersfield General Plan, there are three sand and gravel extraction areas within the Metropolitan Bakersfield General Plan area, primarily along the floodplain and alluvial fan of the Kern River. None of these sand and gravel extraction areas are within or in close proximity to the proposed Project site.



SOURCE: USGS California Quadrangles; Conner, Photorevised 1973, Gosford, Photorevised 1973, Lamont, 1992, Weed Patch, 1992,

0 3000'
APPROXIMATE

99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Natural Gas Pipeline Map

Figure 4.12-1

Other Mineral Resources

The following section describes additional mineral resources relevant to local and regional character.

Gold has been the most important metallic mineral mined in Kern County in terms of total dollar value. It has been recovered by both placer and lode mining mainly in the Sierra Nevada and desert regions. While fluctuation in gold prices has caused a reactivation of interest in the commodity over the last two decades, continuous mining activity has been somewhat limited. Placer gold was mined before 1900, with the greatest number of deposits being mined during the late 1920s and 1930s. Principal placer deposits are in the Rand District, El Paso Mountains and along the Kern River. Approximately 1,500 gold claims have been registered in Kern County with approximately 280 of those claims activated as either lode or placer mines. Total amount of gold extracted from Kern County sites is not available since records were not kept during the more active lode mining activities prior to 1900. Placer yields are in excess of 32,000 fine ounces, a 1957 figure, but not likely to be much more since that date.

The Metropolitan Bakersfield General Plan EIR (Section 4.14, *Mineral and Energy Resources*) identifies the foothills of the Sierra Nevada's as having some potential as fossil and gemstone sites. These mineral resources, although possessing scientific and cultural value, are not considered a major economic resource.

Project Site

There is no evidence of other mineral resources being located within the proposed Project site and/or of mining operations occurring within the site or immediate Project vicinity.

4.12.3 Regulatory Setting

Oil, gas, and minerals, like land, are considered forms of property. The mineral resources that are beneath a tract of land (i.e., the mineral estate or subsurface estate) can be owned, and the ownership provides the holder with the mineral rights or subsurface rights, whereas, surface rights refer to ownership of the land (i.e., the surface estate) and the right to use the surface. When different parties own the surface and subsurface estates, it is referred to as split estate or severed estate lands.

The separation of surface and subsurface rights can occur through a mineral reservation. Severance by mineral reservation may occur if a party owning both surface and subsurface rights sells the land, but retains (or reserves) all or a portion of the mineral, oil and/or gas rights. To preserve title to the subsurface estate, the mineral owner has to record their mineral reservation with the county clerk and recorder's office or other government land title office. Mineral reservations often occur when lands are originally patented (e.g., the federal government sells the land but holds onto the mineral rights).

The following regulatory discussion provides applicable Federal, State, local goals, policies, regulations, codes and acts pertinent to development and operation of the proposed Project.

Federal

Bureau of Land Management

The Bureau of Land Management (BLM), an agency within the United States Department of the Interior, administers 261 million surface acres of America's public lands, located primarily in two Western States. The BLM sustains the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations. The public lands provide a myriad of opportunities for commercial activities. Commercially valuable natural resources include energy and mineral commodities, forest products, grazing forage, and special uses such as rights-of-way for pipelines and transmission lines.

BLM is responsible for managing commercial energy and mineral production from the public lands in an environmentally sound and responsible manner. BLM is responsible for the leasing of Federal oil, gas, and geothermal minerals. BLM is also responsible for supervising the exploration, development, and production operations of these resources on both Federal and Indian lands. The proposed Project is privately owned and is not, in part or in total, under ownership of the BLM.

State

Surface Mining and Reclamation Act of 1975

The mineral resources addressed in this report pertain to those resources that are classified under the State Mining and Reclamation Act of 1975 (SMARA). The SMARA mandated the initiation by the State Geologist of mineral land classification in order to help identify and protect mineral resources in areas within the State subject to urban expansion and other irreversible land uses which would preclude mineral extraction. SMARA also allowed the designation of lands containing mineral deposits of regional or statewide significance. SMARA was amended (1980) to provide for the classification of non-urban area subject to land-use threats incompatible with mining. The classification of land within California takes place according to a priority list that was established by the State Mining and Geology Board (SMGB) in 1982, or when the SMGB is petitioned to classify a specific area. Currently, the State Geologist's SMARA classification activities are carried out under a single program for urban and non-urban areas of the state. Mineral lands are mapped using the California Mineral Land Classification System according to jurisdictional boundaries, mapping all mineral commodities at one time in the area, including aggregate, common clay and dimensions stone. Priority is given to areas where future mineral resource extraction could be precluded by incompatible land use or to mineral resources likely to be mined during the 50-year period following their classification. Detailed mineral land classification and designation reports provided by the State Mining and Geology Board are on file at the City of Bakersfield and County of Kern.

The SMGB established Mineral Resources Zones to designate lands that contain mineral deposits. Accordingly, the Mineral Resource Zone (MRZ) classification system is used to evaluate an area's mineral resources pursuant to SMARA. A "resource" is a concentration of naturally occurring solid, liquid, or gaseous material in such form and amount that economic extraction of a commodity from the concentrations is currently potentially feasible. A "reserve" is that part of the resource base which

could be economically extracted or produced within the foreseeable future. For any given mineral resource, an area may be classified as MRZ-1, MRZ-2, MRZ-3, or MRZ-4, as follows:

- MRZ-1: Areas where the available geologic information indicates that no significant mineral deposits are present, or where it is judged that no significant likelihood exists for their presence.
- MRZ-2a: Areas where the available geologic information indicates that significant mineral deposits are present.
- MRZ-2b: Areas where the available geologic information indicates that there is likelihood for the presence of significant mineral deposits.
- MRZ-3a: Areas where the available geologic information indicates that mineral deposits exist, the significance of which cannot be determined from available data.
- MRZ-3b: Areas where the available geologic information indicates that mineral deposits are likely to exist, the significance of which cannot be determined from available data.
- MRZ-4: Areas where available geologic information is inadequate for assignment into any other MRZ, or where there is not enough information available to determine the presence or absence of mineral deposits.

The MRZ classifications are applied based on available geologic information and upon geologic appraisal of the mineral resource potential of the land, including geologic mapping and other information on surface exposures, drilling records, and mine data; and on socioeconomic factors such as market conditions and urban development patterns.

Division of Oil, Gas, and Geothermal Resources (DOGGR)

DOGGR is responsible for supervising the drilling, operation, maintenance, plugging, and abandonment of oil, gas, and geothermal wells. DOGGR's regulatory program promotes the sensitive development of oil, natural gas, and geothermal resources in California through sound engineering practices, prevention of pollution, and implementation of public safety programs. To implement this regulatory program, DOGGR requires avoidance of building over or near plugged or abandoned oil and gas wells or requires the remediation of wells to current DOGGR standards.

All oil and gas wells drilled and constructed in California must adhere to strict requirements. These requirements include general laws and regulations regarding the protection of underground and surface water, and specific regulations regarding the integrity of the well casing, the cement used to secure the well casing inside the bore hole, and the cement and equipment used to seal off the well from underground zones bearing fresh water and other hydrocarbon resources. (See California Public Resources Code sections 3106, 3203, 3211, 3220, 3222, 3224, 3255; Title 14 of the California Code of Regulations, sections 1722.2, 1722.3, 1722.4, etc.). In addition, the DOGGR requires avoidance of building over or near plugged or abandoned oil and gas wells or requires the remediation of wells to current DOGGR standards.

DOGGR also has the authority under the CCR to adopt field rules for oil and gas pools or zones in a field when sufficient geologic and engineering data is available from previous drilling operations. The administrative boundaries of each pool or zone for which field rules have been adopted and geologic and engineering information is available to accurately describe subsurface conditions are designated through a ministerial process by DOGGR. Applicable field rules identify down hole conditions and well construction information that oil and gas operators should consider when drilling and completing onshore oil and gas wells. In addition to DOGGR facilities regulations, operators that have facilities in designated areas must have Spill Prevention, Control and Countermeasure Plans per U.S. Environmental Protection Agency (EPA) requirements.

In California, wells that inject fluids associated with oil and natural gas production operations (Class II injection wells) are regulated by the DOGGR under the Underground Injection Control (UIC) Program. Injection operations regulated under the UIC Program include water flood, steam flood, cyclic steam, water disposal, gas storage, and other enhanced oil recovery projects. DOGGR's UIC program is monitored and audited by the EPA because in 1982 DOGGR entered into a primacy agreement with the EPA for regulation of Class II injection wells under the federal Safe Drinking Water Act (SDWA). The requirements of DOGGR's UIC Program are found in the Public Resources Code (PRC), the Safe Drinking Water Act, and in the state and federal regulations. The main features of the UIC Program include permitting, inspection, enforcement, mechanical integrity testing, plugging and abandonment oversight, data management, and public outreach.

On November 15, 2013, the DOGGR began the formal rulemaking process for Well Stimulation Treatment Regulations, which, at that time were to go into effect no later than January 1, 2015. Interim regulations went into effect on January 1, 2014, which require oil and gas well operators to submit notification of well stimulation treatments and various types of data associated with well stimulation operations, including chemical disclosure of well stimulation fluids, to the DOGGR. In addition, the DOGGR is required to compile submitted information regarding these activities and make it available to the public in a format that is easily searchable.

On June 20, 2014, Governor Brown signed into law Senate Bill (SB) 861 (Committee on Budget and Fiscal Review, Chapter 35, Statutes of 2014), which took effect immediately. SB 861 amended DOGGR's authority to use emergency rulemaking to establish interim regulations for implementation of SB 4. As allowed under the new law, the readopted SB 4 interim well stimulation treatment regulations will remain in effect until the most current version and status if the final well stimulation regulations went into effect July 1, 2015 (DOGGR 2017).

California Geological Survey (Formerly California Division of Mines and Geology)

The California Geological Survey (formerly the California Division of Mines and Geology within the State Department of Conservation) has responsibility to identify and assist in the utilization of mineral deposits, and to identify geological hazards, including fault locations.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan lists the issues, goals, policies, and implementation measures related to oil, natural gas, sand and gravel, as other minerals and energy resources in the County, as contained in the Energy Element. Project implementation would be guided in part by the goals, policies, and implementation programs, which are presented in Table 4.12-1, *Metropolitan Bakersfield General Plan Goals and Policies for Mineral Resources*.

Table 4.12-1. Metropolitan Bakersfield General Plan Goals and Policies for Mineral Resources

Goals and Policies: Mineral Resources Element
Goal #1: Protect areas of significant resources potential for future use.
Goal #2: Document areas of current mineral and energy resource extraction, as a basis for land use and conservation policies and programs.
Goal #3: Avoid conflicts between the productive use of mineral and energy resource lands and urban growth.
Goal #4: Protect land, water, air and visual resources from environmental damage resulting from mineral and energy resource development.
Policy #1: Maintain maps and descriptions of potential mineral and energy resources as a basis for policy and program implementation.
Policy #2: Document the location, status and long-term viability of sand and gravel quarries and petroleum drilling sites for purposes of avoiding near and long-term land use conflicts and provide a basis of compliance monitoring.
Policy #3: Encourage and support the exchange of information on mineral and energy resources between private industry, City of Bakersfield and Kern County.
Policy #4: Land use decisions shall recognize the importance of identified mineral resources and need for conservation of resources identified by the State Mining and Geology Board.
Policy #5: Protect significant mineral and petroleum resource areas, including potential sand and gravel extraction areas.
Policy #6: Continue implementation of the Kern River Channel Maintenance Program for extraction of river sand and gravel.
Policy #7: Promote development of compatible uses adjacent to mineral extraction areas.
Policy #8: Allow development of resource extraction sites subject to the conditional use permit procedure in zones where such uses are not prohibited by right and where it can be shown that the proposed extraction uses are compatible with surrounding areas.
Policy #9: Encourage preservation of any known deposits of gemstones and fossils.
Policy #10: Implement, as appropriate, the California Environmental Quality Act to minimize land use conflicts and reduce extraction operations.
Policy #11: Prohibit incompatible development in areas, which have a significant potential to harm public health, safety and welfare due to mineral and petroleum extraction and processing.
Policy #12: Design resource extraction operations subject to discretionary permits to maintain the integrity of areas of "high environmental quality" and unique scenic value.
Policy #13: Require surface mineral resource extraction sites to have plans and procedures for land reclamation, conforming with the requirements of the State Mining and Geology Board, to be implemented upon completion of extraction operations at each site or portion thereof.

Table 4.12-1. Metropolitan Bakersfield General Plan Goals and Policies for Mineral Resources
Goals and Policies: Mineral Resources Element
Policy #14: Review all discretionary mineral or petroleum development including renewal of existing authorizations, under the policies and procedures of the California Environmental Quality Act.
Policy #15: Require petroleum production sites in urban areas, which are subject to discretionary permits to install peripheral landscaping to help reduce the noise, dust and visual impacts to adjacent sensitive receptors and public ways.
Policy #16: Require all mineral development to be predicated on appropriate reclamation plans that meet the standards of the State Surface Mining and Reclamation Act and the implementing guidelines of the State Mines and Geology Board, and/or the standards of the State Division of Oil and Gas. Reclamation/restoration of the sites shall be done at each phase of development or as extraction is completed.

Kern County Zoning Ordinance (Title 19 of the Ordinance Code of Kern County)

Chapter 19.98 Oil and Gas Production

This chapter of the Kern County Zoning Ordinance contains the procedures and standards that apply to all exploration drilling and production activities related to oil, gas, and other hydrocarbon substances carried out in unincorporated Kern County. The purpose of this chapter is to promote the economic recovery of oil, gas, and other hydrocarbon substances in a manner compatible with surrounding land uses and protection of the public health and safety.

This chapter, along with related parts of the zoning ordinance, was amended by the Kern County Board of Supervisors on November 9, 2015 to require a ministerial permit for all oil and gas operations along with updated implementation standards and mitigation measures. A comprehensive project level oil and gas activities EIR was certified and includes mitigation measures to address environmental impacts of pre-drilling exploration, well drilling, and the operation of wells and other oil and gas production–related equipment and facilities, including exploration, production, completion, stimulation, reworking, injection, monitoring and plugging and abandonment. This required permit is in conjunction with and coordinated with the permit issued by DOGGR.

Kern County Fire Department

A set back is a minimum distance required by zoning to be maintained between structures or between structures and property lines. Kern County does not currently have any adopted zoning ordinance specifically addressing set back distances for petroleum and natural gas pipelines. However, the Kern County Fire Department has set back distance requirements for buildings constructed adjacent to transmission pipelines that transport petroleum and natural gas. The Pipeline Development Policies of the Kern County Fire Department are as follows:

- No habitable portion of a structure shall be construction within 50 feet of a gas main, or transmission line, or refined liquid product line with 36 inches of cover;

- No structure may be within 40 feet of a hazardous liquids pipeline bearing refined product, with 48 inches or more of cover;
- No habitable portion of a structure shall be built within 30 feet of a crude oil pipeline operating at 20 percent of its design strength;
- Prior to or concurrent with filing of a final map, a covenant shall be recorded on all lots of this tract, or portion thereof, which are within 250 feet of any gas transmission line. Covenant shall acknowledge proximity of pipeline easement to said property and describe the name, type and dimension of the pipelines. Prior to recordation, the subdivider shall submit and obtain approval covenant wording with the City Attorney, Office of Environmental services and City Engineer.

4.12.4 Impacts and Mitigation Measures

Methodology

In accordance with the California Environmental Quality Act (CEQA), the effects of a project are evaluated to determine if they will result in a significant adverse impact on the environment. An EIR is required to focus on these effects and offer mitigation measures to reduce or avoid any significant impacts that are identified. The criteria, or standards, used to determine the significance of impacts may vary depending on the nature of the proposed Project. Mineral Resource impacts resulting from the implementation of the proposed Project could be considered significant if they cause any of the following results.

Thresholds of Significance

- The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; and/or
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan.

The analysis of the existing environment and the impact analysis indicate that this proposed Project could result in a significant environmental impact if it would result in a loss of mineral resources, if not mitigated.

Project Impacts

Impact 4.12-1: The Project Would Not Result in the Loss of Availability of a Known Mineral Resource That Would be of Value to the Region and the Residents of the State

The proposed Project is not located within the administrative boundary of an oil or gas field. One previously abandoned exploration well, "Sea Cliff-Houghton" 1, is located in the northwest corner of

the Project site. The well was installed in November 1934 and drilled to approximately 6,756 feet, where it had no oil shows and one gas show at a depth interval of 2,077 to 2,079 feet. The well was abandoned as a dry hole with mud in the casing in October 1934 (refer to Appendix F, *Hazardous Materials Evaluation*). No other mineral resources or mineral resource facilities are known to occur on the Project site.

The lack of oil shows in prospect well "Sea Cliff-Houghton" 1 indicates that commercial quantities of oil and/or natural gas are not likely to underlie the proposed Project. As discussed in Section 4.9, *Hazards/Hazardous Materials*, the well must be reabandoned to current DOGGR and Kern County standards. Impacts would be less than significant because no known or potential mineral resources are present within, or in close proximity to, the proposed Project.

The Project does not propose mineral and/or energy resource development. However, PG&E currently operates a natural gas pipeline, number L-300B, that traverses the Project site (refer to Figure 4.12-1, *Natural Gas Pipeline Map*). Transport of natural gas through this pipeline would not be impeded by the proposed Project implementation. Mitigation would be required in order to maintain PG&E access to the pipeline. In addition, development on-site, would, also be required to comply with applicable State and local regulations in order to reduce potential impacts on health and safety related to this pipeline to less than significant levels (refer to Section 4.9, *Hazards/Hazardous Materials*). Impacts would be less than significant.

Mitigation Measures

Implementation of MM 4.9-6, 4.9-7, 5.9-9, and 4.9-10.

MM 4.12-1: **Natural Gas Pipeline Easements.** The Pacific Gas and Electric (PG&E) natural gas pipeline easement shall be included on all maps and grading plans to allow for continuous PG&E access for all maintenance activities.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.12-2: The Project Would Result in the Loss of Availability of a Locally Important Mineral Resource Recovery Site Delineated on a Local General Plan, Specific Plan or Other Land Use Plan.

Extraction and use of mineral resources is a significant economic and social value in Kern County. Challenges occur when oil production and mineral extraction activities are located in close proximity to incompatible land uses, such as residential. As discussed in Impact 4.12-1, above, the Project site is not located within the administrative boundaries of an oil or gas field. No oil shows were observed, and one natural gas show was observed at a depth interval or 2,077 to 2,079 feet in 1934-35. The DOGGR requires reabandonment of the prospect well "Sea Cliff-Houghton" 1.

There is no property within the proposed Project that is contained within an MRZ. Therefore, the proposed Project is not anticipated to result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan.

Extraction and use of mineral resources is a significant economic and social value in Kern County. Challenges occur when oil production and mineral extraction activities are located in close proximity to incompatible land uses, such as residential. As discussed in Impact 4.12-1, above, the proposed Project is not located within the administrative boundary of an oil or gas field. No commercial shows of oil or natural gas have been withdrawn from prospect well "Sea Cliff-Houghton" 1. This prospect well is currently abandoned.

The proposed Project in not within an MRZ. Therefore, the proposed Project is not anticipated to result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Cumulative impacts to mineral resources would occur if the cumulative projects would result in the loss of oil or aggregate mineral resources. This proposed Project is not within an administrative boundary for oil or gas fields and is not within an area of aggregate mineral resources. Other projects in the Metropolitan Bakersfield area may occur within or near existing oil fields, as well as sand and gravel mining operations. However, where these resources have substantial remnant supplies, none of the cumulative projects would preclude continued extraction or production of these resources. In addition, because the proposed Project has a less than significant impact on mineral resources, it would not add to a cumulative loss of resources within Kern County. Therefore, cumulative impacts would not result.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.13

Noise

Section 4.13
Noise

4.13.1 Introduction

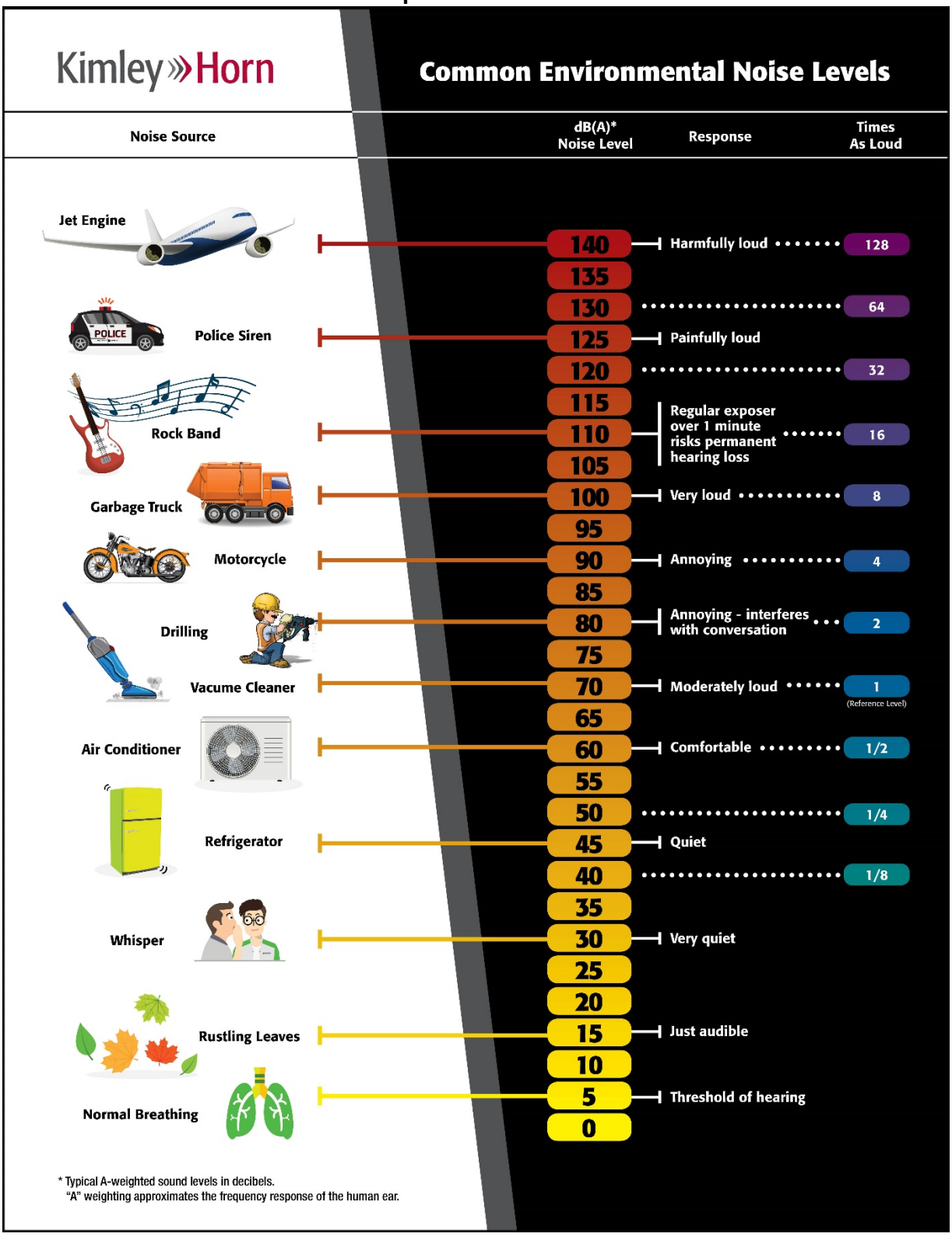
This section of the Recirculated Draft EIR addresses the potential noise impacts associated with construction and operation of the proposed Project. The noise section describes the existing conditions on the proposed Project site, the regulatory setting, the impacts of the proposed Project, and feasible mitigation measures to reduce impacts. An Environmental Noise Assessment was prepared by Bollard Acoustical Consultants, Inc. in April 2009. A second Environmental Noise Assessment was prepared by Bollard Acoustical Consultants, Inc. in May 2016 and an updated Environmental Noise Assessment was prepared in July 2017. See Appendix I, *Environmental Noise Assessment*, and Appendix N, *Original Technical Studies*.

Acoustical Terminology

Sound is technically described in terms of the loudness (amplitude) of the sound and frequency (pitch) of the sound. Noise is typically described as any unwanted or objectionable sound. The standard unit of measurement of the loudness of sound is the decibel (dB). Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity. The A-weighted decibel scale (dBA) performs this compensation by discriminating against sound frequencies in a manner approximating the sensitivity of the human ear. The A-weighted sound level of traffic and other long-term noise-producing activities within and around a community varies considerably with time. Measurements of this varying noise level are accomplished by recording values of the A-weighted level during representative periods during the day.

Decibels are based on the logarithmic scale. The logarithmic scale compresses the wide range in sound pressure levels to a more usable range similar to how the Richter scale measures earthquake magnitudes. In terms of human response to noise, a sound 10 dBA higher than another is perceived to be twice as loud; 20 dBA higher, four times as loud; and so forth. Everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Examples of various sound levels in different environments are shown in Figure 4.13-1, *Sound Levels and Human Response*.

Figure 4.13-1 Sound Levels and Human Response



In most situations, a three-dBA change in sound pressure level is considered a "just-detectable" difference. A five-dBA change (either louder or quieter) is readily noticeable and a 10-dBA change is a doubling (if louder) or a halving (if quieter) of the subjective loudness. Sound from a small localized source (approximating a "point" source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates or drops-off at a rate of six dBA for each doubling of the distance (six dBA/DD). This decrease, due to the geometric spreading of the energy over an ever- increasing area, is referred to as the inverse square law. However, highway traffic noise is not a single, stationary point source of sound. The movement of the vehicles makes the source of the sound appear to emanate from a line (line source) rather than a point when viewed over some time interval. Since the change in surface area of a cylinder only increases by two times for each doubling of the radius instead of the four times associated with spheres, the change in sound level is three dBA per doubling of distance. Numerous methods have been developed to measure sound over a period of time. These methods include (1) the community noise equivalent level (CNEL); (2) the equivalent sound level (L_{eq}); and (3) the day/night average sound level (L_{dn}). These methods and additional noise related terminology is described below.

Community Noise Equivalent Level (CNEL)

Cumulative noise metrics were developed to assess community response to noise. They are useful because they attempt to take into account the loudness and duration of the noise, the total number of noise events and the time of day these events occur in one single-number rating scale. They are designed to account for the known health effects of noise on people. CNEL is a 24-hour, time-weighted energy-average noise level based on dBA that measures the overall noise during an entire day. Noise that occurs during certain sensitive time periods is penalized for occurring at these times by adding decibels to its L_{eq} measurement. On the CNEL scale, noise between 7:00 AM and 10:00 PM is penalized by approximately five dB, to account for the greater potential for noise to interfere during these hours, as well as typically lower ambient (background) noise levels during these hours. Noise during the night (from 10:00 PM to 7:00 AM) is penalized by ten dB to attempt to account for our higher sensitivity to noise in the nighttime and the expected further decrease in ambient noise levels that typically occur in the night.

Equivalent Sound Level (Leq)

The equivalent sound level, abbreviated L_{eq}, is a measure of the exposure resulting from the accumulation of A-weighted sound levels over a particular time period (e.g., one-hour, eight-hour school day, nighttime or a full 24-hour day). However, because the length of the period can be different depending on the time frame of interest, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example $L_{eq(24)}$.

Conceptually, L_{eq} may be thought of as a constant sound level over the period of interest that contains as much sound energy as the actual time-varying sound level with its normal peaks and valleys. It is important to recognize, however, that the two signals (the constant one and the time-varying one) would sound very different from each other if compared in real life. Variations in the "average" sound level suggested by L_{eq} are not an arithmetic value, but a logarithmic ("energy-averaged") sound level. Thus, loud events clearly dominate any noise environment described by the metric.

Day/Night Average Sound Level (L_{dn})

The day/night average sound level (L_{dn}) is a measure of the 24-hour average noise level at a given location. It was adopted by the U.S. Environmental Protection Agency (EPA) for developing criteria for the evaluation of community noise exposure. L_{dn} is based on a measure of the average noise level over a given time period. The L_{dn} is calculated by averaging the L_{eq} for each hour of the day at a given location after penalizing the sleeping hours (from 10:00 PM to 7:00 AM) by 10 dBA to take into account the increased sensitivity of people to noises that occur at night. The sound level exceeded over a specified timeframe can be expressed as L_n (i.e., L_{90}, L_{50}, L_{10}, etc.). L_{50} equals the level exceeded 50 percent of the time; $L_{10,}$ ten percent of the time; etc.

Maximum Sound Level (Lmax)

The maximum sound level recorded during a noise event.

Noise (Exposure) Contours

Noise (exposure) contours illustrate (typical a line drawn on a diagram/map) a noise source indicating constant levels of noise exposure. CNEL contours are frequently utilized to describe a community's exposure to noise.

Sound Propagation and Attenuation

For purposes of sound propagation, noise sources may be classified as point sources or line sources. Point sources usually are localized, such as a piece of machinery, and at a distance, sound from such sources will propagate in a spherical pattern. Sound levels from point sources will attenuate or drop-off at the rate of six dB for each doubling of distance. Sound from line sources, such as a highway, propagates in a cylindrical pattern. Sound from line sources will attenuate at a rate of three dB per doubling of distance.

Additionally, sound levels also may be attenuated by air and ground absorption, and from shielding by natural or man-made obstacles in the sound path. Noise barriers (walls or earth berms) are features that are commonly constructed to interrupt noise propagation and reduce noise levels. Wind and atmospheric temperature inversions also influence sound propagation.

Vibration Characteristics

Vibration is a unique form of noise. It is unique because its energy is carried through structures and the earth, whereas, noise is simply carried through the air. Thus, vibration is generally felt rather than heard. Some vibration effects can be caused by noise; e.g., the rattling of windows from truck pass-bys. This phenomenon is related to the coupling of the acoustic energy at frequencies that are close to the resonant frequency of the material being vibrated. Typically, ground-borne vibration generated by man-made activities attenuates rapidly as distance from the source of the vibration increases. Vibration, which spreads through the ground rapidly, diminishes in amplitude with distance from the source. The ground motion caused by vibration is measured as particle velocity in inches per second and, in the U.S. is referenced as vibration decibels (VdB).

The vibration velocity level threshold of perception for humans is approximately 65 VdB. A vibration velocity of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people. Sources within buildings such as operation of mechanical equipment, movement of people or the slamming of doors causes most perceptible indoor vibration. Typical outdoor sources of perceptible groundborne vibration are construction equipment, steel wheeled trains and traffic on rough roads. Ground type, distance between source and receptor, duration, and the number of perceived vibration events can all influence human and structural responses to vibration. The range of interest is from approximately 50 VdB, which is the typically background vibration velocity, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings.

4.13.2 Environmental Setting

Noise-Sensitive Land Uses

Certain land uses are particularly sensitive to noise, including schools, hospitals, rest homes, long-term medical and mental care facilities, and parks and recreation areas. Residential areas are also considered noise sensitive, especially during the nighttime hours.

The proposed Project is mostly vacant and used for agricultural purposes. Noise sensitive land uses in the immediate vicinity of the proposed Project include existing single-family residences to the east of the proposed Project. These uses may be affected by increased Project-related traffic noise on local area roadways and on-site noise sources.

Existing Noise Environment

The proposed Project consists of approximately 314.30 acres of fallow agricultural land. The topography of the site is relatively flat, sloping slightly from the northwest to the southeast. Elevations range from approximately 331 feet above mean sea level (msl) to 340 feet above msl. Existing noise sources located in the immediate vicinity of the proposed Project include traffic on local roadways and agricultural equipment.

Ambient Noise Measurements

The existing ambient noise environment in the immediate project vicinity is defined primarily by SR-99 traffic, local traffic, and commercial/light industrial operations. In order to quantify existing ambient noise levels in the proposed Project area, a 24-hour ambient noise level measurement survey was completed at the closest residential property to the proposed Project site on December 18-19, 2008 and additional short-term ambient noise measurements were collected in July 10, 2017 (Bollard Acoustical Consultants 2017) at three locations. Figure 4.13-2, *Location of Existing Noise Level Measurements*, shows the location where noise measurements were taken in 2017.

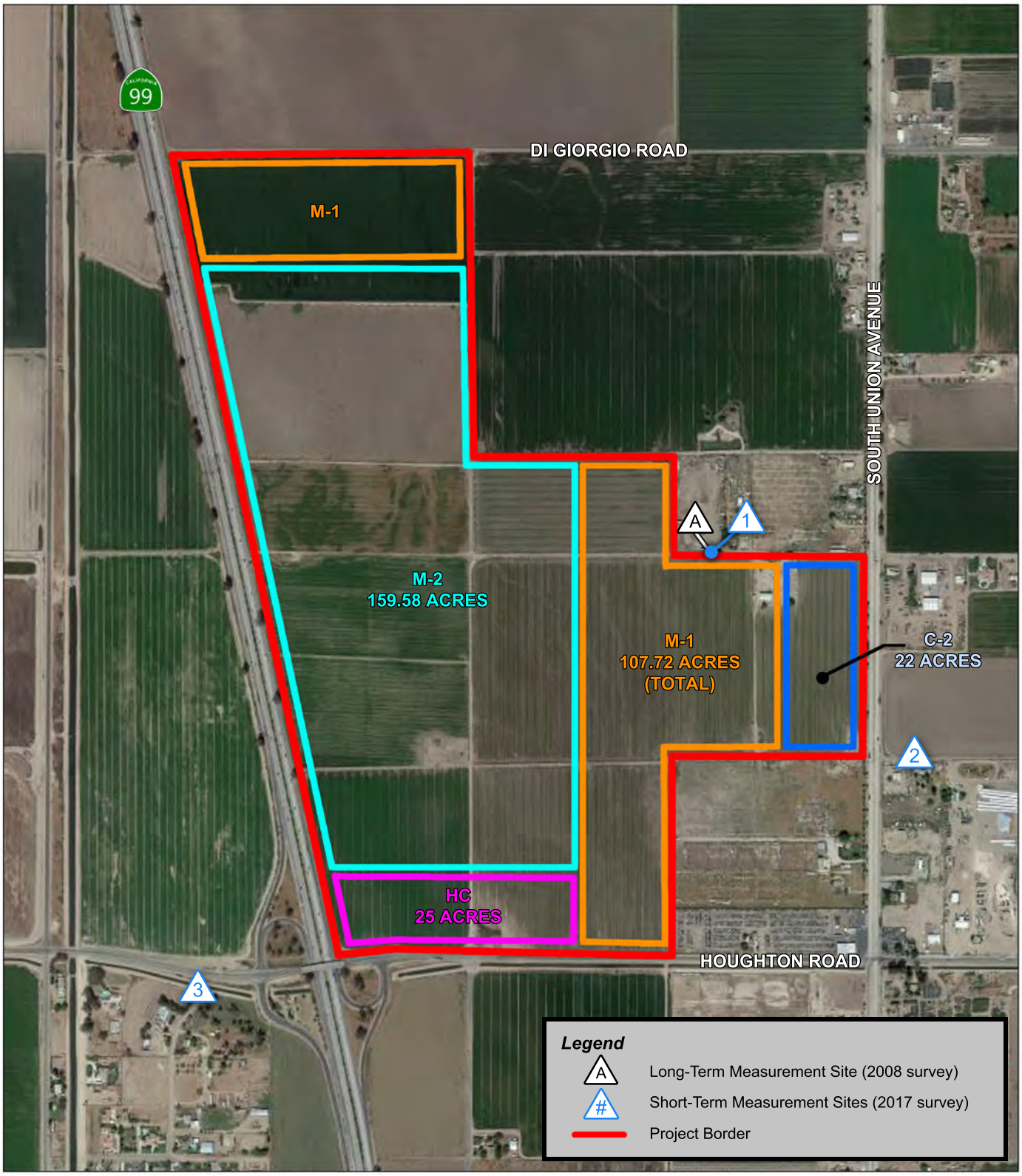
Noise monitoring equipment used for the study consisted of a Larson-Davis Laboratories (LDL) Model 820 precision integrating sound level meter equipped with an LDL Model 2560 1/2" microphone. The instrumentation complies with applicable requirements of the American National

Standards Institute (ANSI) for Type 1 (precision) sound level meters, and was calibrated prior to use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy of the measurements (Bollard Acoustical Consultants 2017).

Existing Traffic Noise Levels

Vehicular noise along major roadways in the vicinity of the proposed Project was modeled to estimate existing noise levels from mobile sources. The existing and future roadway noise levels were projected using the Federal Highway Administration (FHWA) Traffic Noise Prediction Model, together with several roadway and site parameters. The FHWA Traffic Noise Prediction Model's Lookup Table provides a reference of pre-calculated TNPM results for simple highway geometries, which is adequate for the purposes of this analysis.

Traffic volumes used in the FHWA TNPM were obtained from the Traffic Study prepared by McIntosh & Associates, January 2016. Existing modeled traffic noise levels are shown in Table 4.13-1, *Existing Traffic Noise Levels*. Table 4.13-1 shows existing traffic noise levels at a reference distance of 100 feet from the centerlines of existing Project-area roadways. As illustrated in Table 4.13-1, existing traffic noise levels range from 30 to 70 dBA CNEL. Several roadway segments currently exceed the Metropolitan Bakersfield General Plan noise standard of 65 dBA CNEL standard at 100 feet from the centerline.



SOURCE: Bollard Acoustical Consultants, Inc.,
99 Houghton General Plan Amendment EIR

Noise Measurement Location

0 1000'
APPROXIMATE

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07 • AGRICULTURAL PRESERVE #13 EXCLUSION

Location of Existing Noise Level Measurements

Figure 4.13-2

Table 4.13-1. Existing Traffic Noise Levels

Roadway	Segment	L_{dn} (dB) @ 100 feet
Panama Lane	West of 99 SB Ramp	70
	99 SB Ramp to 99 NB Ramp	67
	99 NB Ramp to South H St.	69
	South H St. to South Union Ave.	65
	South Union Ave. to Cottonwood Rd.	64
	East of Cottonwood Rd.	64
Hosking Ave.	West of Hughes Ln.	55
	Hughes Ln. to 99 SB Ramp	54
	99 SB Ramp to 99 NB Ramp	54
	99 NB Ramp to South H St.	54
	South H St. to South Union Ave.	56
	South Union Ave. to Cottonwood Rd.	30
Taft Hwy.	West of Wible Rd.	63
	Wible Rd. to Compangnoni St.	62
	Compangnoni St. to 99 NB Ramp	65
	99 NB Ramp to South H St. (2015)	69
	South H St. to South Union Ave.	69
	South Union Ave. to Cottonwood Rd.	68
	East of Cottonwood Rd.	68
Di Giorgio Rd.	West of Chevalier Rd. (Entrance #1)	n/a
	Chevalier Rd. (Entrance #1) to South Union Ave.	n/a
	South Union Ave. to Cottonwood Rd.	33
	East of Cottonwood Rd.	46
Curnow Rd.	West of South Union Ave.	44
	South Union Ave. to Cottonwood Rd.	38
Houghton Rd.	West of Stine Rd.	60
	Stine Rd. to Wible Rd.	58
	Wible Rd. to South H St.	53
	South H St. to 99 SB Ramp	58
	99 SB Ramp to 99 NB Ramp	62
	99 NB Ramp to Entrance #7	64
	Entrance #7 to Chevalier Rd. (Entrance #6)	64
	Chevalier Rd. (Entrance #6) to Entrance #5	64
	Entrance #5 to South Union Ave.	64
	South Union Ave. to Cottonwood Rd.	65
	Cottonwood Rd. to Adobe Rd.	65
	East of Adobe Rd.	64
Shafter Rd.	Chevalier Rd. to South Union Ave.	39
	East of South Union Ave.	43
Bear Mountain Blvd.	West of Costajo Rd.	60
	Costajo Rd. to 99 NB Ramp	67
	99 NB Ramp o South Union Ave.	69
	East of South Union Ave.	69
Stine Road	North of Houghton Rd.	50
	South of Houghton Rd.	48

Table 4.13-1. Existing Traffic Noise Levels

Roadway	Segment	L_{dn} (dB) @ 100 feet
Wible Road	North of Taft Hwy.	55
	Taft Hwy to Houghton Rd.	54
	South of Houghton Rd.	49
Hughes Lane	South of Hosking Ave.	54
Compangnoni St.	South of Taft Hwy.	50
South H St.	North of Panama Ln.	59
	Panama Ln. to Hosking Ave.	62
	Hosking Ave. to Taft Hwy.	57
	South of Taft Hwy.	46
	North of Houghton Rd. (2015)	48
	South of Houghton Rd. (2015)	49
Chevalier Rd.	Di Giorgio Rd. to Houghton Rd.	n/a
	Houghton Rd. to Shafter Rd. (2015)	40
South Union Ave.	North of Panama Ln.	70
	Panama Ln. to Hosking Ave.	67
	Hosking Ave. to Taft Hwy.	64
	Taft Hwy. to Curnow Rd.	60
	Curnow Rd. to Di Giorgio Rd.	59
	Di Giorgio Rd. to Lamb Ave. (Entrance #2)	59
	Lamb. Ave. (Entrance #2) to Entrance #3	59
	Entrance #3 to Mugsy Ave. (Entrance #4)	59
	Mugsy Ave. (Entrance #4) to Houghton Rd.	59
	Houghton Rd. to Shafter Rd.	58
	Shafter Rd. to Bear Mountain Blvd.	57
	South of Bear Mountain Blvd.	55
Cottonwood Rd.	North of Panama Ln.	53
	Panama Ln. to Hosking Ave.	42
	Hosking Ave. to Taft Hwy.	42
	Taft Hwy. to Curnow Rd.	47
	Curnow Rd. to Di Giorgio Rd.	47
	Di Giorgio Rd. to Houghton Rd.	36
Adobe Rd.	North of Buena Vista Blvd.	36
	South of Buena Vista Blvd. (2015)	51

Notes: SR = State Route
Where "N/A" appears in the table, the particular roadway segment does not have traffic data because the road is not yet constructed.
Source: Bollard Acoustical Consultants, Inc., 2016, Bollard Acoustical Consultants, Inc., 2017.

Stationary Sources

The proposed Project is located in a primarily agricultural area. Transient noise generation from agricultural operations and equipment occurs within the Project vicinity on a seasonal basis. There are no other sources of stationary noise in the vicinity of the proposed Project.

4.13.3 Regulatory Setting

Federal

There are a number of laws and guidelines at the Federal level that direct the consideration of a broad range of noise and vibration issues. Because the project does not require action by Federal agencies, at this time, the project is not directly subject to Federal noise regulations other than those of the Federal Occupational Safety and Health Administration (OSHA). For perspective, several of the more significant noise-related Federal regulations and guidelines are described below.

Noise Control Act of 1972 (42 USC 4910)

This act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the act establishes a means for the coordination of Federal research and activities in noise control, authorizes the establishment of Federal noise emissions standards for products distributed in commerce, and provides information to the public with respect to the noise-emission and noise-reduction characteristics of such products.

USEPA Recommendations in "Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety" (NTIS 550\9-74-004, USEPA, Washington, D.C., March 1974)

In response to a Federal mandate, U.S. Environmental Protection Agency (EPA) provided guidance in Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety (National Technical Information Service [NTIS], 550\9-74-004, EPA, Washington, D.C., March 1974). Commonly referenced as the "Levels Document," it establishes an Ldn of 55 dBA as the requisite level, with an adequate margin of safety, for areas with outdoor uses, including residential and recreational areas. This document does not constitute EPA regulations or standards but identifies safe levels of environmental noise exposure without consideration of costs for achieving these levels or other potentially relevant considerations. It is intended to "provide State and local governments, as well as the Federal government and the private sector, with an informational point of departure for the purpose of decision-making." The agency is careful to stress that the recommendations contain a factor of safety and do not consider technical or economic feasibility issues and, therefore, should not be construed as standards or regulations.

Federal Highway Administration

The purpose of the Federal Highway Administration (FHWA) Noise Abatement Procedures (23 CFR 772) is to provide procedures for noise studies and noise abatement measures to help protect the public health and welfare, supply noise abatement criteria, and establish requirements for information to be given to local officials for use in the planning and design of highways. The purpose of this regulation is to provide procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria (NAC), and to establish requirements for information to be given to local officials for use in the planning and design of highways. It establishes five categories of noise-sensitive receptors and prescribes the use of the hourly L_{eq} as the criterion metric for evaluating traffic noise impacts.

All highway projects that are developed in conformance with this regulation shall be deemed to be in conformance with the Department of Transportation-FHWA Noise Standards. Title 23 establishes an NAC of 67 dBA $L_{eq(h)}$ applicable to federal highway projects for evaluating impacts to land uses including residences, recreational uses, hotels, hospitals, and libraries (23 CFR Chapter 1, Part 772, Section 772.19). Additionally, FHWA requires that individual states establish an allowable noise level increase (at or above which the increase is deemed to be "substantial" (between 5 and 15 dB) and abatement should be considered) for Type 1 highway projects. Type I projects include projects that would: construct a highway in a new location; physically alter and existing highway where there is a substantial horizontal or vertical alteration; add through-traffic lane(s); add auxiliary lane(s); add or relocate interchange lands or ramps; restripe pavement for the purposes of adding lane(s); and add a new, or substantially altering and existing, weigh station, rest stop, ride-share lot, or toll plaza.

Occupational Safety and Health Administration

The OSHA Occupational Noise Exposure: Hearing Conservation Amendment (Federal Register 48 [46], 9738–9785, 1983) stipulates that protection against the effects of noise exposure shall be provided for employees when sound levels exceed 90 dBA over an 8-hour exposure period. Protection shall consist of feasible administrative or engineering controls. If such controls fail to reduce sound levels to acceptable levels, personal protective equipment shall be provided and used to reduce exposure of the employee. Additionally, a hearing conservation program must be instituted by the employers whenever employee noise exposure equals or exceeds the action level of an 8-hour, time-weighted average sound level of 85 dBA. The hearing conservation program requirements consider periodic area and personal noise monitoring, the performance and evaluation of audiograms, the provision of hearing protection, annual employee training, and record keeping.

State

California Environmental Quality Act (CEQA) Guidelines

The California Environmental Quality Act (CEQA) was enacted in 1970 and requires that all known environmental effects of a project be analyzed, including environmental noise impacts. Under CEQA, a project has a potentially significant impact if the project exposes people to noise levels in excess of standards established in the local general plan or noise ordinance. Additionally, under CEQA, a project has a potentially significant impact if the project creates a substantial increase in the ambient noise levels in the project vicinity above levels existing without the proposed Project. If a project has a potentially significant impact, mitigation measures must be considered. If mitigation measures to reduce the impact to less than significant are not feasible due to economic, social, environmental, legal, or other conditions, the most feasible mitigation measures must be considered.

California Government Code

The California Department of Health Services has studied the correlation of noise levels and their effects on various land uses and established guidelines for evaluating the compatibility of various land uses as a function of community noise exposure. The State requires all municipalities to prepare and adopt a comprehensive long-range general plan. General plans must contain a noise element (California Government Code Section 65302[f] and Section 46050.1 of the Health and Safety Code). The requirements for the noise element of the general plan include describing the noise environment

quantitatively using a cumulative noise metric, such as CNEL or DNL, establishing noise/land use compatibility criteria, and establishing programs for achieving and/or maintaining land use compatibility. Noise elements should address all major noise sources in the community, including mobile and stationary noise sources.

The State Office of Planning and Research (OPR) Noise Element Guidelines include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise. The Noise Element Guidelines contain a land use compatibility table that describes the compatibility of various land uses with a range of environmental noise levels in terms of the CNEL. Table 4.13-2, *California Land Use Compatibility Noise Guidelines*, presents guidelines for determining acceptable and unacceptable community noise exposure limits for various land use categories. The guidelines also present adjustment factors that may be used to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Table 4.13-2. California Land Use Compatibility Noise Guidelines

LAND USE CATEGORY	COMMUNITY NOISE EXPOSURE (dBA CNEL)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential – Low Density, Single-Family, Duplex, Mobile Homes	50 - 60	55 - 70	70 – 75	75 – 85
Residential – Multiple Family	50 - 65	60 - 70	70 – 75	70 – 85
Transient Lodging – Motels, Hotels	50 - 65	60 - 70	70 – 80	80 – 85
Schools, Libraries, Churches, Hospitals, Nursing Homes	50 - 70	60 - 70	70 – 80	80 – 85
Auditoriums, Concert Halls, Amphitheaters	NA	50 - 70	NA	65 – 85
Sports Arenas, Outdoor Spectator Sports	NA	50 – 75	NA	70 – 85
Playgrounds, Neighborhood Parks	50 - 70	NA	67.5 – 75	72.5 – 85
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50 - 70	NA	70 – 80	80 – 85
Office Buildings, Business Commercial and Professional	50 - 70	67.5 – 77.5	75 – 85	NA
Industrial, Manufacturing, Utilities, Agriculture	50 - 75	70 - 80	75 – 85	NA

Table 4.13-2. California Land Use Compatibility Noise Guidelines

LAND USE CATEGORY	COMMUNITY NOISE EXPOSURE (dBA CNEL)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable

Source: General Plan Guidelines, Office of Planning and Research, California, October 2003, page 250.

CNEL = community noise equivalent level; NA = not applicable.

Notes:

Normally Acceptable – Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable – New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable – New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable – New construction or development should generally not be undertaken.

California Division of OSHA

Occupational exposure to noise is regulated by the California Division of OSHA in Title 8, Group 15, Article 105, Sections 5095–5100. As mentioned above, the agency's standards stipulate that protection against the effects of noise exposure shall be provided when sound levels exceed 90 dBA over an 8-hour exposure period. Protection shall consist of feasible administrative and/or engineering controls. If such controls fail to reduce sound levels to acceptable levels, personal protective equipment shall be provided and used to reduce exposure of the employee. In addition, a hearing conservation program must be instituted by employers whenever employee noise exposure equals or exceeds the action level of an 8-hour time-weighted average sound level of 85 dBA. The hearing conservation program requirements consider periodic area and personal noise monitoring, the performance and evaluation of audiograms, the provisions of hearing protection, annual employee training, and record keeping. The California Environmental Quality Act (CEQA) (PRC Section 21000 et seq.) requires the identification of "significant" environmental impacts and their feasible mitigation.

Section XI of Appendix G to the CEQA Guidelines (CCR Title 14, Appendix G) lists some indicators of potentially significant impacts, which are included below under "Thresholds of Significance."

CEQA does not define a threshold for "significant increase" with respect to noise exposure; however, based on human response and commonly applied industry standards, the following thresholds of significance would be applied to the project, as set forth by the CEQA Guidelines:

- The project causes the ambient noise level measured at the property line of affected uses to increase by 3 dBA in CNEL, to a level at or within the "normally unacceptable" or "clearly unacceptable" noise/land use compatibility category; or
- The project causes any 5-dBA or greater noise increase.

California Noise Control Act of 1973

Sections 46000 through 46080 of the California Health and Safety Code, known as the California Noise Control Act of 1973, declares that excessive noise is a serious hazard to the public health and welfare and that exposure to certain levels of noise can result in physiological, psychological, and economic damage. It also identifies a continuous and increasing bombardment of noise in the urban, suburban, and rural areas. The California Noise Control Act declares that the State of California has a responsibility to protect the health and welfare of its citizens by the control, prevention, and abatement of noise. It is the policy of the state to provide an environment for all Californians free from noise that jeopardizes their health or welfare.

California Noise Insulation Standards

In 1974, the California Commission on Housing and Community Development adopted noise insulation standards for hotels, motels, dormitories, and multifamily residential buildings (Title 24, Part 2, California Code of Regulations [CCR]). Title 24 establishes standards for interior room noise (attributable to outside noise sources). The regulations also specify that acoustical studies must be prepared whenever a multifamily residential building or structure is proposed to be located near an existing or adopted freeway route, expressway, parkway, major street, thoroughfare, rail line, rapid transit line, or industrial noise source, and where such noise source(s) create an exterior CNEL (or L_{dn}) of 60 dBA or greater. Such acoustical analysis must demonstrate that the residence has been designed to limit intruding noise to an interior CNEL (or L_{dn}) of at least 45 dBA (California's Title 24 Noise Standards, Chap. 2-35).

California Department of Transportation

The California Department of Transportations (Caltrans) has oversees the traffic noise analysis protocol for new highway construction and reconstruction projects. This protocol specifies the policies, procedures, and practices that are to be used by agencies that sponsor federal or federal-aid highway projects involving new construction or reconstruction. The NAC specified in the protocol are the same as those specified in 23 CFR 772. The protocol defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA. The protocol also states that a sound level is considered to approach an NAC level when the sound level is within 1 dB of the NAC identified in 23 CFR 772 (e.g., 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not).

Local

Most jurisdictions have unique standards and guidelines regarding noise and nuisance. These are set out in county and municipal codes and general plans. Each noise ordinance or noise element within a municipal/county code will address noise levels that create a nuisance in surrounding communities. Noise ordinances and noise elements occasionally classify different areas within these communities according to zoning standards. Such zones can include residential areas, which are analyzed further according to the density of the population; industrial areas; commercial areas; agricultural areas; and rural areas. The possible adverse effects of construction noise are included within the noise standards. The ambient noise level, type of noise source, distance to the noise source, time of day, duration of the noise, and zoning of the areas are variables that are considered when assessing the adverse effects

of noise on noise-sensitive receptors. Virtually all municipal/county codes categorize noise by dBA. Many standards will use a continuous L_{eq}, CNEL, or L_{dn} to express the sound levels over a given timeframe. The applicable standards for noise levels that apply to this proposed Project are those within the Kern County General Plan and the Metropolitan Bakersfield General Plan.

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan has established land use compatibility criteria for various community land uses. For noise generated by transportation noise sources such as traffic, the Noise Element of the Metropolitan Bakersfield General Plan specifies that residential land uses are compatible with exterior noise levels of up to 60 dB L_{dn} without the need for noise mitigation. The 60 dB L_{dn} noise level is considered an acceptable noise environment for residential outdoor activities. The Metropolitan Bakersfield General Plan may allow an exterior noise level of up to 65 dB L_{dn} provided that available exterior noise level reduction measures have been implemented and interior noise levels satisfy the Metropolitan Bakersfield General Plan's standard.

An interior noise level criterion of 45 dB L_{dn} is specified in the Noise Element for residential land uses exposed to transportation noise sources. The intent of this interior noise standard is to provide a suitable environment for indoor communication and sleep. In addition to the L_{dn} criteria discussed above, the Metropolitan Bakersfield General Plan establishes noise level performance criteria applied to non-transportation noise exposure at noise sensitive uses. Table 4.13-3, *Hourly Noise Level Performance Standards Metropolitan Bakersfield General Plan*, summarizes the hourly standards. The standards are applied to any hour the noise source is operating, and are five dBA more restrictive during the hours of 10:00 PM to 7:00 AM.

Table 4.13-3. Hourly Noise Level Performance Standards Metropolitan Bakersfield General Plan

Maximum Acceptable Noise Level, dBA		
Min./Hr. (Ln)	Day (7:00 AM – 10:00 PM)	Night (10:00 PM – 7:00 AM)
30 (L_{50})	55	50
15 (L_{25})	60	55
5 ($L_{8.3}$)	65	60
1 ($L_{1.7}$)	70	65
0 (L_{max})	75	70

Note: Ln means the percentage of time the noise level is exceeded during an hour. L50 means the level exceeded 50% of the hour, L25 is the level exceeded 25% of the hour, etc.

Source: City of Bakersfield, Metropolitan Bakersfield General Plan, December 11, 2002.

Significance Criteria for Project-Related Noise Level Increases

The potential increase in traffic noise exposure due to the project is a factor in determining significance. Research into the human perception of changes in sound level indicates the following.

- A 3 dB change is barely perceptible,
- A 5 dB change is clearly perceptible, and
- A 10 dB change is perceived as being twice or half as loud.

A limitation of using a single noise level increase value to evaluate noise impacts is that it fails to account for pre-project noise conditions. Table 4.13-4, *Significance of Changes in Cumulative Noise Exposure*, is based on recommendations made in August 1992 by the Federal Interagency Committee on Noise (FICON) to provide guidance in the assessment of changes in ambient noise levels resulting from aircraft operations. The recommendations are based on studies that relate aircraft noise levels to the percentage of persons highly annoyed by the noise. Although the FICON recommendations were specifically developed to assess aircraft noise impacts, it has been asserted that they are applicable to all sources of noise described in terms of cumulative noise exposure metrics such as the L_{dn}. Specifically, they provide good correlation to transportation-related noise sources.

Table 4.13-4. Significance of Changes in Cumulative Noise Exposure

Significance of Changes in Cumulative Noise Exposure	
Noise Level Without Project (L_{dn})	Increase Required for Significant Impact
<60	+5.0 dB or more
60-65 dB	+3.0 dB or more
>65	+1.5 dB or more

Sources: FICON, City of Bakersfield, Metropolitan Bakersfield General Plan, December 11, 2007.

An increase in the traffic noise levels becomes more significant as the ambient noise levels increase. For instance, a significant increase in traffic noise levels is expected to be 1.5 dB when the no-project traffic noise levels exceed 65 dB L_{dn}. However, a significant increase in traffic noise levels is expected to be 5 dB when the no-project traffic noise levels are less than 60 dB L_{dn}. In other words, as ambient noise levels increase, a smaller increase in noise resulting from the project is sufficient to cause significant annoyance.

Generally, a project may have a significant impact on the environment if it will substantially increase the ambient noise levels at adjoining areas or expose people to severe noise exposure. In practice, more specific professional standards have been developed, as discussed above. These standards state that a noise impact may be considered significant if it would generate noise that would conflict with local planning criteria. Additionally, noise impacts associated with the proposed project would be considered significant if they would expose existing noise-sensitive land uses to traffic noise level increases consistent with Table 4.13-4, above.

The Metropolitan Bakersfield General Plan also provides goals, policies and implementation measures in order to reduce noise impacts. Applicable goals relative to the Project site within these elements are listed below in Table 4.13-5, *Metropolitan Bakersfield General Plans Goals and*

Policies for Noise, followed by a brief explanation of how the proposed Project complies with the goals and policies.

Table 4.13-5. Metropolitan Bakersfield General Plan Goals and Policies for Noise

Goals and Policies: Noise Element
Goal #1: "Ensure that residents of the Bakersfield Metropolitan Area are protected from excessive noise and existing moderate levels of noise are maintained."
Goal #2: "Protect the citizens of the Planning area from the harmful effects of exposure to excessive noise, and protect the economic base of the area by preventing the encroachment of incompatible land uses near known noise-producing roadways, industries, railroads, airports and other sources."
Policy #1: "Identify noise-impact areas exposed to existing or projected noise levels exceeding 65 dB CNEL (exterior) or the performance standards described in Table VII-4. The noise exposure contour maps on file at the City of Bakersfield and County of Kern indicate areas where existing and projected noise exposures exceed 65 dB CNEL (exterior) for the major noise sources identified."
Policy #2: "Prohibit new noise-sensitive land uses in noise-impacted areas unless effective mitigation measures are incorporated into project design to acceptable levels. "
Policy #3: Review discretionary industrial, commercial or other noise generating land use projects for compatibility with nearby noise-sensitive land uses. Additionally, the development of new noise generating land uses which are not preempted from local noise regulation will be reviewed if resulting noise levels will exceed the performance standards contained within Table VII-4 in areas containing residential or other noise-sensitive land uses.
Policy #4: Require noise level criteria applied to land uses other than residential or other noise-sensitive uses to be consistent with the recommendations of the California Office of Noise Control (see Figure VII-1(I-4))
Policy #5: "Encourage vegetation and landscaping along roadways and adjacent to other noise sources in order to increase absorption of noise."
Policy #6: "Encourage interjurisdictional coordination and cooperation with regard to noise impact issues. "
Policy #7: "Establish threshold standards for the determination of the existence of cumulative noise impacts that are significant, and will therefore require mitigation to achieve acceptable noise standards that do not exceed the standards contained in this element."

Vibration Standards

The County does not have regulations that define acceptable levels of vibration. One of the most recent reference suggesting vibration standards is the Federal Transit Administration's (FTA) publication concerning noise and vibration impacts assessment from transit activities (U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, April 1995). The term VdB is used by the FTA. To prevent vibration annoyance in residences, a level of 80 VdB or less is suggested to prevent damage to fragile buildings.

Kern County Ordinance

Title 19 Kern County Zoning Ordinance

Section 19.04.252 of the Kern County Zoning Ordinance defines *exterior noise level* as "the noise level near the exterior of a structure usually within fifty (50) feet of the structure."

Section 19.80.030.S (1) restricts noise generated by commercial or industrial uses within 500 feet of a residential use or residential zone district. The commercial or industrial use shall not generate noise that exceeds an average 65 dB L_{dn} between the hours of 7 AM and 10 PM. and shall not generate noise that exceeds 65 dB, or which would result in an increase of 5 dB or more from ambient sound levels, whichever is greater, between the hours of 10 PM and 7 AM. Commercial or industrial facilities that are located in the M-3 zone district are exempt from these noise-generation restrictions.

Title 8 Kern County Health and Safety Ordinance

Chapter 8.36 Noise Control

The Noise Control Ordinance in the Kern County Municipal Ordinance (Section 8.36.020 et seq.) prohibits a variety of nuisance noises. Construction-related noise is regulated by means of a limitation on the hours of construction activity for projects located within 1,000 feet of an occupied residential dwelling. In such cases, construction is prohibited between the hours of 9 PM and 6 AM on weekdays and 9 PM and 8 AM on weekends, except as provided below:

- The development services agency director or his designated representative may for good cause exempt some construction work for a limited time.
- Emergency work is exempt from this section.

4.13.4 Impacts and Mitigation Measures

Methodology

CEQA requires determination of the significance of noise impacts associated with the proposed Project. The process of assessing the significance of noise impacts associated with the proposed Project first involved establishing thresholds at which significant impacts on noise-sensitive uses were considered to occur. Next, noise levels associated with activities related to the proposed Project were predicted and compared to the significance thresholds. Where a noise level is predicted to exceed a threshold, the impact is considered significant. Details about assumptions and methods used to predict noise levels are discussed under each impact type.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Exposes persons to, or generates, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

- Exposes persons to, or generates, excessive ground borne vibration or ground borne noise levels;
- Results in a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project;
- Results in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project;
- Exposes persons residing or working in the Project area to excessive noise levels as identified in the Kern County Airport Land Use Compatibility Plan; and/or
- Exposes people residing or working in the Project area to excessive noise levels due to a private airstrip within the vicinity of the project.

Project Impacts

Impact 4.13-1: The Project Would Result in Exposure of Persons to, or Generation of, Noise Levels in Excess of Standards Established in the Local General Plan or Noise Ordinance or Applicable Standards of Other Agencies.

There are a variety of noise sources associated with the future development of the proposed Project site which have the potential to create noise levels in excess of the 65 dB County noise standards. These noise sources could result in annoyance at existing noise-sensitive receivers surrounding the proposed Project area such as the residential uses to the east. Proposed Project implementation would result in both short-term construction-related and long-term operational-related impacts.

The identified, primary noise-producing elements associated with the proposed Project are increased traffic on the local roadway network, Project-related traffic on new roadways, and industrial operations associated with the proposed Project.

At this time, specific industrial uses on the proposed Project site are not available. As a result, it is not feasible to identify specific noise impacts associated with each of the proposed uses; however, a general discussion and assessment of impacts can be conducted based upon the possible types of uses associated with these land use designations. The following is a discussion of the potentially significant noise sources associated with the possible industrial uses proposed at the Project site.

Industrial Land Uses

The conceptual layout of the proposed Project site includes lots zoned for light and service industrial uses, and highway and general commercial uses. Various uses could be permitted under these uses. The purpose of the proposed M-1 PD (Light Industrial Precise Development Combining) District is to designate areas for wholesale commercial, storage, trucking, assembly-type manufacturing, and other similar industrial uses. The purpose of the proposed M-2 PD (Medium Industrial Precise Development Combining) District is to designate areas for general manufacturing, processing and assembly activities. The purpose of the proposed CH PD (Highway Commercial Precise Development Combining) and C-2 PD (General Commercial Precise Development Combining) is to designate areas for retail uses. Uses may not produce fumes, odor, dust, smoke, gas, or vibrations extending beyond zoning district boundaries.

The production of noise is a result of many industrial processes, even when the best available noise control technology is applied. Noise exposures within industrial facilities are controlled by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) and the California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA), but exterior noise levels may exceed locally acceptable standards. Commercial, recreational, and public service facility activities can also produce noise which affects adjacent sensitive land uses.

These noise sources can be continuous and may contain tonal components which have a potential to annoy individuals who live nearby. In addition, noise generation from fixed noise sources may vary based upon climatic conditions. Noise production due to future project industrial uses may significantly impact nearby existing residential uses on Lamb Avenue west of South Union Avenue (SR-204). The Project-related industrial uses are unknown at this time and would be considered a potentially significant impact.

Increased Traffic Along Roadways and Site Entrance

Future development within the area would result in additional traffic on adjacent roadways, thereby increasing vehicular noise in the vicinity of existing and proposed land uses. To assess noise impacts due to project-related traffic increases on the local roadway network, traffic noise levels were predicted at a representative distance (100 feet from the roadway centerlines) for the 2025, 2025+Project, 2035, and 2035+Project scenarios. Results of the Project-related traffic noise analyses are summarized in Table 4.13-6 *Predicated Traffic Noise Exposure Levels 100 Feet from Roadway Centerlines*.

Table 4.13-6 Predicated Traffic Noise Exposure Levels 100 Feet from Roadway Centerlines

Roadway	Segment	Ldn, dB (Change, dB)	
		2025+ Project	2035+Project
Panama Lane	West of 99 SB Ramp	72 (+2)*	72 (+2) *
	99 SB Ramp to 99 NB Ramp	69 (+2) *	70 (+3) *
	99 NB Ramp to South H St.	70 (+1)	71 (+2) *
	South H St. to South Union Ave.	68 (+3) *	69 (+4) *
	South Union Ave. to Cottonwood Rd.	67 (+3) *	68 (+4) *
	East of Cottonwood Rd.	66 (+2)	66 (+2)
Hosking Ave.	West of Hughes Ln.	60 (+5) *	63 (+8) *
	Hughes Ln. to 99 SB Ramp	61 (+7) *	65 (+11) *
	99 SB Ramp to 99 NB Ramp	61 (+7) *	64 (+10) *
	99 NB Ramp to South H St.	61 (+7) *	65 (+11) *
	South H St. to South Union Ave.	59 (+3)	61 (+5) *
	South Union Ave. to Cottonwood Rd.	49 (+19) *	57 (+27) *

Table 4.13-6 Predicated Traffic Noise Exposure Levels 100 Feet from Roadway Centerlines

Roadway	Segment	Ldn, dB (Change, dB)	
		2025+ Project	2035+Project
Taft Hwy.	West of Wible Rd.	67 (+4) *	69 (+6) *
	Wible Rd. to Compangnoni St.	67 (+5) *	69 (+7) *
	Compagnoni St. to 99 NB Ramp	68 (+3) *	70 (+5) *
	99 NB Ramp to South H St. (2015)	70 (+1)	70 (+1)
	South H St. to South Union Ave.	71 (+2) *	72 (+3) *
	South Union Ave. to Cottonwood Rd.	70 (+2) *	70 (+2) *
	East of Cottonwood Rd.	70 (+2) *	70 (+2) *
Di Giorgio Rd.	West of Chevalier Rd. (Entrance #1)	n/a	46 (n/a)
	Chevalier Rd. (Entrance #1) to South Union Ave.	n/a	58 (n/a)
	South Union Ave. to Cottonwood Rd.	50 (+17) *	53 (+20) *
	East of Cottonwood Rd.	52 (+6) *	49 (+3)
Curnow Rd.	West of South Union Ave.	52 (+8) *	55 (+11) *
	South Union Ave. to Cottonwood Rd.	47 (+9) *	47 (+9)
Houghton Rd.	West of Stine Rd.	59 (-1)	59 (-1)
Buena Vista Blvd.	Stine Rd. to Wible Rd.	58 (0)	58 (0)
	Wible Rd. to South H St.	58 (+5) *	58 (+5) *
	South H St. to 99 SB Ramp	62 (+4)	62 (+4)
	99 SB Ramp to 99 NB Ramp	70 (+8) *	70 (+8) *
	99 NB Ramp to Entrance #7	73 (+9) *	74 (+10) *
	Entrance #7 to Chevalier Rd. (Entrance #6)	73 (+9) *	73 (+9) *
	Chevalier Rd. (Entrance #6) to Entrance #5	71 (+7) *	71 (+7) *
	Entrance #5 to South Union Ave.	70 (+6) *	70 (+6) *
	South Union Ave. to Cottonwood Rd.	67 (+2) *	67 (+2) *
	Cottonwood Rd. to Adobe Rd.	66 (+1)	67 (+2) *
	East of Adobe Rd.	66 (+2)	66 (+2)
Shafter Rd.	Chevalier Rd. to South Union Ave.	46 (+7) *	47 (+8) *
	East of South Union Ave.	47 (+4)	47 (+4)
Bear Mountain Blvd.	West of Costajo Rd.	62 (+2)	63 (+3) *
	Costajo Rd. to 99 NB Ramp	68 (+1)	68 (+1)
	99 NB Ramp o South Union Ave.	70 (+1)	71 (+2) *
	East of South Union Ave.	71 (+2) *	71 (+2) *
Stine Road	North of Houghton Rd.	49 (-1)	48 (-2)
	South of Houghton Rd.	49 (+1)	49 (+1)
Wible Road	North of Taft Hwy.	57 (+2)	58 (+3)
	Taft Hwy to Houghton Rd.	54 (0)	53 (-1)
	South of Houghton Rd.	52 (+3)	53 (+4)
Hughes Lane	South of Hosking Ave.	57 (+3)	59 (+5) *
Compangnoni St.	South of Taft Hwy.	51 (+1)	52 (+2)
South H St.	North of Panama Ln.	62 (+3)	64 (+5) *

Table 4.13-6 Predicated Traffic Noise Exposure Levels 100 Feet from Roadway Centerlines

Roadway	Segment	Ldn, dB (Change, dB)	
		2025+ Project	2035+Project
	Panama Ln. to Hosking Ave.	64 (+2)	65 (+3) *
	Hosking Ave. to Taft Hwy.	61 (+4) *	63 (+6) *
	South of Taft Hwy.	53 (+7) *	56 (+10) *
	North of Houghton Rd. (2015)	50 (+2)	50 (+2)
	South of Houghton Rd. (2015)	51 (+2)	51 (+2)
Chevalier Rd.	Di Giorgio Rd. to Houghton Rd.	n/a	62 (n/a)
	Houghton Rd. to Shafter Rd. (2015)	49 (+9) *	49 (+9) *
South Union Ave.	North of Panama Ln.	72 (+2) *	73 (+3) *
	Panama Ln. to Hosking Ave.	70 (+3) *	72 (+5) *
	Hosking Ave. to Taft Hwy.	68 (+4) *	70 (+6) *
	Taft Hwy. to Curnow Rd.	67 (+7) *	69 (+9) *
	Curnow Rd. to Di Giorgio Rd.	68 (+9) *	69 (+10) *
	Di Giorgio Rd. to Lamb Ave. (Entrance #2)	67 (+8) *	68 (+9) *
	Lamb. Ave. (Entrance #2) to Entrance #3	68 (+9) *	69 (+10) *
	Entrance #3 to Mugsy Ave. (Entrance #4)	68 (+9) *	69 (+10) *
	Mugsy Ave. (Entrance #4) to Houghton Rd.	69 (+10) *	70 (+11) *
	Houghton Rd. to Shafter Rd.	64 (+6) *	66 (+8) *
	Shafter Rd. to Bear Mountain Blvd.	63 (+6) *	65 (+8) *
	South of Bear Mountain Blvd.	61 (+6) *	63 (+8) *
Cottonwood Rd.	North of Panama Ln.	59 (+6) *	61 (+8) *
	Panama Ln. to Hosking Ave.	53 (+11) *	57 (+15) *
	Hosking Ave. to Taft Hwy.	52 (+10) *	55 (+13) *
	Taft Hwy. to Curnow Rd.	52 (+5) *	52 (+5) *
	Curnow Rd. to Di Giorgio Rd.	51 (+4)	51 (+4)
	Di Giorgio Rd. to Houghton Rd.	47 (+11) *	49 (+13) *
Adobe Rd.	North of Buena Vista Blvd.	46 (+10) *	46 (+10) *
	South of Buena Vista Blvd. (2015)	52 (+1)	52 (+1)

Sources: McIntosh & Associates 2016, Bollard Acoustical Consultants, Inc. 2017.

* Represent significant noise level impacts. Cumulative noise impact was assessed based on application of the Table 5 criteria to the future plus project increase relative to the existing condition. Project-related traffic noise impact was assessed based on the project's contribution to the cumulative impact or application of the Table 5 criteria to the project-related increase relative to the no project condition. Please see a more detailed presentation of the significance methodology presented in the Regulatory Setting section. Where a cumulative noise impact or project-related noise impact was identified, the roadway segment in question was inspected in order to identify any existing noise-sensitive land uses.

Based on the information presented in Table 4.13-6, significant Project-related traffic noise exposure would be expected along parts of Panama Lane, Hosking Avenue, Taft Highway, Di Giorgio Road, Curnow Road, Houghton Road/Buena Vista Boulevard, Shafter Road, Bear Mountain Boulevard, Hughes Lane, South H Street, Chevalier Road, South Union Avenue (SR-204), Cottonwood Road, and Adobe Road in the proposed Project vicinity.

Chevalier Road between Houghton Road and Di Giorgio Road, Di Giorgio Road west of South Union Avenue, and Lamb Avenue west of South Union Avenue (SR-204) would be constructed as part of the proposed Project. With the exception of a single existing residence along Lamb Avenue, west of South Union Avenue, there are no current noise-sensitive uses in the immediate project vicinity or near the future Chevalier Road, Di Giorgio Road, and Mugsy Avenue on the proposed Project site. Future (2025 and 2035) traffic noise exposure at the home on Lamb Avenue west of South Union Avenue (SR-204) would be approximately 68 and 69 dB L_{dn}, respectively. This level is above the existing measured ambient noise level of 61 dB L_{dn} and would be expected to add significantly to the overall noise environment at this location based on the established significance criteria. There are no current noise-sensitive uses near the future Chevalier Road and Di Giorgio Road on the proposed Project site.

On portions of Di Giorgio Road, Chevalier Road, Cottonwood Road, Shafter Road, Kaiser Lane, and Adobe Road, Project-related traffic noise exposure increases from their respective roadways would generally be considered significant if not for the existing ambient noise exposure dominated by SR-99. In these cases, existing ambient noise exposure in the proposed Project area are assumed to be no less than 53 dB L_{dn} (conservatively 10 dB less than the measured ambient noise exposure near the east side of the proposed Project site), and future (2025 and 2035) project-related traffic noise exposures would not be expected to add significantly to the noise environments.

As shown in Table 4.13-6, future (2025 and 2035) Project-related traffic noise exposure increases would be expected to exceed the applicable significance criterion (+1.5 dB) along sections of Panama Lane, Hosking Avenue, Taft Highway, Houghton Road/Buena Vista Boulevard, Bear Mountain Boulevard, and South Union Avenue (SR-204) in the proposed Project vicinity. There are no noise sensitive land uses adjacent to Houghton Road between SR-99 and Project Entrance #3, and South Union Avenue between Lamb Avenue and Mugsy Avenue. Therefore, there are no Project-related noise impacts along these roadway segments.

As shown in Table 4.13-6, traffic noise impacts would be expected along roadway segments where both significant traffic noise increases were identified and where existing noise-sensitive land uses along those roadway segments were identified. Depending on the proximity of a particular roadway segment to SR-99, a noise impact may not necessarily materialize. The roadway segments closer to SR-99 would have a higher background ambient noise level environment which may mask the significant increases in traffic noise levels identified along some individual roadways. The farther away a roadway segment is from SR-99, the more likely it would be that the background ambient noise level would be low enough that such masking would not be significant, and the noise impact would occur.

Significant project-related traffic noise level increases are assumed along South Union Avenue (SR-204) between Panama Lane and Lamb Avenue where residential uses currently exist. In addition, the proposed Project would generate increased traffic on local area roadways that exceed thresholds. Project-related traffic noise levels impacts would also be expected along roadway segments where both significant increases were identified and where existing noise-sensitive land uses along those roadway segments were identified. These impacts would be significant.

Mitigation Measures

MM 4.13-1: **Acoustical Analysis.** Prior to the submittal of any Precise Development Plan or modification to an approved Master Precise Development Plan:

1. The project proponent shall be required to prepare an acoustical analysis to ensure that all appropriate noise control measures are incorporated in to the proposed project design so as to mitigate any noise impacts to off-site sensitive uses. Such noise control measures may include, but are not limited to: noise barrier use, site redesign, silencers, partial or complete enclosures of critical equipment, etc.

2. Noise impacts shall be evaluated by the Planning and Natural Resources Department during the Precise Development Plan review process.

MM 4.13-2: **Noise Levels.** The following measures are recommended to reduce short-term noise levels associated with project construction:

1. Construction activities at the project site shall comply with the hourly restrictions for noise-generating construction activities, as specified in the Kern County Noise Ordinance (Municipal Ordinance Code 8.36.020). Accordingly, construction activities shall be prohibited between the hours of 9:00 PM to 6:00 AM on weekdays, and between 9:00 PM to 8:00 AM on weekends. These hourly limitations shall not apply to activities where hourly limitations would result in increased safety risk to workers or the public.

2. Equipment staging and laydown areas shall be located at the furthest practical distance from nearby residential land uses. To the extent possible, staging and laydown areas should be located at least 500 feet of existing residential dwellings.

3. Where feasible construction equipment shall be fitted with approved noise-reduction features such as mufflers, baffles, and engine shrouds that are no less effective than those originally installed by the manufacturer.

4. Haul trucks shall not be allowed to idle for periods greater than five minutes, except as needed to perform a specified function (e.g., concrete mixing).

5. On-site vehicle speeds shall be limited to 15 miles per hour, or less (except in cases of emergency).

6. Back-up beepers for all construction equipment and vehicles shall be broadband sound alarms or adjusted to the lowest noise levels possible, provided that the Occupational Safety and Health Administration and California Division of Occupational Safety and Health's safety requirements are not violated. On vehicles where back-up beepers are not available, alternative safety measures such as escorts and spotters shall be employed.

MM 4.13-3: **Noise Disturbance Coordinator.** Prior to the issuance of grading permits, a "Noise Disturbance Coordinator" shall be established. The project operator shall submit evidence of methods of implementation and shall continuously comply with the following during construction:

1. The disturbance coordinator shall be responsible for responding to any local complaints about construction noise.

2. The disturbance coordinator shall determine the cause of the noise complaint (e.g., starting to early, bad muffler, etc.) and shall be required to implement reasonable measures such that the complaint is resolved.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

Impact 4.13-2: The Project Would Expose Persons to or Generation of Excessive Ground Borne Vibration or Ground Borne Noise Levels.

The types of construction vibration impacts include human annoyance and building structural damage. Human annoyance occurs when construction vibration rises significantly above the threshold of perception. Building damage can take the form of cosmetic or structural.

Construction activities such as blasting, pile driving, pavement breaking, demolition, diesel locomotives, and rail-car coupling can produce vibration that may be felt by adjacent uses. It is not anticipated that construction or operation of the proposed Project would require the use of equipment that is known to generate substantial construction vibration levels, however, given the uncertainty as to the specific use, impacts are considered potentially significant.

Mitigation Measures

Implement Mitigation Measure MM 4.13-2, above.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

Impact 4.13-3: The Project Would Create a Substantial Permanent Increase in Ambient Noise Levels in the Project Vicinity Above Levels Existing Without the Project.

At this time, specific industrial uses on the Project site are not available. As a result, it is not feasible to identify specific noise impacts associated with each of the proposed uses; however, as identified in Impact 4.13-1, general discussion and assessment of impacts can be conducted based upon the possible types of uses associated with these land use designations.

Although a specific industrial use is not proposed at this time, previous discussion has indicated that the Project site will be subject to the existing Metropolitan Bakersfield General Plan thresholds of significance for noise evaluation and attenuation. The proposed Project is located in an area of similar

type industrial uses as those proposed. With implementation, impacts are not expected to expose people to a substantial permanent increase in the ambient noise level in the project vicinity.

Mitigation Measures

Implement Mitigation Measures MM 4.13-2, above.

MM 4.13-4: **Noise Reduction Methods.** The following notes shall be placed on all grading and building permits issued for the project site:

1. Construction noise reduction methods such as shutting off idling equipment, installing temporary acoustic barriers around stationary construction noise sources, maximizing the distance between construction equipment staging areas and occupied residential areas, and use of electric air compressors and similar power tools, rather than diesel equipment, shall be used where feasible.

2. During construction, stationary construction equipment shall be placed such that emitted noise is directed away from sensitive noise receivers.

3. All equipment shall be fitted with factory equipped mufflers, and be in good working condition. Construction contracts shall specify that all construction equipment, fixed or mobile, shall be equipped with properly operating and maintained mufflers and other state required noise attenuation devices.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.13-4: The Project Would Create a Substantial Temporary or Periodic Increase in Ambient Noise Levels in the Project Vicinity Above Levels Existing Without the Project.

Short-term noise impacts would be associated with the excavation and grading activities during the construction phase. Construction activities would result in short-term noise levels higher than existing ambient noise levels within the proposed Project area. Noise would also be generated during the construction phase(s) of the proposed Project by increased truck traffic on local area roadways. A significant Project-generated noise source would be truck traffic associated with the transport of heavy materials and equipment to and from the construction site.

During the construction phase(s) of the proposed Project, noise from building equipment would be expected to add to the noise environment in the immediate vicinity of the proposed Project. Activities involved in construction would likely generate maximum noise levels, of 77 to 85 dB at a distance of 50 feet. Construction activities would be temporary in nature and are anticipated to occur during normal daytime working hours (7 AM to 6 PM). Although, the noise generated by equipment and experienced at surrounding uses during construction would vary hourly, daily and weekly, due to the number and types of equipment used, existing residences near the proposed Project site would likely be affected by this noise.

Groundborne noise and other types of construction-related noise impacts would typically occur during the initial site preparation, which can create the highest levels of noise; but is also generally the shortest of all construction phases. High groundborne noise levels and other miscellaneous noise levels can be created by the operation of heavy-duty trucks, backhoes, bulldozers, excavators, front-end loaders, compactors, scrapers and other heavy-duty construction equipment. Operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three to four minutes at lower power settings. Other primary sources of acoustical disturbance would be random incidents, which would last less than one minute (such as dropping large pieces of equipment or the hydraulic movement of machinery lifts).

Typically, the site preparation phase, which includes excavation and grading of the site and infrastructure construction, tends to generate the highest noise levels, because the noisiest construction equipment is earthmoving equipment. Earthmoving includes excavation machinery such as back fillers, bulldozers, excavators/front-end loaders and earthmoving equipment (i.e., compactors, scrapers and graders).

Table 4.13-7, *Typical Construction Noise Levels*, indicates the characteristics of specific types of construction equipment. As indicated in Table 4.13-7, noise levels generated by heavy construction equipment could range from 77 dB to 85 dB at 50 feet. The noise generated by equipment and experienced at surrounding uses during construction would vary hourly, daily, and weekly, due to the number and types of equipment used; however, construction activities would be temporary and would likely occur during daytime working hours.

Table 4.13-7. Typical Construction Noise Levels

Type of Equipment	Maximum Equipment Noise Level dBA, CNEL at 50 feet
Backhoe	78
Concrete Mixer Truck	79
Dump Truck	77
Front End Loader	79
Pneumatic Tools	85
Air Compressor	78

Source: Bollard Acoustical Consultants, Inc. 2017.

During construction and grading activities, all equipment would tend to be operated in a localized area. Thus, at any given moment, there would be a combined sound level from multiple pieces of equipment. However, the tendency is for the use to be sequential. For example, the haul trucks dump the dirt, followed by the loaders, bulldozers and graders, which push it around. These activities are then followed by the compactors and water trucks that pass over the area periodically. The period of time for each operation would vary with graders and compactors in an area for the longest period of time.

During the construction of the proposed Project, construction activities have the potential to impacts noise sensitive land uses in the immediate vicinity. Construction noise is usually not considered to be

significant if construction noise limits to the daytime hours (7:00 AM to 10:00 PM), if extraordinary noise-producing activities (e.g., pile driving) are not anticipated, and if construction equipment is adequately maintained and muffled and would not result in an exceedance of noise standards identified in the Metropolitan Bakersfield General Plan. Implementation of mitigation measures would ensure compliance with the Metropolitan Bakersfield General Plan and County's noise standards. As a result, the proposed Project would result in less than significant construction-related noise impacts.

Mitigation Measures

Implementation of Mitigation Measure MM 4.13-2, above.

MM 4.13-5: **Written Notice to the Public.** Prior to commencement of any on-site construction activities (i.e., fence construction, mobilization of construction equipment, initial grading, etc.) the project proponent shall provide written notice to the public through mailing a notice.

1. The mailing notice shall be to all residences within 1,000 feet of the project site, 15 days or less prior to construction activities. The notices shall include: The construction schedule, telephone number and email address where complaints and questions can be registered with the noise disturbance coordinator.

2. A minimum of one sign, legible at a distance of 50 feet, shall be posted at the construction site or adjacent to the nearest public access to the main construction entrance throughout construction activities that shall provide the construction schedule (updated as needed) and a telephone number where noise complaints can be registered with the noise disturbance coordinator.

3. Documentation the public notice has been sent and the sign has been posted shall be provided to the Kern County Planning and Natural Resources Department.

Level of Significance after Mitigation

Impacts would be significant and unavoidable.

Impact 4.13-5: The Project is Not Located Within an Airport Land Use Plan or, Where Such a Plan Has Not Been Adopted, Within Two Miles of a Public Airport or Public Use Airport, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.

The proposed Project is not located within any area subject to the land use restrictions of the adopted Kern County Airport Land Use Compatibility Plan. The closest public airport is Bakersfield Municipal Airport, located approximately five (5) miles northeast of the proposed Project site. However, no sensitive receptors would be constructed as part of the proposed Project, and the

Bakersfield Municipal Airport would not expose the Project to excessive noise levels. Airport noise would be considered less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.13-6: The Project is Within the Vicinity of a Private Airstrip, Would the Project Expose People Residing or Working in the Project Area to Excessive Noise Levels.

Refer to Impact 4.13-5, above. As previously mentioned, the proposed Project is not located in within any area subject to the land use restrictions of the adopted Kern County Airport Land Use Compatibility Plan. Costerisan Farms Airport, a private airstrip, is located approximately two (2) miles northwest of proposed Project site; however, this airport does not generate significant daily flights. Activities at the airport would not significantly impact the proposed Project. Impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Noise by definition is a localized phenomenon, and drastically reduces as distance from the source increases. Consequently, only projects and growth due to occur in the general vicinity of the proposed Project site would contribute to cumulative noise impacts. Cumulative noise impact was assessed based on application of the Table 4.13-3 criteria to the future plus project increase relative to the existing condition. Project-related traffic noise impact was assessed based on the project's contribution to the cumulative impact or application of the Table 4.13-3 criteria to the project-related increase relative to the no project condition.

Cumulative Construction Noise

With regard to the exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies (Impact 4.13-1) and with regard to the project resulting in a substantial temporary or periodic increase (e.g. during construction) in ambient noise levels in the project vicinity above levels existing without the project (4.13-4), construction noise impacts are localized in nature because they are limited to the construction site where construction equipment is operating. As discussed under Impact 4.13-1, noise levels from typical construction equipment range from 78 dBA to 85 dBA L_{eq} at 50 feet from the

source. Although other projects may be constructed in the vicinity at the same time as the proposed Project, construction noise would temporary and all projects would be required to conform to all applicable noise reduction standards. However, the proposed Project could combine with past, present, and reasonably foreseeable future projects. Impacts are potentially significant and mitigation measures are required.

Groundborne Vibration

With regard to exposing persons to, or generation of, excessive ground borne vibration or ground borne noise levels (Impact 4.13-2), the proposed Project would not result in substantial levels of ground-borne vibration at sensitive receptors. As described above, major construction activity within 200 feet of a noise-sensitive land use may be potentially disruptive to sensitive operations. In order to result in a cumulative vibration impact, major construction activities would have to be located within 200 feet of another project. Due to the localized nature of vibration impacts and the fact that all construction would not occur at the same time or at the same location, cumulative development in the surrounding Kern County would not result in the exposure of people to or the generation of excessive groundborne vibration and/or noise levels. Therefore, when considered cumulatively with the construction of the other projects in the surrounding area, it is not anticipated that the project would contribute to substantial groundborne vibration levels at sensitive receptors. Therefore, impacts of the proposed Project would not be cumulatively considerable.

Cumulative Operation Impacts

Roadway Noise Exposure

With regard to the exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies (Impact 4.13-1) and with regard to increasing ambient noise levels with respect to increased traffic noise in the proposed Project vicinity above levels existing without the Project (4.13-4), along with future regional growth, and other projects to be developed within the proposed project vicinity would result in increases in traffic that would cumulatively increase traffic noise at 15 roadway segments. These roadways include: Panama Lane, Hosking Avenue, Taft Highway, Di Giorgio Road, Curnow Road, Houghton Road/Buena Vista Boulevard, Shafter Road, Bear Mountain Boulevard, Hughes Lane, South H Street, Chevalier Road, South Union Avenue (SR-204), Cottonwood Road, and Adobe Road.

With regard to the residential land uses, the residence located along Lamb Avenue, west of South Union Avenue (SR-204), would be subject to cumulative impacts associated with roadway noise from traffic associated with past, present, and reasonably foreseeable projects. Therefore, the proposed Project would have a significant cumulative impact in this regard.

Noise Generation

With regard to the generation of noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies (Impact 4.13-3) and with regard to increasing ambient noise levels with respect to development operations in the Project vicinity above levels existing without the proposed Project, the proposed Project's operational impacts would be less

than significant with the implementation of Mitigation Measures. The implementation of reasonably foreseeable development projects would have the potential to increase ambient noise from new operational noise sources (such as HVAC equipment, parking lots, and truck deliveries) and by increasing human activity throughout the project sites and surrounding areas. Mechanical HVAC equipment located on the ground or on rooftops of new buildings have the potential to generate noise levels that exceed 65 dBA within an approximately 100-foot radius of the equipment. Additionally, commercial development would have the potential to result in noise levels above 65 dBA CNEL within approximately 70 feet of the source. Noise sources from parking lots typically range from about 30 to 66 dBA at a distance of 100 feet. Therefore, the project, in combination with other reasonably foreseeable development project, would have the potential to result in ambient noise levels that exceed 65 dBA CNEL.

In general, the noise levels generated by commercial, industrial and recreational facility operations would not exceed 65 dBA at a distance of 100 feet from each individual source. Thus, impacts from operational noise would be site-specific in nature and reasonably foreseeable development projects would be required to conform to policies in the MBGP and Kern County Zoning Ordinance to minimize exposure to excessive noise levels. In addition, each individual project is required to undergo site-specific analysis to determine individual noise impacts and provide mitigation measures as appropriate. The proposed Project would have the potential to combine with reasonably foreseeable projects in the vicinity to increase ambient noise levels; however, the proposed Project operational noise impacts would be mitigated to a less than significance level with the incorporation of the above measures. It is expected that through conformance with adopted policies and requirements to reduce noise, and project specific mitigation; impacts of the proposed Project, in combination with reasonably foreseeable nearby projects, cumulative impacts would be reduced to less than significant levels.

Private or Public Airstrip Noise

With regard to the project exposing people residing or working in the project area to excessive noise levels from a private or public airstrip (Impact 4.13-5), project impacts would be less than significant; however, the project would result in a greater number of people working in the project site and potentially being exposed to airstrip noise from Costerisan Farms Airport, a private airstrip, located approximately two (2) miles northwest of proposed. As stated above, this airport does not generate significant daily flights and activities at the airport would not significantly impact the proposed Project. As such, these impacts would not combine with impacts from past, present, or reasonably foreseeable projects to make a considerable contribution to a significant cumulative impact. Impacts would be less than significant, and no mitigation measures would be required.

Mitigation Measures

Implement Mitigation Measures MM 4.13-1 through MM 4.13-5 above.

Level of Significance after Mitigation

Cumulative impacts would be significant and unavoidable.

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Section 4.14

Population and Housing

Section 4.14
Population and Housing

4.14.1 Introduction

This section examines the impacts of the proposed Project on population, housing, and employment in the area. This section also outlines the existing population and housing in the area, as well as projected population growth, future housing demands, and employment growth in Kern County. Information in this section is based on data from the Kern Council of Governments (Kern COG), including its Regional Housing Needs Allocation Plan (2014); the Kern County Housing Element 2015-2023 (December 2016); the U.S. Census Bureau; and California Department of Finance (DOF) demographic information.

4.14.2 Environmental Setting

Population

According to the DOF, the population in Kern County, including incorporated areas, was estimated to be 916,464 persons as of January 1, 2019 (California Department of Finance [DOF] 2019). In 2018 the population was approximately 906,563, which equates to a one-year increase of approximately 9,901 residents, or a 1.09 percent increase (DOF 2018a). As of January 1, 2019, approximately 318,006 persons (or approximately 34.7 percent) resided within the unincorporated area of Kern County (DOF 2019). The 2019 population within the unincorporated area of Kern County represents an increase of 2,531 residents, over the 2018 population of 315,475 (DOF 2018a). According to the DOF's projections, the County's population is anticipated to increase to 996,506 persons by the year 2025 and 1,214,656 persons in 2040 (DOF 2018).

Existing and Projected Housing

Kern County's housing supply totaled 290,706 dwelling units in 2014 and 299,674 dwelling units in 2019. This represents an increase in housing supply of approximately 3.0 percent (8,968 units). The residential vacancy rate, a translation of the number of unoccupied housing units on the market, is a good indicator of the balance between housing supply and demand in the community. Kern County's vacancy rate is approximately 10.7 percent as of January 1, 2019. The average number of persons per household in the County is 3.95 (DOF 2019).

The DOF estimates that 114,973 dwelling units were located within the unincorporated area of Kern County as of January 1, 2019. These units represent approximately 38.3 percent of the total number of dwelling units within Kern County. The average number of persons per household in the unincorporated area of Kern County was 2.74. Approximately 14.5 percent of the dwelling units within the area were vacant.

Employment

As of March 2019, Kern County had a labor force of 388,700 persons (Employment Development Department [EDD] 2019a). An estimated 39,300 people (approximately 10.1 percent) of the labor force was unemployed. In 2012, Kern County had a labor force of 391,900 persons and approximately 51,500 persons (approximately 13.1 percent) of the labor force were unemployed (EDD 2019a). The unemployment rate as of March 2019 is lower than the estimate seven years ago. Kern County's current unemployment rate is higher than California's rate (4.6 percent) and higher than the national rate (3.8 percent) for April 2019 (USDL 2019). The predominant industries for Kern County for employment growth were not available, but information for the Bakersfield MSA is. Within this area software developers, database administrators, web developers, personal care aides, and helpers, brick masons and tile setters have the highest degree of job growth. In 2017 the government industry accounted for approximately 21.1 percent of Kern County's employment as of April 2019 (EDD 2019c).

4.14.3 Regulatory Setting

State

State law requires each city and county to adopt a general plan for future growth. This plan must include a housing element that identifies housing needs for all economic segments and provides opportunities for housing development to meet that need. At the state level, HCD estimates the relative share of California's projected population growth that would occur in each county in the state based on DOF population projections and historic growth trends. Where there is a regional council of governments, as in Kern County, HCD provides the regional housing need to the council. The council then assigns a share of the regional housing need to each of its cities and counties. The process of assigning shares provides cities and counties the opportunity to comment on the proposed allocations. HCD oversees the process to ensure that the council of governments distributes its share of the state's projected housing need.

Each city and county must update its general plan housing element on a regular basis (generally, every 5 years). Among other things, the housing element must incorporate policies and identify potential sites that would accommodate the city's share of the regional housing need. Before adopting an update to its housing element, the city or county must submit the draft to HCD for review. HCD will advise the local jurisdiction whether its housing element complies with the provisions of California Housing Element Law.

The councils of governments are required to assign regional housing shares to the cities and counties within their region on a similar 5-year schedule. At the beginning of each cycle, HCD provides population projections to the councils of governments, who then allocate shares to their cities and counties. The shares of the regional need are allocated before the end of the cycle so that the cities and counties can amend their housing elements by the deadline.

Local

Kern County Housing Element 2015-2023

The Kern County Housing Element (Kern County Planning Department 2016) covers only the unincorporated portions of the Metropolitan Bakersfield General Plan and the Kern County General Plan. The City of Bakersfield has a separate housing element. The housing element is one of the seven mandated elements of the local general plan. Housing element law, enacted in 1969, mandates that local governments adequately plan to meet the existing and projected housing needs of all economic segments of the community. The law acknowledges that, in order for the private market to adequately address housing needs and demand, local governments must adopt land use plans and regulatory systems that provide opportunities for, and do not unduly constrain, housing development. As a result, housing policy in the state rests largely upon the effective implementation of local general plans and, in particular, local housing elements. Housing element law also requires the Department of Housing and Community Development (HCD) to review local housing elements for compliance with State law and to report its written findings to the local government. State law requires the Kern County Housing Element be updated regularly; the current 2015-2023 Housing Element Update was adopted by the Kern County Board of Supervisors on April 16, 2016 and approved by the State.

Kern Council of Governments (Kern COG)

Kern COG is an association of city and county governments created to address regional transportation issues while protecting the integrity and autonomy of each jurisdiction. Its member agencies include the County and the 11 incorporated cities within Kern County.

Under California Housing Element Law, Kern COG is the regional council of governments responsible for allocating the regional housing need to the County. Kern COG adopted a Regional Housing Needs Allocation Plan (RHAP) in June 2014 that establishes housing production goals for each jurisdiction within the region for the period between 2013 and 2023.

Future housing needs refer to the projected amount of housing a community is required to plan for during a specified planning period. California's Housing and Community Development Department provides each regional council of governments its share of the statewide housing need. In turn, all councils of governments are required by State law to determine the portion allocated to each jurisdiction within the region. This allocation process is known as the RHAP in the Kern COG region.

The RHAP determines housing needs with a special emphasis on ensuring adequate housing for persons in the very low, low, and moderate income ranges. This assessment allows communities to anticipate growth so that they can grow in a way that enhances quality of life; improves access to jobs, transportation, and housing; and does not adversely affect the environment. Kern COG has determined the total number of units needed in the County by 2023 (the 11-year projection period) is 67,675. For Bakersfield, the number of units is 36,290, or 53.6 percent of the County total, and for Unincorporated County, the number of units is 21,583, or 31.8 percent of the County total, by 2023.

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan lists the issues, goals, policies, and implementation measures related to population and housing in the County, as contained in the Land Use Element.

Project implementation would be guided in part by the goals, policies, and implementation programs, which are presented in Table 4.14-1, *Metropolitan Bakersfield General Plan Goals and Policies for Population and Housing.*

Table 4.14-1. Metropolitan Bakersfield General Plan Goals and Policies for Population and Housing

Goals and Policies: Land Use Element
Goal #3: Accommodate new development which provides a full mix of uses to support its population.
Goal #3: Accommodate new development which is compatible with and complements existing land uses.
Goal #4: Accommodate new development which channels land uses in phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.
Policy #3: Ensure that residential uses are located in proximity to commercial services, employment centers, public services, transportation routes, and recreational and cultural resources.
Policy #15: Allow for the development of a variety of commercial centers/corridors which are differentiated by their function, intended users and level of intensity, including convenience centers serving local residential neighborhoods, sub-regional centers which serve groupings of neighborhoods, and major regional centers which serve the planning area and surrounding areas.
Policy #16: Allow for the development of a variety of commercial uses, including those which serve residents (groceries, clothing, etc.), highway users, and tourists-visitors.
Policy #34: Provide for the clustering of new industrial development adjacent to existing industrial uses and along major transportation corridors.
Policy #76: Provide for a mix of land uses which meets the diverse needs of residents; offers a variety of employment opportunities; capitalizes, enhances, and expands upon existing physical and economic assets; and allows for the capture of regional growth.
Policy #79: Provide for an orderly outward expansion of new "urban" development (any commercial, industrial, and residential development having a density greater than one unit per acre) so that it maintains continuity of existing development, allows for the incremental expansion of infrastructure and public services, minimizes impacts on natural environmental resources, and provides a high-quality environment for living and business.

4.14.4 Impacts and Mitigation Measures

Methodology

The potential impacts to population and housing are based on qualitative and quantitative analyses of the proposed Project's related increases in population and housing compared to planned growth estimates and population projections for the Kern County and the Southern San Joaquin Valley area.

Thresholds of Significance

Significance Criteria

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Induce substantial population growth in an area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure);
- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere; and/or
- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere.

The lead agency determined in the NOP/IS (see Appendix A) that the following environmental issues areas resulted in no impact and were scoped out of requiring further review in this Recirculated Draft EIR. Please refer to Appendix A of this Recirculated Draft EIR for a copy of the NOP/IS and additional information regarding the following impacts:

- Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere.

The proposed Project includes approximately 314.30 acres of agricultural land. A steel storage building associated with agricultural activities is located in the eastern portion of the Project site, near South Union Avenue (SR-204). Implementation of the proposed Project would not require the removal or displacement residential structures; therefore, no housing would be displaced, and the project would not require construction of replacement housing elsewhere. No impact would occur.

- Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere.

The proposed Project includes approximately 314.30 acres of agricultural land. A steel storage building associated with agricultural activities is located in the eastern portion of the Project site, near South Union Avenue (SR-204). Implementation of the proposed Project would not require the removal or displacement residential structures or their inhabitants; therefore, no people would be displaced, and the project would not require construction of replacement housing elsewhere. No impact would occur.

Project Impacts

Impact 4.14-1: The Project Would Directly Induce Substantial Population Growth.

The Project proposes the future development of industrial and commercial uses on-site, which would not result in an increase in local population and housing units when compared to current conditions. The proposed Project includes a General Plan Amendment (GPA) to modify the existing Metropolitan Bakersfield General Plan land use designations and a Zone Change (ZCC) for the Project site. The GPA and ZCC would alter the existing land use and zone designations for the Project site's estimated 314.30 acres to allow for light and service industrial uses. The industrial areas would contain approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. No residential uses would be constructed under the proposed Project.

A project could induce population growth in an area either directly or indirectly. More specifically, the development of new homes or businesses could induce population growth directly, whereas the extension of roads or other infrastructure could induce population growth indirectly. The introduction

of approximately 4,613,004 square feet of light to medium industrial development within the Project site would increase the number of employees needed within the County. Given the current unemployment rate within the County, it is anticipated that any new jobs generated from this proposed Project would not result in a need for new housing or a population increase. This is because the existing labor force can be used to provide employees to the new industrial facilities.

As the Project proposes to amend the Metropolitan Bakersfield General Plan to allow for the industrial uses, the proposed Project would be removing an obstacle to growth in the Project area by changing the existing land use designation from R-IA (Resource-Intensive Agriculture) to LI (Light Industrial), SI (Service Industrial), GC (General Commercial), and HC (Highway Commercial). This allows for additional employment opportunities, which can lead to the relocation of people to jobs and ultimately and increase in population. However, the size of the labor force within Kern County and the current unemployment rates as discussed above, are considered to be sufficient for the current County population to accommodate jobs generated by the proposed Project.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

As discussed above, the proposed Project would not increase population, as no new residences would be constructed and the current labor force would be used to provide the number of employees necessary for the industrial facilities proposed by the Project. This proposed Project would not directly increase population or the housing stock.

Because the proposed Project would not directly increase population and there is a high unemployment rate, the proposed Project is not anticipated to result in a direct or indirect impact on population and housing, nor is it anticipated to be growth inducing. Therefore, the proposed Project, in conjunction with the current and reasonably foreseeable projects discussed in Chapter 3, *Project Description*, would not lead to population growth. The employment opportunities provided by the proposed Project and other reasonably foreseeable projects would help to provide a balance with the current and projected labor force associated with future conditions. Therefore, this cumulative impact would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.15

Public Services

Section 4.15
Public Services

4.15.1 Introduction

This section focuses on public services, comprised of fire protection, sheriff / police protection, schools, parks and recreation, and libraries. The potential impacts on public services were evaluated, based in part, on coordination with the appropriate local service agencies that serve the proposed Project area. This section provides baseline information, and evaluates potential impacts, on public services practices and policies related to the proposed Project. A Public Services Report was prepared by McIntosh & Associates in October 2008 (refer to Appendix N). A second Public Services Report was prepared by McIntosh & Associates in June 2017. See Appendix J, *Public Support Services*, and Appendix N, *Original Technical Studies*.

4.15.2 Environmental Setting

The public services addressed in this section include police and fire protection, parks, schools, libraries, and other countywide public protection facilities.

Fire Protection

The Kern County Fire Department (KCFD) is responsible for fire protection services, fire prevention, emergency medical and rescue services, arson investigation and hazardous materials coordination with citizens within the Metropolitan Bakersfield General Plan area. The KCFD has established a ratio of staff to resident population and operates at a ratio of 1.092 fire personnel per 1,000 residents which slightly exceeds the national standards. The KCFD provides primary fire protection to unincorporated areas of the county and on regional transportation corridors such as Interstate (I) 5. The KCFD also acts as a secondary responder. The Emergency Communications Center was established as a joint dispatch center for the Bakersfield Fire Department and the KCFD in 1988, which provides for the closest station response concept. The center's dispatch covers more than 8,000 square miles, includes more than 65 fire stations, including 15 Kern County Fire Stations, and receives calls from nine separate public safety agencies. A Joint Powers Agreement has been established between the County and City of Bakersfield fire departments that provides for the closest station response concept. The two fire departments have adopted nonoverlapping, but contiguous station response boundaries without regard to City or County limits.

The National Fire Code set forth by the National Fire Protection Association (NFPA), California Fire Code, the California Building Code (CBC) and the Ordinance Code of Kern County are applied and utilized to regulate fire safety in the County.

Facilities and Services

The KCFD would serve the proposed Project. All KCFD first alarm response companies are staffed with a three-person engine company and a three-person truck company that provides basic Emergency Medical Technician medical aid services. Currently, Kern County Fire Station 52, located at 312 Taft Highway, is the first responding station for the Project area. Station 52 also houses a heavy

rescue vehicle that is "shared staffing" with either engine. There is a potentially low, first-unit emergency response time of three minutes to the edge of the site (at South Union Avenue [SR-204]), given the proximity of the project site to Station 52. Due to traffic and distance, the response time could range from four to eight minutes. An overall average response time for engine and truck companies is 5.2 minutes for any property within a 2.6-mile area around a specific station. Station No. 52 is located approximately 1.1 miles from the northeast corner of the project site, while the furthest point (southwest corner) is approximately 2.7 miles away.

Because the proposed Project is located outside of the boundaries of the Joint Powers Agreement, response companies located at City of Bakersfield Fire Station 13 (the closest City Fire Station at Poppyseed Street and Stine Road, south of Panama Lane) are not currently available.

The KCFD has established a ratio of staff to resident population, but the national industry standard is 1.0 fire personnel per 1,000 residents. Currently, the KCFD operates at a ratio of 1.092 fire personnel per 1,000 residents, slightly exceeding the national standard.

Whether the existing facilities, manpower, and equipment are adequate to maintain a sufficient level of service in the Greenfield area would depend on the density of new occupancy. In the last five to ten years, the KCFD has witnessed a marked increase in the population of Kern County. An increase in service requests, such as for residential fires, vehicle accidents, medical aid, mandated business inspections and safe programs, have been associated with this increase in population. As with most businesses, fire service is also impacted with growth, rather small or large impacts.

Sheriff/Police Protection

The Kern County Sheriff's Department is responsible for providing law enforcement services through the enforcement of local, State and Federal laws. The completion of this goal involves crime prevention, field patrol (ground and air), crime investigation, apprehension of offenders, regulation of noncriminal activity and the performance of a number of related and support services. Traffic and parking control functions are also provided, with some investigation of property damage, traffic accidents and complete investigations of all injury, fatal, intoxication and hit-and-run accidents.

The Kern County Sheriff's Department administers police services throughout the County, enforcing local, State and federal laws. The Kern County Sheriff's Department is responsible for crime prevention, field patrol (ground and air), crime investigation, the apprehension of offenders, regulation of noncriminal activity, and a number of related and support services. Traffic and parking control functions are also provided, along with some investigation of property damage reports and traffic accidents.

Response time is the time required to handle a call for service, which is measured from the time a call is received until the time a patrol car arrives at the scene. Response times are variable, particularly because the nearest responding patrol car may be located anywhere in the station's patrol area and may not respond from the nearest substation. The average response used by the Kern County Sheriff's Department is five minutes or less for an emergency or immediate response incident (e.g., a crime that is underway and/or a life-or-death situation) and eight to ten minutes for routine calls (e.g., a crime that has already occurred and/or an incident that is not life threatening). Response to an

emergency at or near the proposed Project site can vary depending on the demands of the substation at the time of the call. If demands are high, response time will be longer than estimated. The response time for a non-emergency call could range from 15 to 30 minutes or more, depending on staffing and other calls for service.

Facilities and Services

The proposed Project is located within the Lamont Substation's jurisdiction of the Kern County Sheriff's Department, located at 12022 Main Street, in the township of Lamont, and is approximately 6 miles east from the proposed project. The Lamont Substation is responsible for providing law enforcement services to the residents and businesses located throughout an almost 500-square-mile area. The Kern County Sheriff's Department Lamont Substation has 20 deputies assigned for patrol within the geographic service area, which includes the proposed Project. The Lamont Substation has 1 sergeant, 3 senior deputies, 16 deputies, and 1 section lieutenant during the day. At night, an additional sergeant and lieutenant are responsible for monitoring calls within the Lamont service area (McIntosh & Associates 2017). If a situation warranted immediate aid, deputies from Frazier Park and Taft would be requested first. The next level of assistance would be requested department side from 10 other Substations, Metro Patrol and Special Units (McIntosh & Associates 2017).

The County of Kern and the City of Bakersfield have a formal mutual aid agreement for law enforcement and emergency services. Beyond departmental capabilities, a formal request for mutual aid will occur by established protocols. Agencies within the County of Kern will be requested first and then request outside the county will begin by region. Additionally, both the Kern County Sheriff's Department and the Bakersfield Police Department aided dispatch systems identify calls for service by City and County aid jurisdiction. The Lamont Substation response time to an emergency in the proposed Project area could range from 15 to 30 minutes depending on call priority (McIntosh & Associates 2017). The Kern County Sheriff's patrol units traveling through the City shall respond to observed public safety problems and then call the City Police Department for follow-up.

California Highway Patrol (CHP)

As a major Statewide law enforcement agency, the California Highway Patrol (CHP) is responsible for the management and regulation of traffic to achieve safe, lawful and efficient use of the California highways as well as provide disaster and lifesaving assistance.

The purpose of the CHP is to ensure safety and provide service to the public on the highway transportation system and to assist local government during emergencies when requested. The primary responsibility of the CHP is to patrol state highways and all county roadways, enforce traffic regulations, respond to traffic accidents, and provide service and assistance to disabled vehicles. The CHP maintains a mutual aid agreement with the Kern County Sheriff's Department.

The CHP is divided into eight different divisions. The proposed Project is located in the CHP Central Division, which includes which includes 15 area offices, two commercial vehicle enforcement facilities (CVEF), and three communications and dispatch centers (CHP 2017). The closest CHP area office to the proposed Project area is the Bakersfield office, located approximately one mile north of the proposed Project site, at 9855 Compagnoni Street (CHP 2017).

Schools

Primary and secondary school facilities are provided throughout Metropolitan Bakersfield by several school districts and collegiate institutions. The educational institutions are responsible for the operation, staffing and scheduling of more than 70 individual school facilities. Two of the key factors that affect existing and future school facilities are funding and student generation rates. The proposed Project is located within the Greenfield Union School and Kern High School Districts.

Greenfield Union School District

The proposed Project is located within the Greenfield Union School District (GFUSD) jurisdiction. The closest elementary school is Granite Point Elementary School, located at 2900 Berkshire Road, approximately 5.5 miles north of the proposed Project. Granite Point Elementary School has a design capacity of 750 students and has a current enrollment of approximately 958 students. The closest middle school is McKee Middle School, located at 205 McKee Road, approximately two miles north of the proposed Project. McKee Middle School has a design capacity of 1,100 students and has a current enrollment of approximately 946 students (McIntosh & Associates 2017).

Kern County High School District

The proposed Project is also located within Kern High School District boundaries. The proposed Project site and the area west of South Union Avenue (SR-204) are located within the Ridgeview High School (8501 Stine Road) attendance area. Ridgeview High School is located at 8501 Stine Road, and is approximately 5.5 miles northwest of proposed Project. The school serves grades 9th through 12th, has a capacity of 2,176 students, and has a current enrollment of approximately 2,274 students. The District has no plans to increase enrollment capacity (McIntosh & Associates 2017).

Collegiate Institutions

Higher education within Metropolitan Bakersfield is provided by Bakersfield College and California State University at Bakersfield (CSU Bakersfield). Bakersfield College is a two-year community college, whereas CSU Bakersfield has four-year and graduate degree programs.

Parks and Recreation

The Kern County Parks and Recreation Department manages eight (8) regional parks, 25 public buildings, and 40 neighborhood parks. There are no recreational facilities currently serving the Project, nor are there existing parks located within ¾-mile of the proposed Project. The nearest developed park to the proposed Project is Kern Delta Park (approximately 1.5 miles north-northwest of the proposed Project).

Libraries

The Kern County Library system consists of 24 branches and two (2) bookmobiles throughout Kern County, with the main branch library (the Beale Memorial Library) located in Bakersfield. Materials for use at county branches include books, government documents, computers, CDs, and other informational media. The Kern County library system maintains a collection of 1.15 million books,

audiovisual items, periodicals, and other informational sources (Kern County Library 2017). The closest libraries to the proposed Project are the Lamont Branch Library, located approximately 5.25 miles northeast of the proposed Project, at 8304 Segrue Road, Lamont, and Wilson Branch Library, located approximately 5.5 miles north of the proposed Project site, at 1901 Wilson Road in Bakersfield.

4.15.3 Regulatory Setting

State

Senate Bill (SB) 50

The Leroy F. Greene School Facilities Act of 1998, or Senate Bill 50 (SB 50), authorizes school districts to levy developer fees to finance the construction or reconstruction of school facilities. In January 2015, the State Allocation Board (SAB) approved maximum Level 1 developer fees at $0.54 per square foot of enclosed and covered space in any commercial or industrial development, and $3.36 per square foot for residential development. These fees are intended to address the increased educational demands on the school district resulting from new development. Public school districts can, however, impose higher fees than those established by the SAB, provided they meet the conditions outlined in the act. Private schools are not eligible for fees collected pursuant to SB 50.

The payment of school mitigation impact fees authorized by SB 50 is deemed to provide full and complete mitigation of project impacts on school facilities. SB 50 provides that a State or local agency may not deny or refuse to approve the planning, use, or development of real property on the basis of a developer's refusal to provide mitigation in amounts in excess of that established by SB 50.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals and policies in order to ensure that public services have adequate capacity to service proposed developments. Applicable public services goals and policies relative to the proposed Project site are identified in Table 4.15-1, *Metropolitan Bakersfield General Plan Goals and Policies for Public Services*, below.

Table 4.15-1. Metropolitan Bakersfield General Plan Goals and Policies for Public Services
Metropolitan Bakersfield General Plan: Safety Element
Safety Element Goal #2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development of metropolitan police and fire facilities and services.
Public Services and Facilities (PSF) School Policies
PSF School Policy #1: New development will be required to pay its proportional share of the cost of school impact fees within the Plan area.
Public Services and Facilities (PSF) Parks Element Policies
PSF Park Policy #3: "Require developers to dedicate land, provide improvements and/or in lieu fees to serve the needs of the population in newly developing areas."

Capital Improvement Plan

A countywide Capital Improvement Plan (CIP) was presented to the board of supervisors on October 9, 2007, and adopted in 2008. This report presents the best current understanding regarding new public facilities that would be needed to serve projected development in the County through 2030. The scope of services includes parks; libraries; Kern County Sheriff's Department (public protection and investigation), fire department, animal control, public health, and landfill/transfer facilities; and, general government services. Road and sewer costs, as well as related impacts, are not part of this program. The program includes three phased components:

Phase One: Develop a conceptual CIP for the included facility categories, assessing what additional capacity and conceptual projects are required to provide needed infrastructure for new development through 2030;

Phase Two: Evaluate existing and potential funding sources, and outline options available as financing mechanisms, including a development fee proposal; and

Phase Three: Perform a fiscal (operational) analysis for use in evaluating the ongoing operating and maintenance impact of a new development on the County's general fund.

The adopted CIP includes a summary of proposed service levels for the included facilities and a conceptual list of the planned projects upon which the CIP was based.

Public Facilities Mitigation Program

The changing fiscal landscape in California during the past 30 years has steadily undercut the financial capacity of local governments to fund infrastructure. Three dominant trends stand out:

- The passage of a string of tax limitation measures, starting with Proposition 13 in 1978 and continuing through the passage of Proposition 218 in 1996;
- Declining popular support for bond measures to finance infrastructure for the next generation of residents and businesses; and

- Steep reductions in federal and state assistance.

Faced with these trends, the County has adopted a policy of "growth pays its own way" through use of a public facilities mitigation program. The primary policy objective of this program is to ensure that new development pays the capital costs associated with growth. In 2008, the County adopted a Capital Improvement Plan (CIP) that document identifies the best current understanding of the public facilities that will be needed to accommodate new development anticipated through 2030. The CIP further identified appropriate facility demand standards to be used as a basis for estimating future facility needs and level of service. The basic purpose of the CIP is to identify the facilities and infrastructure needed to serve the population in 2030.

Continued growth within the County and the associated impacts resulting from that growth have increased the demands to Countywide public services and have made it difficult to not only implement and fund many of those facilities identified within the Capital Improvement Plan, but maintain existing public service demand standards as growth occurs. In short, despite the increase in property taxes generated as a result of the proposed project and other similar projects within the County, public facility impacts are still underfunded and unable to maintain existing and adopted facility standards.

The purpose of the Public Facilities Mitigation Program is to identify those impacts on public services and determine the California Environmental Quality Act (CEQA)-required mitigation (in dollars) that would be needed to address the growth impacts adequately. The following categories have been identified to help determine which specific public needs are impacted by the proposed project.

- Countywide Public Protection Facilities;
- Sheriff Patrol and Investigation Facilities;
- Library Facilities;
- Animal Control Facilities:
- Park Facilities;
- Fire Facilities;
- Waste Management Facilities;
- Public Health Facilities; and
- General government Facilities.

4.15.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed Project are evaluated on a quantitative basis through a comparison of the anticipated project effects on public services. The evaluation of project impacts as based on professional judgment, consistency analysis with the goals and polices of Metropolitan Bakersfield General Plan and the significance criteria established by Appendix G of the

State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR. In accordance with CEQA, the effects of a project are evaluated to determine if they will result in a significant adverse impact on the environment. An EIR is required to focus on these effects and offer feasible mitigation measures to reduce or avoid any significant impacts that are identified.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed project would:

- Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities; and/or result in the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services, which include:

    i. Fire Protection

    ii. Police Protection

    iii. Schools

    iv. Parks

    v. Other Public Facilities

Project Impacts

Impact 4.15-1: The Project Would Result in Adverse Physical Impacts Associated with New or Physically Altered Governmental Facilities or Result in the Need for New or Physically Altered Governmental Facilities and Have Significant Fiscal Impacts on Public Services.

In May 2009, the County prepared, in consultation with Willdan Financial Services a Public Services Study, the purpose of which was to calculate and present development factors that will enable the County to expand its inventory of public facilities, and therefore maintain its existing facilities standards, as new development leads to service population increases. The applicability of these factors assumes full property taxes and are based on the services provided by the County to a given area to determine the underfunded public service needs. Table 4.15-2, *Applicability of Proposed Mitigation Factors to Residential and Non-Residential Uses*, identified below, summarizes the applicability of each of the proposed mitigation factors to residential and non-residential uses.

Table 4.15-2. Applicability of Proposed Mitigation Factors to Residential and Non-Residential Uses

Fee Category	Geographic Applicability	Service Population	
		Residential	Non-Residential
Public Protection	Countywide	X	X
Sheriff Patrol & Investigation	Unincorporated	X	X
Library	Countywide	X	
Animal Control	Unincorporated areas, Maricopa, McFarland, Tehachapi, Arvin, Bakersfield	X	
Community Parks	Countywide	X	
Regional Parks	Countywide	X	
Fire	Kern County Fire Service Area	X	X
Waste Management	Countywide	X	X
Public Health	Countywide	X	X
General Government	Countywide, different rates for cities	X	X

Future development of industrial uses would create public services typical of any new industrial development. As a non-residential facility, implementation of the proposed Project has the potential to result in a demand for new and/or additions to existing public protection facilities, sheriff facilities, fire facilities, waste management facilities, public health facilities and various general governmental facilities.

At this time, specific industrial uses on the proposed Project site are not available. The proposed M-1 PD (Light Industrial, Precise Development Combining), M-2 PD (Medium Industrial, Precise Development Combining), C-2 PD (General Commercial, Precise Development Combining), and CH PD (Highway Commercial, Precise Development Combining) Zone Districts would allow for, gas stations, restaurants, motels, wholesale commercial, storage, trucking, assembly-type manufacturing, general manufacturing, processing, office, or industrial uses to be constructed on-site. As a result, it is not feasible to specifically identify monetary mitigation for public facilities at this time, given the various commercial, office or industrial uses allowed within the M-2 PD Zone District. Given the proposed Project is non-residential, impacts to library, animal control, community and regional parks are considered less than significant.

The following is a discussion on the various public service impacts that would result with implementation of the proposed Project.

Fire Protection

Construction of the proposed Project has the potential to create an increased demand for fire services on the KCFD due to the increase in urban/industrial development. According to Captain Jim Eckroth, the proposed Project could increase the demand for fire protection and emergency services that could require manpower and equipment that are adequate to maintain a sufficient level of service in the

Greenfield area depending on the density of the new proposed commercial and industrial development (McIntosh &Associates 2017).

At this time mitigation development fees and taxes are undetermined by the KCFD; however, the proposed Project would be required to pay all fees and taxes established for the fire department prior to issuance of building permits. During the plan review phase, the Project Applicant may be required to agree to Conditions of Approval for development of the proposed Project in order to mitigate the demand for additional fire personnel and additional emergency equipment necessary to maintain adequate fire protection service. As such, implementation of the required mitigation measures below would reduce impacts to a less than significant level for fire protection services related to increase fire personnel.

The proposed Project has the potential of having short-term construction-related impacts. If during construction there is a need to redirect traffic or block access routes or residential streets, potential delays in emergency response could result. This temporary impact would be reduced to less than significant with implementation of mitigation measures pertaining to coordination during construction (refer to Section 4.16, *Transportation and Traffic*). Additionally, compliance with fire safety standards and requirements such as interior sprinkler systems, fire alarms, emergency access and adequate fire flow at public and on-site hydrants would be required during the plan review process and would reduce impacts to less than significant levels.

Furthermore, construction of the proposed Project would be subject to the provisions of the Uniform Fire Code and local amendments; Titles 19, 22 and 27 of the California Safety Code Regulations; the Kern County Ordinance Code; and the National Fire Prevention Association Standards. Thus, ensuring adequate fire protection services are maintained within the Project site.

Therefore, the proposed Project and the increase demand would not create an adverse impact because planned growth is something that is simply responded to by the KCFD. The KCFD and the Kern County Planning and Natural Resources Department reviews each new development to ensure that all requirements for emergency access, fire hydrant location and spacing, fire flows, and fire lanes are incorporated into the proposed project designs. Kern County code of Ordinances, regulations, guidelines, and fees are periodically updated. Development projects, including the proposed Project, are required to incorporate the most current code requirement that are in effect at the time of map recordation or building permit issuance. Impacts would be less than significant.

Sheriff/Police Protection

Construction of the proposed Project has the potential to create an increased demand for police services on the Kern County Sheriff's Department due to the increase in urban/industrial development. However, according to Commander Drake Massey, the existing facility, manpower and equipment are adequate to maintain sufficient service for this response area (McIntosh & Associates 2017). Additionally, the addition of officers, clerical staff, and law enforcement equipment pursuant to conditions of approval as set forth by the County, would decrease the demand on the existing police services and reduce the significance of impacts to less than significant levels.

Similar to the fire protection services, the proposed Project has the potential of having short-term construction related impacts. Construction areas may require additional police monitoring throughout

the duration of Project construction both during day and nighttime periods. Additionally, the need to redirect traffic or block access routes or residential streets may arise which would result in potential delays in police response. These temporary impacts would not be considered significant with implementation of mitigation measures pertaining to coordination during construction (refer to Section 4.16, *Transportation and Traffic*).

Other Public Facilities

Public protection facilities include criminal detention facilities, courthouses, coroner, 911 communications, and the Kern County Sheriff's Department administrative buildings. In contrast with sheriff patrol and investigation facilities, which are used primarily to provide services in unincorporated areas of the County, public protection facilities serve residential and nonresidential development countywide. Similar to sheriff facilities, demand for public protection services per employee are less than compared per resident, however implementation of the proposed Project would increase the service need. With implementation of the mitigation measures, impacts will be considered less than significant for public protection.

Refuse collection services for the proposed project is operated and managed by Price Environmental Services, Inc. Refuse collected is transported to one of two landfills, the Metropolitan Bakersfield Sanitary Landfill at (Bena Landfill) or Shafter-Wasco Sanitary Landfill. Calculations made utilizing the Kern County Waste Management Department methodology of solid waste estimation; the proposed project is anticipated to generate 12,883 tons of construction waste to buildout, and 13,519 tons of solid waste annually thereafter. Bena Landfill has reported the remaining capacity at 22,174,654 tons and the landfill is projected to accommodate solid waste for 26.8 years and is currently scheduled for closure in the year 2038. Shafter-Wasco Landfill has reported the remaining capacity at 3,671,755 tons and is projected to accommodate solid waste for 16.4 years (McIntosh & Associates 2017).

The County's waste management facility standard adopted in the CIP is 38.45 tons of landfill capacity per capita. This standard is based on the existing per capita landfill capacity. A planned system-wide transition from the several local sanitary landfill sites to regional sanitary landfills supplemented by local transfer stations is currently in process. The Kern County Waste Management Department presently has plans for eleven new facilities, several facility closures, and numerous miscellaneous capital projects which expand existing disposal facilities, consolidate local disposal sites to three regional disposal sites, and protect landfills from encroachment of incompatible land uses by acquiring buffer zones around disposal sites. Implementation of the project will contribute to the overall service needs for the Kern County Waste Management Department on a Countywide level. Implementation of the mitigation measures below will reduce impacts to waste management to a less than significant level.

General government facilities provide space for the Board of Supervisors and for general County administration including the Assessor, Treasures, Tax Collector and the Auditor-Controller County Clerk. Some general government facilities are primarily used to provide service and administration in unincorporated areas, while others provide service on an equal basis countywide. It is estimated that new development, Countywide, between now and the year 2030 would result in an increase of service population by 448,500 people (residents and workers combined). The Kern County CIP identifies a general government facility standard of 0.25 building square feet per capita, which was

the existing standard of general government facilities at the time the CIP was adopted. The County anticipates that less than 0.25 general government building square feet per capita will be needed to accommodate new development through 2030, therefore, the general government impact fee is based on the cost of planned facilities per capita. With implementation of the mitigation measure below, impacts to general government facilities will be reduced to less than significant levels.

These increased facility demands to public protection, waste management, and general government go above and beyond those funded through the increase in property taxes generated as a result of rezoning the property to industrial use.

Schools

As mentioned above, the proposed Project is located within the Greenfield Union School District and the Kern High School District. No school age children would reside on the proposed Project because no residential structures are proposed for this property. The Project applicant would be required to pay applicable statutory school fees under California Government Code Section 65995-65996. The rate factor for the Greenfield Union School District's students is determined by the factors based on total student generation impact per 1,000 square feet of commercial and industrial development, as shown in Table 4.15-3.

Table 4.15-3. Total Student Generation Impact

Commercial and Industrial Category	Elementary School Inter-District Impact	Middle School Inter-District Impact	Total Inter-District Cost Impact
Banks	0.0878	0.0373	0.1251
Community Shopping Center	0.0477	0.0202	0.0679
Neighborhood Shopping Center	0.0870	0.0370	0.1240
Industrial Business Parks	0.1093	0.0464	0.1557
Industrial Parks/Warehousing	0.0419	0.0178	0.0597
Research & Development	0.0945	0.0402	0.1347
Hospitality (Lodging)	0.0352	0.0149	0.0501
Commercial Offices (Standard)	0.1489	0.0633	0.2122
Corporate Offices	0.0835	0.0355	0.1190
Medical Offices	0.1326	0.0563	0.1889

Source: McIntosh & Associates, Public Services Report, 2017.
Notes: Total student generation impact per 1,000 square feet of commercial and industrial development.

The proposed Project is projected, in a worst-case scenario, to indirectly cause the addition of some residents based on the number people that will move to the area to fill managerial and other positions created by the development. This increase may create a demand for housing that may include school age children, which will indirectly create a demand for school services. Therefore, although the proposed Project would increase the intensity of land use on the Project site, the proposed Project is a commercial and industrial development and will not directly create a demand for school services. Thus, impacts to schools in the proposed Project area would not be considered substantial, as no residential uses are proposed.

In addition, the proposed Project would be required to contribute development impact fees in accordance with Senate Bill 50 (SB 50) (Level 1 impact fees) and the above-mentioned standards and

policies. Therefore, Project-related impacts to schools regarding acceptable service levels would be reduced to less than significant levels following implementation of State law.

Parks and Recreation

The proposed Project includes industrial uses and would not directly result in a demand for park facilities. According to the Metropolitan Bakersfield Kern County General Plan, a level of service standard of 2.5 acres of park area per 1,000 residents shall be implemented; therefore, the demand for park facilities is based on the residential population with the County. Since the proposed Project does not include housing, the proposed Project would not result in a direct demand for park and recreation facilities.

Mitigation Measures

MM 4.15-1: **Fire Safety Plan.** Prior to the issuance of grading or building permits, the project proponent shall develop and implement a Fire Safety Plan for use during construction and operation. The project proponent will submit the Fire Safety Plan, along with maps of the project site and access roads, to the Kern County Fire Department for review and approval. The Fire Safety Plan will contain notification procedures and emergency fire precautions for construction and operations phases of the proposed project.

MM 4.15-2: **Land Development Services Fee Schedule.** Prior to the issuance of grading or building permits, the project proponent shall coordinate with Kern County to determine the need for payment of land development services fees, in accordance with the Kern County Land Development Services Fee Schedule, for impacts to countywide public protection, sheriff's patrol and investigative services, and fire services.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Significant cumulative impacts to public services would occur if the cumulative projects would overburden the public service agencies and if utility providers were unable to provide adequate services. The cumulative impacts of this proposed Project, in conjunction with all the other projects, would result in the need for new fire, sheriff, library, and general governmental facilities. Implementation of the Development Impact Fee Program as directed by the Kern County Board of Supervisors, is appropriate mitigation to reduce cumulative impacts to public services. The cumulative projects would substantially increase the demand for public service providers and utility servers. However, public agencies and utilities have the opportunity to respond to an inquiry for information regarding potential increase in demand on their services. Monetary mitigation is determined on a project-by-project basis to mitigate for the increase in demand on public services and utilities. Incorporation of the mitigation measures would reduce impacts from the proposed Project, in conjunction with other projects in the area, to a less than significant cumulative level.

Mitigation Measures

Implement Mitigation Measures MM 4.15-1 and 4.15-2, above.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.16

Transportation and Traffic

Section 4.16
Transportation and Traffic

4.16.1 Introduction

The purpose of this section is to evaluate existing traffic conditions and the potential traffic impacts of the proposed Project. The evaluation considers impacts on local roadways, intersections, and regional facilities, as well as proposed Project access and internal circulation. Mitigation measures are recommended to avoid or lessen impacts, as necessary. A Traffic Impact Study (Traffic Study) was prepared by McIntosh & Associates in November 2016, and a technical memo regarding trip generation counts was prepared in May 2018. See Appendix M, *Traffic Study*.

The following analysis scenarios are evaluated in this section:

- Existing 2016 Conditions
- Future Year 2025 (Project Buildout) Without Project Conditions
- Future Year 2025 (Project Buildout) With Project Conditions
- Future Year 2035 Without Project Conditions
- Future Year 2035 With Project Conditions

Project impacts were assessed based on intersection and roadway levels of service (LOS). Improvements needed to maintain or improve operational LOS were also identified.

4.16.2 Environmental Setting

Study Area

The proposed Project is located approximately 1.10 miles southeast of the Bakersfield city limits, within the Metropolitan Bakersfield General Plan in Kern County. The proposed Project consists of approximately 314.30 acres, generally located north of Houghton Road, east of State Route 99 (SR-99), west of South Union Avenue, and south of DiGiorgio Road. South Union Avenue, Houghton Road, and the DiGiorgio Road alignment provide the primary access to and from the proposed Project area. The Project study area is illustrated on the figures provided in this section. A total of 43 intersections were analyzed within the study area. Of these intersections, 36 currently exist and seven (7) are proposed. The seven (7) proposed intersections were assumed to be in operation by Year 2025.

Existing and Proposed Street Network

The following is a summary of roadways within the study area:

Panama Lane is a designated east-west arterial west of the SR-99 Southbound Off-Ramp to east of Cottonwood Road in various stages of widening. Panama Lane currently exists as a six-lane, divided

roadway from the west of SR-99 Southbound Off-Ramp to South H Street. It then continues east from South H Street as a four-lane, divided roadway to South Union Avenue. Panama Lane exists at a two-lane, undivided roadway from South Union Avenue to the east of Cottonwood Road.

Hosking Avenue is a designated east-west arterial that exists as a two-lane, undivided roadway from west of SR-99 to Cottonwood Road.

Taft Highway/ State Route 119 (SR-119)/Panama Road is a designated east-west expressway from west of Wible Road to SR-99 and a designated arterial from SR-99 to the east of Cottonwood Road. Taft Highway/SR-119 is aligned with Panama Road to the east of South Union Avenue. Taft Highway/SR-119 currently exists as a two-lane, undivided roadway from west of Wible Road to South Union Avenue. Panama Road exists as a two-lane, undivided roadway from South Union Avenue to the east of Cottonwood Road.

Curnow Road is a designated east-west collector that currently exists as a two-lane, undivided roadway from west of South Union Avenue to Cottonwood Road.

DiGiorgio Road is a designated east-west arterial that currently exists as a two-lane, undivided roadway from South Union Avenue to the east of Cottonwood Road. DiGiorgio Road will be constructed in the future along the project's frontage and from the future Chevalier Road to South Union Avenue. DiGiorgio Road will provide direct access to the project site via the project's northern frontage.

Lamb Avenue is a designated east-west collector that currently exists as a two-lane, undivided roadway to the east of South Union Avenue. Lamb Avenue will be constructed in the future within the project boundary from Chevalier Road to South Union Avenue, and it will serve as direct access to the project site via several entrances on both the north and south sides of Lamb Avenue.

Mugsy Avenue is a designated east-west local roadway that currently exists as a two-lane, undivided roadway from South Union Avenue to east of South Union Avenue. Mugsy Avenue will provide direct access to the project site via several entrances within the project's interior.

Houghton Road/ Buena Vista Boulevard is a designated east-west arterial that currently exists as a two-lane, undivided roadway from west of Stine Road to South Union Avenue. Houghton Road is aligned with Buena Vista Boulevard at South Union Avenue and becomes Buena Vista Boulevard to the east of South Union Avenue. Buena Vista Boulevard is a designated east-west arterial that currently exists as a two-lane, undivided roadway from South Union Avenue to east of Adobe Road. Houghton Road will front the project's southern boundary and provide direct access to the project site via entrances on the project's southern frontage.

Shafter Road is a designated east-west collector that currently exists as a two-lane, undivided roadway from Chevalier Road to South Union Avenue. Shafter Road then becomes a designated arterial to the east of South Union Avenue, and it exists as a two-lane, undivided roadway to the east of South Union Avenue.

Kaiser Lane is a designated east-west collector that currently exists as a two-lane, undivided roadway from Chevalier Road to South Union Avenue.

Bear Mountain Boulevard/State Route 223 (SR-223) is a designated east-west arterial that currently exists as a two-lane, undivided roadway from west of Costajo Street to east of South Union Avenue.

Stine Road is a designated north-south arterial that currently exists as a two-lane, undivided roadway from north of Houghton Road to south of Houghton Road.

Wible Road is a designated north-south arterial that currently exists as a two-lane, undivided roadway from north of Taft Highway/SR-119 to south of Houghton Road.

South H Street is a designated north-south arterial that currently exists in various stages of widening. South H Street currently exists as a four-lane, divided roadway to the north of Panama Lane, and it continues southerly from Panama Lane to south of Houghton Road as a two-lane, undivided roadway. South H Street is aligned with Curnow Road to the south of Taft Highway/SR-119, but it realigns with its original alignment on the west side of SR-99 to the south of Curnow Road.

SR-99 is a designated north-south freeway that currently exists as a six-lane, divided roadway from north of Panama Lane to south of Bear Mountain Boulevard/SR-223. The freeway right-of-way will serve as the western boundary of the project site.

Costajo Road is a designated north-south collector that currently exist as a two-lane, undivided roadway from Houghton Road to Bear Mountain Boulevard/SR-223.

Chevalier Road is a designated north-south collector that currently exists as a two-lane, undivided roadway from Houghton Road to Kaiser Lane. Chevalier Road will be constructed in the future within the project boundary from DiGiorgio Road to Houghton Road. Chevalier Road will provide direct access to the project via several entrances within the project's interior.

South Union Avenue (SR-204)/SR-99 Business is a designated north-south arterial that currently exists as a four-lane, divided roadway from north of Panama Lane to south of Bear Mountain Boulevard/SR-223. This roadway will provide direct access to the project site via entrances along the project's eastern frontage. SR-204 and Union Avenue coexist north of SR-58.

Cottonwood Road is a designated north-south arterial that currently exists as a two-lane, undivided roadway from north of Panama Road to Buena Vista Boulevard.

Adobe Road is a designated north-south arterial that currently exists as a two-lane, undivided roadway from north of Buena Vista Boulevard to south of Buena Vista Boulevard.

Performance Criteria

For California Environmental Quality Act (CEQA) purposes, defined performance criteria are utilized to determine if a proposed project causes a significant impact. In general, according to the Transportation Research Board, National Research Council's 2010 Highway Capacity Manual (HCM), LOS ranges from LOS "A" (free-flow conditions) to LOS "F" (severely congested conditions), based on the average delay experienced per vehicle. The Metropolitan Bakersfield General Plan performance criterion for intersections and roadway segments is LOS "C" or better.

Existing Traffic Conditions

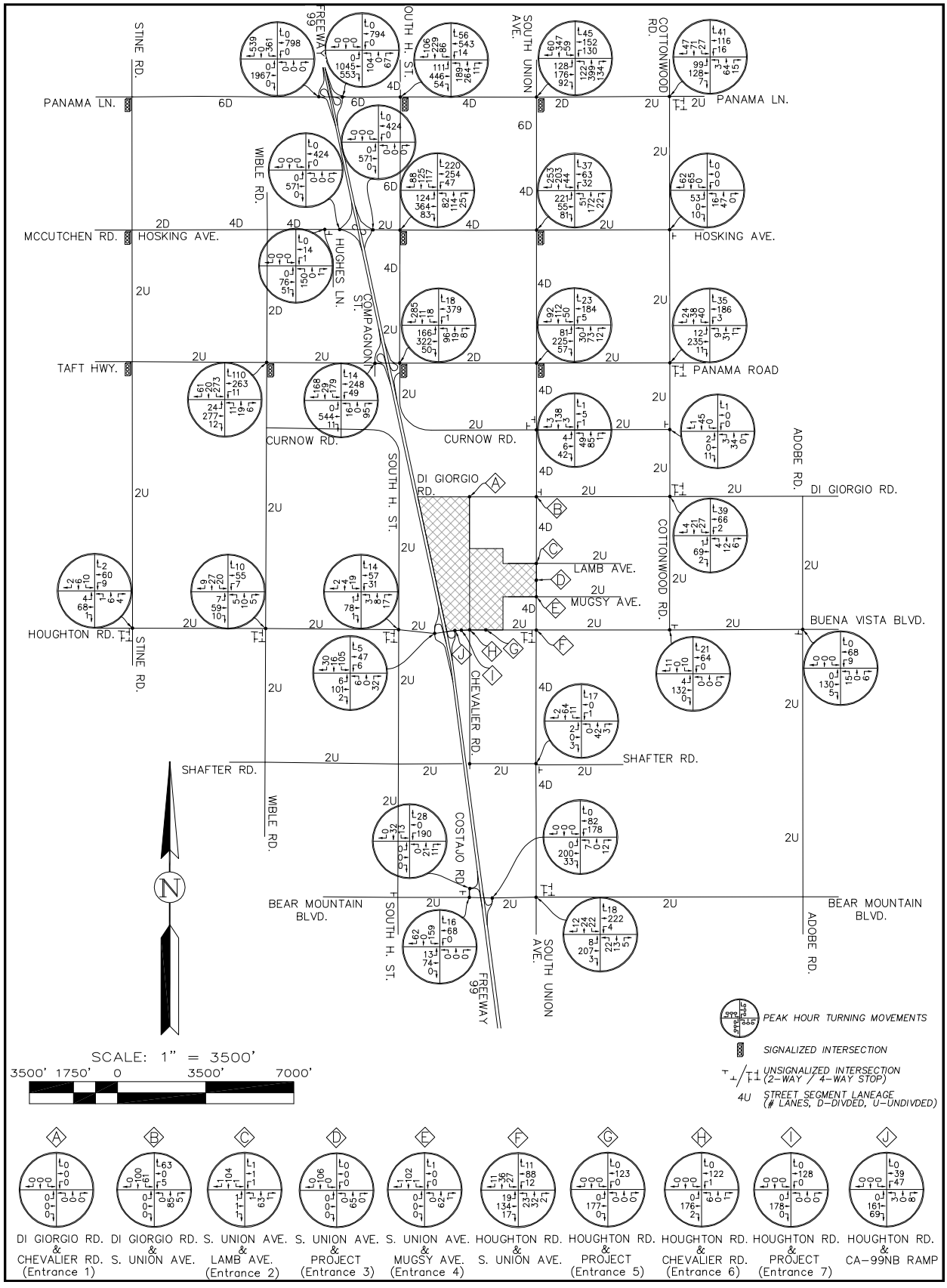
Existing Traffic Volumes

Traffic counts were taken at major intersections within the study area, as required by the City of Bakersfield, County of Kern, and the California Department of Transportation (Caltrans). The counts were used to determine the local peak-hour period, directional distribution, and existing operational LOS. Existing traffic counts were taken at the AM and PM peak hours for all intersections within the study area, and are illustrated in Figure 4.16-1a, *AM Peak Hour Turning Movements,* and Figure 4.16-1b, *PM Peak Hour Turning Movements.*

Existing Intersection Level of Service

Table 4.16-1, *Intersection Level of Service*, outlines the AM and PM peak hour LOS of the study intersections under Year 2016, Year 2025, and Year 2035 conditions. Based on the traffic counts taken for the Traffic Study, and as illustrated in Table 4.16-1, the following study intersections operate at an unacceptable LOS under existing 2016 conditions.

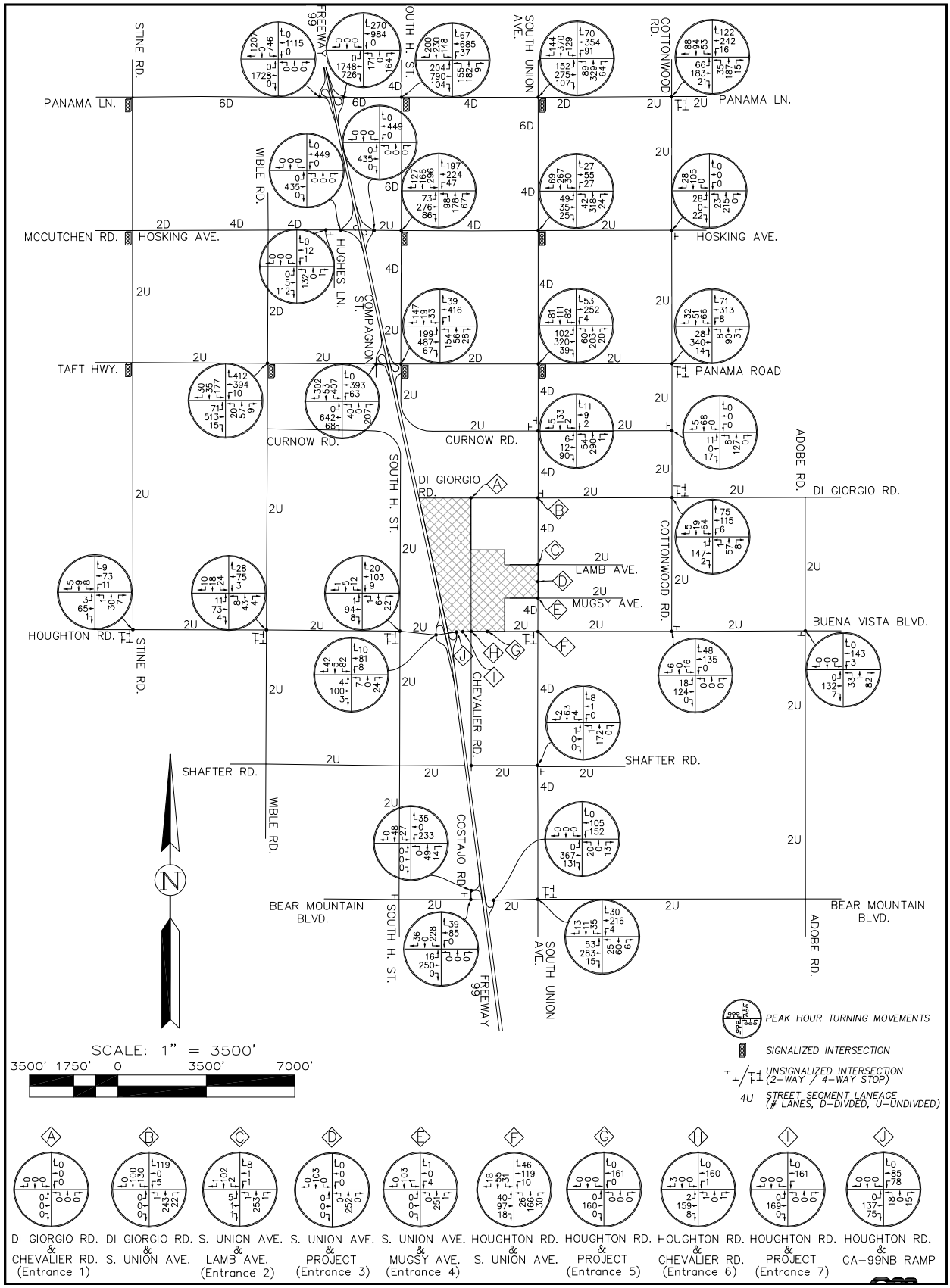
- Panama Lane and South H Street (PM Peak Hour LOS "D")
- Panama Lane and South Union (PM Peak Hour LOS "D")
- Hosking Avenue and South H Street (PM peak hour LOS "D")
- Taft Highway/SR-119 and SR-99 Southbound Ramp/Compagnoni Street (PM Peak Hour LOS "D")
- Taft Highway / SR-119 and South H Street (AM peak hour LOS "D")



Source: McIntosh & Associates, 2016

AM Peak Hour Turning Movements

Figure 4.16-1a



Source: McIntosh & Associates, 2016

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07 • AGRICULTURAL PRESERVE #13 EXCLUSION

PM Peak Hour Turning Movements

Figure 4.16-1b

Table 4.16-1. Intersection Level of Service

Intersection	Scenario	Type	LOS
PANAMA LANE and SR-99 SB RAMP AM PEAK	Existing	S	B
	2025 Future w/o Project	S	B
	2025 Future with Project	S	B
	2035 Future w/o Project	S	C
	2035 Future with Project	S	C
PANAMA LANE and SR-99 SB RAMP PM PEAK	Existing	S	C
	2025 Future w/o Project	S	E
	2025 Future with Project	S	E
	2035 Future w/o Project	S	F
	2035 Future with Project	S	F
PANAMA LANE and SR-99 NB RAMP AM PEAK	Existing	S	B
	2025 Future w/o Project	S	B
	2025 Future with Project	S	B
	2035 Future w/o Project	S	B
	2035 Future with Project	S	B
PANAMA LANE and SR-99 NB RAMP PM PEAK	Existing	S	B
	2025 Future w/o Project	S	B
	2025 Future with Project	S	B
	2035 Future w/o Project	S	B
	2035 Future with Project	S	C
PANAMA LANE and SOUTH H STREET AM PEAK	Existing	S	C
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	D
	2035 Future with Project	S	D
PANAMA LANE and SOUTH H STREET PM PEAK	Existing	S	D
	2025 Future w/o Project	S	D
	2025 Future w/o Project (Improved)	S	D
	2025 Future with Project	S	D
	2035 Future w/o Project	S	E
	2035 Future with Project	S	E

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
PANAMA LANE and SOUTH UNION AVENUE AM PEAK	Existing	S	C
	2025 Future w/o Project	S	D
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	D
	2025 Future with Project (Mitigated)	S	C
	2035 Future w/o Project	S	E
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	D
PANAMA LANE and SOUTH UNION PM PEAK	Existing	S	D
	2025 Future w/o Project	S	E
	2035 Future w/o Project (Improved)	S	D
	2025 Future with Project	S	D
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
PANAMA LANE and COTTONWOOD ROAD AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	B
	2025 Future with Project	AWS	C
	2035 Future w/o Project	AWS	E
	2035 Future w/o Project (Improved)	AWS	C
	2035 Future with Project	AWS	C
PANAMA LANE and COTTONWOOD ROAD PM PEAK	Existing	AWS	C
	2025 Future w/o Project	AWS	F
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
HOSKING AVENUE and HUGHES AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	F
	2035 Future w/o Project (Improved)	S	D
	2035 Future with Project	S	D
HOSKING AVENUE and HUGHES PM PEAK	Existing	U	A
	2025 Future w/o Project	U	F
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	D
	2035 Future with Project	S	D

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
HOSKING AVENUE and SR-99 SB RAMP AM PEAK	Existing	N/A	
	2025 Future w/o Project	U	B
	2025 Future with Project	U	B
	2035 Future w/o Project	U	C
	2035 Future with Project	U	C
HOSKING AVENUE and SR-99 SB RAMP PM PEAK	Existing	N/A	
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	B
	2035 Future with Project	U	B
HOSKING AVENUE and SR-99 NB RAMP AM PEAK	Existing	N/A	
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
HOSKING AVENUE and SR-99 NB RAMP PM PEAK	Existing	N/A	
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
HOSKING AVENUE and SOUTH H STREET AM PEAK	Existing	S	C
	2025 Future w/o Project	S	E
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	E
	2035 Future with Project	S	E
HOSKING AVENUE and SOUTH H STREET PM PEAK	Existing	S	D
	2025 Future w/o Project	S	F
	2025 Future w/o Project (Improved)	S	D
	2025 Future with Project	S	D
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	E
	2035 Future with Project	S	E
HOSKING AVENUE and SOUTH UNION AVENUE AM PEAK	Existing	S	C
	2025 Future w/o Project	S	F
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
HOSKING AVENUE and SOUTH UNION AVENUE PM PEAK	Existing	S	B
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	D
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
HOSKING AVENUE and COTTONWOOD ROAD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
HOSKING AVENUE and COTTONWOOD ROAD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
TAFT HIGHWAY/SR-119 and WIBLE AM PEAK	Existing	S	B
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	E
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
TAFT HIGHWAY/SR-119 and WIBLE PM PEAK	Existing	S	B
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
TAFT HIGHWAY/SR-119 and COMPAGNONI STREET / SR-99 SB RAMP AM PEAK	Existing	S	C
	2025 Future w/o Project	S	D
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	C
	2035 Future with Project	S	C
TAFT HIGHWAY/SR-119 and COMPAGNONI STREET / SR-99 SB RAMP PM PEAK	Existing	S	E
	2025 Future w/o Project	S	F
	2025 Future w/o Project (Improved)	S	D
	2025 Future with Project	S	D
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
TAFT HIGHWAY/SR-119 and SOUTH H STREET AM PEAK	Existing	S	D
	2025 Future w/o Project	S	F
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	D
	2035 Future with Project	S	D
TAFT HIGHWAY/SR-119 and SOUTH H STREET PM PEAK	Existing	S	C
	2025 Future w/o Project	S	E
	2025 Future w/o Project (Improved)	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	E
	2035 Future w/o Project (Improved)	S	D
	2035 Future with Project	S	E
	2035 Future with Project (Mitigated)	S	D
TAFT HIGHWAY/ SR-119/PANAMA ROAD and SOUTH UNION AVENUE AM PEAK	Existing	S	B
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	C
	2035 Future with Project	S	C
TAFT HIGHWAY/SR-119/PANAMA ROAD and SOUTH UNION AVENUE PM PEAK	Existing	S	C
	2025 Future w/o Project	S	C
	2025 Future with Project	S	C
	2035 Future w/o Project	S	D
	2035 Future w/o Project (Improved)	S	C
	2035 Future with Project	S	C
PANAMA ROAD[1] and COTTONWOOD AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	C
	2025 Future with Project	AWS	C
	2035 Future w/o Project	AWS	F
	2035 Future w/o Project (Improved)	S	D
	2035 Future with Project	S	D
PANAMA ROAD[1] and COTTONWOOD PM PEAK	Existing	AWS	C
	2025 Future w/o Project	AWS	F
	2025 Future w/o Project (Improved)	S	D
	2025 Future with Project	S	D
	2035 Future w/o Project	S	F
	2035 Future w/o Project (Improved)	S	E
	2035 Future with Project	S	E

[1] Taft Highway/ SR-119 becomes Panama Road at South Union Avenue.

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
CURNOW ROAD and SOUTH UNION AVENUE AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
CURNOW ROAD and SOUTH UNION AVENUE PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	C
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	U	C
CURNOW and COTTONWOOD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
CURNOW and COTTONWOOD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
DiGIORGIO and CHEVALIER (#1) AM PEAK	Existing	N/A	
	2025 Future w/o Project		
	2025 Future with Project	U	A
	2035 Future w/o Project		
	2035 Future with Project	U	A
DiGIORGIO and CHEVALIER (#1) PM PEAK	Existing	N/A	
	2025 Future w/o Project		
	2025 Future with Project	U	A
	2035 Future w/o Project		
	2035 Future with Project	U	A
DiGIORGIO and SOUTH UNION AVENUE AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	B

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
DiGIORGIO and SOUTH UNION AVENUE PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	E
	2025 Future with Project (Mitigated)	U	C
	2035 Future w/o Project	U	B
	2035 Future with Project	U	A
DiGIORGIO and COTTONWOOD AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
DiGIORGIO and COTTONWOOD ROAD PM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	B
LAMB AVENUE and SOUTH UNION AVENUE (#2) AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
LAMB AVENUE and SOUTH UNION AVENUE (#2) PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	D
	2035 Future with Project (Mitigated)	U	A
ENTRANCE # 3 and SOUTH UNION AM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	A
ENTRANCE # 3 and SOUTHUNION AVENUE PM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	A

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
MUGSY AVENUE (#4) and SOUTH UNION AVENUE AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
MUGSY (#4) and SOUTH UNION AVENUE PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
HOUGHTON and STINE AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
HOUGHTON and STINE PM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
HOUGHTON and WIBLE AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
HOUGHTON and WIBLE PM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
HOUGHTON and SOUTH H STREET AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A
HOUGHTON and SOUTH H STREET PM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	A
	2035 Future w/o Project	AWS	A
	2035 Future with Project	AWS	A

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
HOUGHTON and SR-99 SB RAMP AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	C
	2035 Future w/o Project	U	A
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	S	C
HOUGHTON and SR-99 SB RAMPS PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	D
	2035 Future with Project (Mitigated)	U	C
HOUGHTON and SR-99 NB RAMPS AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	S	C
HOUGHTON and SR-99 NB RAMPS PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	B
	2035 Future w/o Project	U	A
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	S	C
HOUGHTON and PROJECT ENTRANCE #7 AM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	A
HOUGHTON and PROJECT ENTRANCE # 7 PM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	U	A
HOUGHTON and CHEVALIER (#6) AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	C
	2035 Future w/o Project	U	A
	2035 Future with Project	U	F
	2025 Future with Project (Mitigated)	S	D

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
HOUGHTON and CHEVALIER (#6) PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	F
	2025 Future with Project (Mitigated)	S	C
	2035 Future w/o Project	U	A
	2035 Future with Project	S	F
	2035 Future with Project (Mitigated)	S	E
HOUGHTON and ENTRANCE #5 AM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	A
HOUGHTON and ENTRANCE # 5 PM PEAK	Existing	N/A	
	2025 Future w/o Project	U	
	2025 Future with Project	U	A
	2035 Future w/o Project	U	
	2035 Future with Project	U	B
HOUGHTON and SOUTH UNION AVENUE AM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	A
	2025 Future with Project	AWS	B
	2035 Future w/o Project	AWS	B
	2035 Future with Project	AWS	C
HOUGHTON ROAD/ and SOUTH UNION AVENUE PM PEAK	Existing	AWS	A
	2025 Future w/o Project	AWS	B
	2025 Future with Project	AWS	D
	2025 Future with Project (Mitigated)	AWS	C
	2035 Future w/o Project	AWS	C
	2035 Future with Project	AWS	F
	2035 Future with Project (Mitigated)	S	D
BUENA VISTA BLVD and COTTONWOOD ROAD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
BUENA VISTA BLVD and COTTONWOOD ROAD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
BUENA VISTA BLVD and ADOBE ROAD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
BUENA VISTA BLVD and ADOBE ROAD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
SHAFTER ROAD and SOUTH UNION AVENUE AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
SHAFTER ROAD and SOUTH UNION AVENUE PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
SR-99 SB RAMP and COSTAJO ROAD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	D
	2035 Future with Project	U	D
.			
SR-99 SB RAMP and COSTAJO ROAD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	B
	2025 Future with Project	U	B
	2035 Future w/o Project	U	F
	2035 Future with Project	U	F
	2035 Future with Project (Mitigated)	U	F
BEAR MOUNTAIN BLVD and COSTAJO ROAD AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
BEAR MOUNTAIN BLVD and COSTAJO ROAD PM PEAK	Existing	U	A
	2025 Future w/o Project	U	B
	2025 Future with Project	U	B
	2035 Future w/o Project	U	F
	2035 Future with Project	U	F

Table 4.16-1 (Continued). Intersection Level of Service.

Intersection	Scenario	Type	LOS
BEAR MOUNTAIN BLVD and SR-99 NB RAMP AM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
BEAR MOUNTAIN BLVD AND SR-99 NB RAMP PM PEAK	Existing	U	A
	2025 Future w/o Project	U	A
	2025 Future with Project	U	A
	2035 Future w/o Project	U	A
	2035 Future with Project	U	A
BEAR MOUNTAIN BLVD and SOUTH UNION AVENUE AM PEAK	Existing	AWS	B
	2025 Future w/o Project	AWS	B
	2025 Future with Project	AWS	B
	2035 Future w/o Project	AWS	C
	2035 Future with Project	AWS	C
BEAR MOUNTAIN BLVD/ SR-223 and SOUTH UNION AVENUE PM PEAK	Existing	AWS	B
	2025 Future w/o Project	AWS	C
	2025 Future with Project	AWS	C
	2035 Future w/o Project	AWS	E
	2035 Future with Project	AWS	E

U-Unsignalized Intersection; S-Signalized Intersection; AWS - All Way Stop
Notes:
[1] Taft Highway/ SR-119 becomes Panama Road at South Union Avenue.

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

Existing Traffic Signal Warrants

Signalization of an intersection is not necessarily justified by the satisfaction of a single warrant. Poor operations (LOS) and poor safety characteristics, as well as satisfaction of multiple warrants are normally the criteria for installing a traffic signal. For purposes of the Traffic Study, a poor operational LOS for multiple movements, and satisfaction of signal warrants, was considered justification for traffic signal installations.

All unsignalized intersections within the Traffic Study scope were analyzed for traffic signal warrants using the procedures outlined in the California Manual on Uniform Traffic Control Devices (MUTCD) for Warrants 1A: ADT – Minimum Vehicular Traffic; 1B: ADT – Interruption of Continuous Traffic; 1A and 1B: ADT – Combinations of Warrants 1A and 1B; and 3: Peak Hour (70% Factor) Warrant.

Under Existing 2016 Conditions, traffic signal warrants are not satisfied at any of the study intersections.

Existing Roadway Volume to Capacity (V/C)

The volume-to-capacity (V/C) ratios were calculated for roadways under existing conditions, based on published average daily traffic (ADT) information. The proposed Project is located within the Metropolitan Bakersfield General Plan; therefore, Metropolitan Bakersfield General Plan performance criterion was utilized for intersections and roadway segments. A V/C of greater than 0.80 corresponds to a LOS "D", "E", or "F".

The following roadway segments operate at unacceptable LOS under Existing 2016 Conditions:

- Taft Highway/SR-119/SR-99 Northbound Ramp: South H Street (V/C=0.98; LOS "E")
- Taft Highway/SR-119/Panama Road: South H Street to South Union Avenue (V/C=1.03; LOS "F")
- Taft Highway/SR-119/Panama Road: South Union Avenue to Cottonwood Road (V/C=0.89; LOS "D")
- Panama Road: East of Cottonwood Road (V/C=0.85; LOS "D")
- Bear Mountain Boulevard/SR-223: SR-99 Northbound Ramp to South Union Avenue (V/C=0.93; LOS "E")
- Bear Mountain Boulevard/SR-223: East of South Union Avenue (V/C=0.94; LOS "E")

Non-Motorized Transportation

There are no dedicated pedestrian or bicycle facilities in the immediate proposed Project vicinity or along the surrounding roadways.

Public Transit

Public transportation in Kern County is provided by Kern Regional Transit. Kern County provides service between Bakersfield and rural communities, such as Lamont and the Kern River Valley, while the private carriers serve other major cities. Kern Regional Transit has 16 fixed routes, and also provides a dial-a-ride general public transportation service for residents in Lake Isabella, Lamont, Mojave, Rosamond, Tehachapi, and Frazier Park. In addition, Kern Regional Transit provides a non-emergency medical dial-a-ride service to passengers traveling to and from the Metropolitan Bakersfield area on the fixed routes for medical appointments.

The largest transit system for the Metropolitan Bakersfield area is Golden Empire Transit (GET), which is the local bus operator. GET operates 18 routes throughout the Metropolitan Bakersfield area and carries approximately 23,000 passengers per day. This amounts to one percent of total travel in the Metropolitan Bakersfield area. GET does not provide service outside of the Metropolitan Bakersfield area.

Intercity bus operators are Greyhound, Orange Belt Stages, Airport Bus of Bakersfield and Kern County. Paratransit providers include the taxicab system and various social service agencies that provide specialized transportation to their clients.

Amtrak provides rail service to and from Bakersfield. The Amtrak station is located at Truxtun Avenue and S Street.

Existing rail lines include two major railroads that provide freight service to Bakersfield: Burlington Northern-Santa Fe (BNSF) and Southern Pacific. The BNSF and the Union Pacific (UPRR) rail yard is located in East Bakersfield between Kentucky and Sumner Streets.

Airport Facilities

Commercial air travel in the area is provided by Meadows Field Airport, which is owned by Kern County and is one of seven airports operated by the Department of Airports. Located approximately seven (7) miles north of downtown Bakersfield and approximately 12 miles north of the proposed Project site, Meadows Field Airport serves more than 700,000 people in or near the southern San Joaquin Valley. The airport is approximately 1,400 acres in size.

The Bakersfield Municipal Airport, owned by the City of Bakersfield, is approximately 200 acres in size with two runways and is located approximately five (5) miles northeast of the proposed Project site. It is a corporate airport that is home to over 100 general aviation aircraft and primarily serves general aviation small aircraft for destinations in southern California.

Costerisan Farms Airport, a private airstrip, was located approximately two (2) miles northwest of proposed Project site. Costerisan Farms Airport was serviced by two grass runways. This private airstrip is no longer in use (pilotnav 2017).

Because several miles exist between the airports and the proposed Project site, neither construction nor completion of the proposed Project is expected to have any effect on air traffic patterns. Thus, air traffic patterns are not further addressed in the impact analysis for this proposed Project.

4.16.3 Regulatory Setting

Federal

Federal Aviation Administration (FAA)

The FAA regulates aviation at regional, public, private, and military airports, such as Lemoore Naval Air Station Tejon Ag Airport. The FAA regulates objects affecting navigable airspace and structures taller than 200 feet according to Federal Aviation Regulation 14 Code of Federal Regulations Part 77 (14 CFR 77). The U.S. and California Departments of Transportation also require the proponent to submit FAA Form 7460-1, Notice of Proposed Construction or Alteration.

As described in 14 CFR 77.9 (Construction or alteration requiring notice), each sponsor who proposes any of the following construction or alteration scenarios shall notify the FAA in the form and manner as follows:

> If requested by the FAA, or if you propose any of the following types of construction or alteration, you must file notice with the FAA of:
>
> (a) Any construction or alteration that is more than 200 feet AGL at its site.

(b) Any construction or alteration that exceeds an imaginary surface extending outward and upward at any of the following slopes:

(1) 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway more than 3,200 ft. in actual length, excluding heliports.

(2) 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway no more than 3,200 feet in actual length, excluding heliports.

(3) 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport described in paragraph (d) of this section.

(c) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed a standard of paragraph (a) or (b) of this section.

(d) Any construction or alteration on any of the following airports and heliports:

(1) A public use airport listed in the Airport/Facility Directory, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Publications;

(2) A military airport under construction, or an airport under construction that will be available for public use;

(3) An airport operated by a Federal agency or the DOD.

(4) An airport or heliport with at least one FAA-approved instrument approach procedure.

(e) You do not need to file notice for construction or alteration of:

(1) Any object that will be shielded by existing structures of a permanent and substantial nature or by natural terrain or topographic features of equal or greater height, and will be located in the congested area of a city, town, or settlement where the shielded structure will not adversely affect safety in air navigation;

(2) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device meeting FAA-approved siting criteria or an appropriate military service siting criteria on military airports, the location and height of which are fixed by its functional purpose;

(3) Any construction or alteration for which notice is required by any other FAA regulation.

(4) Any antenna structure of 20 feet or less in height, except one that would increase the height of another antenna structure.

Per 14 CFR 77.7, notification requirements include sending one executed form set of FAA Form 7460-1, Notice of Proposed Construction or Alteration, to the Manager, Air Traffic Division, FAA Regional Office having jurisdiction over the area within which the construction or alteration will be located. The notice required must be submitted at least 45 days before the earlier of the following dates: (1) the date the proposed construction or alteration is to begin, or (2) the date an application for a construction permit is to be filed.

State

California Department of Transportation

The California Department of Transportation (Caltrans) is responsible for operating and maintaining the State highway system. In the project vicinity, SR-99 and associated freeway ramps and ramp terminal intersections fall under Caltrans jurisdiction. Caltrans provides administrative support for transportation programming decisions made by the California Transportation Commission (CTC) for state funding programs. The State Transportation Improvement Program (STIP) is a multi-year capital improvement program that sets priorities and funds transportation projects envisioned in long-range transportation plans. The Caltrans *Guide for the Preparation of Traffic Impact Studies* provides general guidance regarding the preparation of traffic impact studies for projects that may have an impact on the State Highway System. The Caltrans *Highway Design Manual* (HDM) establishes uniform policies and procedures for State highway designs. Caltrans also sets maximum load limits for trucks and safety requirements and administers the following regulations for oversized vehicles that operate on State highways:

California Vehicle Code (CVC), Division 15, Chapters 1 through 5 (Size, Weight, and Load)

Includes regulations pertaining to licensing, size, weight, and load of vehicles operated on highways.

California Street and Highway Code Sections 660-711, 670-695

Requires permits from Caltrans for any roadway encroachment during truck transportation and delivery, includes regulations for the care and protection of State and county highways and provisions for the issuance of written permits, and requires permits for any load that exceeds Caltrans weight, length, or width standards for public roadways.

Local

Metropolitan Bakersfield General Plan

Traffic analysis in the State of California is guided by policies and standards set at the state level by Caltrans and local jurisdictions. Transportation policies that may apply to the proposed Project are discussed within the Metropolitan Bakersfield General Plan. The Metropolitan Bakersfield General Plan is the product of a joint planning effort between the City of Bakersfield and Kern County, and it covers all territory within the Bakersfield Metropolitan Priority Area of the Kern County General Plan. The goals and policies that apply to transportation are discussed below in Table 4.16-2, *Metropolitan Bakersfield General Plan Goals and Policies for Traffic and Circulation.*

Kern Council of Governments (Kern COG) Congestion Management Program (CMP)

All urbanized areas larger than 200,000 persons are required to have a Congestion Management System, Program, or Process. Kern COG refers to its congestion management activities as the Congestion Management Program (CMP). Kern COG was designated as the Congestion Management Agency.

The CMP is a systematic process for managing congestion that provides information on: (1) transportation system performance, and (2) alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs.

The purpose of the CMP is to help ensure that a balanced transportation system is developed that relates population growth, traffic growth and land use decisions to transportation system LOS performance standards and air quality improvement. The CMP is an effort to more directly link land use, air quality, transportation and the use of new advanced transportation technologies as an integral and complementary part of this region's plans and programs.

The purpose of defining the CMP network is to establish a system of roadways that will be monitored in relation to established LOS standards. At a minimum, all State highways and principal arterials must be designated as part of the Congestion Management System of Highways and Roadways. Kern County has 18 designated state highways.

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Table 4.16-2. Metropolitan Bakersfield General Plan Goals and Policies for Traffic and Circulation
GOALS AND POLICIES
Circulation Element - Streets Goals
Streets Goal #1: Provide a safe and efficient street system that links all parts of the area for movement of people and goods.
Streets Goal #2: Provide for safe and efficient motorized, non-motorized, and pedestrian traffic movement.
Streets Goal #3: Minimize the impact of truck traffic on circulation, and on noise sensitive land uses.
Streets Goal #4: Provide a street system that creates a positive image of Bakersfield and contributes to residents' quality of life.
Streets Goal #6: Provide a local street network that contributes to the quality and safety of residential neighborhoods and commercial districts.
Streets Goal #7: Develop and maintain a circulation system that supports the land use plan shown in the General Plan.
Circulation Element - Streets Policies
Streets Policy #3: Provide additional right-of-way and pavement width to accommodate turn lanes at intersections.
Streets Policy #4: Provide additional right-of-way and pavement width at other locations for turn lanes, bus lanes, etc., as needed, based on engineering study.
Streets Policy #5: Place traffic signals to minimize delay.
Streets Policy #6: Design and locate site access driveways to minimize traffic disruption where possible considering items such as topography, past parcelization and other factors.
Streets Policy #7: Minimize direct and uncontrolled property access from arterials.
Streets Policy #8: Limit full access median breaks on arterials to a maximum of three per mile and include left-turn lanes at each.
Streets Policy #10: Design local streets to conform to topography. Allow for deviation from "grid" system on local streets when they do not interfere with other traffic policies and traffic flows.
Street Policy #11: Design local collector street systems to minimize through traffic movements and include short block lengths to discourage excessive speeds.
Streets Policy #12: Maintain the integrity of the circulation system.
Streets Policy #18: Provide and maintain landscaping on both sides and in the median of arterial streets within incorporated areas. In unincorporated areas, landscaping within road right-of-way may be allowed and shall be limited to low shrubs; blank irrigation conduit only will be provided within the median of arterial streets.
Streets Policy #19: Provide and maintain landscaping on both sides of collector streets. In unincorporated areas, landscaping within road right-of-way may be allowed and shall be limited to low shrubs.
Streets Policy #21: Route traffic around, rather than through, pedestrian-oriented areas.
Streets Policy #22: Design transportation improvements to minimize noise impacts on adjacent uses.

Table 4.16-2. Metropolitan Bakersfield General Plan Goals and Policies for Traffic and Circulation
GOALS AND POLICIES
Streets Policy #32: Reserve or acquire right-of-way for all future transportation facilities in conformance with the Circulation Plan Map.
Streets Policy #35: Require new development and expansion of existing development in incorporated areas to fully provide for on-site transportation facilities including, streets, curbs, traffic control devices, etc. Within unincorporated areas street improvements will be determined by County Ordinance.
Streets Policy #36: Prevent streets and intersections from degrading below Level of Service "C" where possible due to physical constraints (as defined in a Level of Service Ordinance) or when the existing Level of Service is below "C" prevent where possible further degradation due to new development with a three-part mitigation program: adjacent right-of-way dedication, access improvements and/or on area-wide impact fee. The area-wide impact fee would be used where the physical changes for mitigation are not possible due to existing development and/or the mitigation measures is part of a larger Project, such as freeways, which will be built at a later date.
Streets Policy #37: Require new development and expansion of existing development to pay for necessary access improvements, such as street extensions, widenings, turn lanes, signals, etc., as identified in the transportation impact report as may be required for a Project.
Streets Policy #39: Require new development and expansion of existing development to pay or participate in its pro rata share of the costs of expansions in area-wide transportation facilities and services which it necessitates.
Streets Policy #40: Provide new local street systems that are logical and comprehensible and systems of street names and addresses that are simple, consistent, and understandable.
Streets Policy #41: Plan alignments for local streets to permit economical and practical patterns, shapes, and sizes of development parcels.
Circulation Element - Transit Goals
Transit Goal #2: Provide a street system and land development policies that support public transportation.
Transit Goal #3: Provide cost-effective public transportation services.
Transit Goal #4: Reduce traffic congestion and parking requirements and improve air quality through improved transportation services.
Circulation Element - Transit Policies
Transit Policy #1: Consider transit service issues in the design of the arterial and collector street system.
Transit Policy #2: Consider for bus turnouts along arterials and collectors where appropriate.
Transit Policy #3: Consider transit service issues in the site planning review process.
Transit Policy #4: Coordinate with GET [Golden Empire Transit] to locate bus stops as close as possible to the facilities they serve.
Circulation Element - Bikeways Goals
Bikeways Goal #1: Provide a circulation system which recognizes and responds to the needs of bicycle travel.
Bikeways Goal #2: Provide a circulation system that minimizes cyclist/motorist conflicts.

Table 4.16-2. Metropolitan Bakersfield General Plan Goals and Policies for Traffic and Circulation
GOALS AND POLICIES
Circulation Element - Bikeways Policies
Bikeways Policy #5: Consider bicycle safety when implementing improvements for automobile traffic operations.
Bikeways Policy #7: Provide bicycle parking facilities at activity centers such as shopping centers, employment sites, and public buildings.
Bikeways Policy #9: Require new subdivisions to provide bike lanes on collector and arterial streets in accordance with the Bikeway Master Plan.
Bikeways Policy #11: Construct bike lanes in conjunction with all street improvement Projects that coincide with the Bikeway Master Plan.
Circulation Element - Parking Goals
Parking Goal #1: Provide an efficient parking system to respond to the needs of motorists.
Parking Goal #2: Satisfy parking requirements in all new developments (residential, commercial, industrial, etc.) through off-street facilities.
Parking Goal #3: Preserve and enhance residential neighborhoods through parking policy.
Circulation Element - Parking Policies
Parking Policy #1: Periodic review and, if needed, revision of adopted minimum parking requirements based on parking demand.
Parking Policy #2: Periodic review and, if needed, revision of adopted stall and aisle widths that are convenient and efficient.
Parking Policy #5: Remove abandoned vehicles promptly from city streets.
Parking Policy #6: Regulate parking of vehicle, boats, trailers, etc. on city streets.
Parking Policy #7: Identify on-site parking needs in activity centers and outline procedures to finance and provide the facilities.
Parking Policy #8: Give top priority to satisfying short-term parking needs, i.e., less than or equal to three hours, and second priority to long-term parking needs.
Parking Policy #9: Locate short-term parking to be convenient to the businesses served.
Parking Policy #10: Locate long-term parking on peripheral lands, accessible to arterial streets.
Parking Policy #11: Discourage parking between the sidewalk and buildings in pedestrian sensitive areas.
Circulation Element - Pedestrian Ways Goals
Pedestrian Ways Goal #1: Encourage pedestrian travel as a viable mode of movement throughout the Planning area.
Pedestrian Ways Goal #2: Provide adequate sidewalks throughout the planning area.

Table 4.16-2. Metropolitan Bakersfield General Plan Goals and Policies for Traffic and Circulation
GOALS AND POLICIES
Circulation Element - Pedestrian Ways Policies
Pedestrian Ways Policy #1: Provide sidewalks along streets where pedestrian use warrants.
Pedestrian Ways Policy #4: Provide for the physically handicapped in the design of all pedestrian facilities.
Pedestrian Ways Policy #5: Encourage development of pedestrian sensitive uses and design characteristics in the following areas: a) Downtown b) Baker Street c) Southwest Center d) Northwest Center

4.16.4 Impacts and Mitigation Measures

Methodology

This section presents the methodologies used to perform the traffic analyses. The study methodology is consistent with the guidelines of the City of Bakersfield, Caltrans, Kern County, and the Metropolitan Bakersfield General Plan. The overall methodologies used to develop future traffic volume forecasts and the explicit traffic operations analysis methodologies are summarized herein.

Analyses were performed for Year 2016 for existing conditions, and Years 2025 and 2035 for both the "without Project" and "with Project" scenarios. The Traffic Study obtained Year 2016 traffic volumes by conducting traffic counts in accordance with all agencies within the study area: Kern County, City of Bakersfield, and Caltrans. Year 2025 and Year 2035 traffic volumes in the Traffic Study were determined using data from a regional cumulative projects traffic model prepared by Kern COG. Proposed Project impacts were assessed based on roadway and intersection LOS. Improvements needed to maintain or improve traffic operational LOS were also identified.

Intersection Analysis Methodology

Traffic LOS is commonly used as a qualitative description of intersection operation and is based on the capacity of the intersection and the volume of traffic using the intersection. The methods used to evaluate cumulative plus project traffic conditions were taken from the Transportation Research Board, National Research Council's 2010 Highway Capacity Manual (HCM). Additionally, the SYNCHRO 9 computer software package was utilized to coordinate and facilitate extensive HCM intersection calculations.

The 2010 HCM Operational Analysis Methodology describes the operation of an unsignalized intersection using a range from LOS "A" (free-flow conditions) to "F" (severely congested conditions), based on the average delay experienced per vehicle, as shown in Table 4.16-3, *Level of Service Criteria for Unsignalized Intersections.*

Table 4.16-3. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (Seconds per Vehicle)	Expected Delay to Minor Street Traffic
A	= 10	Little or no delay
B	> 10 and = 15	Short traffic delays
C	> 15 and = 25	Average traffic delays
D	> 25 and = 35	Long traffic delays
E	> 35 and = 50	Very long traffic delays
F	> 50	When demand volume exceeds the capacity of the lane, extreme delays will be encountered. This condition usually warrants improvement to the intersection.

Source: 2010 Highway Capacity Manual.

Operating conditions at intersections are assessed in terms of the LOS during a typical hour-long period. The LOS is based on the volume of traffic passing through an intersection, the number of lanes available to serve the traffic demands, and the type of traffic control at the intersection (i.e., stop sign control or traffic signal). Table 4.16-4, *Level of Service Criteria for Signalized Intersections,* summarizes the LOS criteria for signalized intersections as identified by the HCM. LOS "A" represents free flow conditions, LOS "D" represents conditions where vehicles on some approaches may have to wait through more than one traffic signal cycle to pass through the intersection, LOS "E" represents the theoretical capacity of the intersection, and LOS "F" represents jammed conditions.

Table 4.16-4. Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay (Seconds per Vehicle)	Volume/Capacity
A	< 10	< 0.60
B	> 10 and = 20	0.61-0.70
C	> 20 and = 35	0.71-0.80
D	> 35 and = 55	0.81-0.90
E	> 55 and = 80	0.91-1.00
F	> 80	> 1.0

Source: 2010 Highway Capacity Manual.

Roadway Analysis Methodology

Operating conditions for roadway segments are based on corresponding V/C ratios shown in Table 4.16-5, *LOS Criteria – Roadway Segments*. A V/C of greater than 0.80 corresponds to an LOS "D", "E" or "F", as defined in the Highway Capacity Manual. The Metropolitan Bakersfield General Plan performance criterion for intersections and roadway segments is LOS "C".

Table 4.16-5. LOS Criteria – Roadway Segments

Level of Service (LOS)	Description	Volume/Capacity Ratio
A	Free flow conditions, unimpeded ability to maneuver and pass, very little delay, no platoons, highest average travel speeds.	≤ 0.60
B	Mostly free flow conditions, presence of other vehicles beings to be noticeable. Passing is required to maintain speeds, slightly less average travel speeds than Level of Service "A'.	0.61 – 0.70
C	Traffic density clearly affects the ability to pass and maneuver within the stream. Speeds are reduced to about 50 mph on highways and about 50% of the average on urban arterials.	0.71 – 0.80
D	Unstable flow. Speeds are reduced from 40% to 60% of normal. Passing demand is high although mostly impossible on 2-land highways. Traffic disruptions usually cause extensive queues.	0.81 – 0.90

Table 4.16-5. LOS Criteria – Roadway Segments

Level of Service (LOS)	Description	Volume/Capacity Ratio
E	Very unstable flow at or near capacity. Passing and maneuvering virtually impossible. Extensive platooning on highways and queuing on arterials. Speeds range from 20 mph to less on arterials and 2-lane highways, and up to 50 mph on multi-lane highways.	0.91 – 1.00
F	Forced or breakdown flow. Demand exceeds capacity. Vehicles experience short spurts of movement followed by stoppages. Intersection congestion, long queues and delays are common.	> 1.00

Source: 2010 Highway Capacity Manual.

Definition of Deficiency and Significant Impact

The definition of deficiency was obtained from the Metropolitan Bakersfield General Plan Circulation Element. The performance criteria for all intersections and street segments is LOS "C". Kern County has two standards for determining whether project traffic has a significant impact, and therefore, requires mitigation:

- Mitigation would be required when the addition of project traffic causes the LOS of an intersection or street to drop below LOS "C".
- If an intersection or street operates below LOS "C" prior to the addition of project traffic, mitigation would be required only as necessary to maintain the status quo.

Thresholds of Significance

The traffic issues related to the proposed land use and development have been evaluated in the context of CEQA and the Kern COG Regional Transportation Plan (RTP). Kern County is the lead agency responsible for preparation of the traffic impact analysis, in accordance with both CEQA and CMP authorizing legislation.

The Kern County CEQA Implementation Document and Kern County Environmental Checklist state that a project could potentially have a significance effect if it would:

- Conflict with an applicant plan, ordinance, or policy establishing measures of effectiveness (as designated in a general plan policy, ordinance, etc.), taking into account all relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit;
- Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency or adopted County threshold for designated roads or highways. Specifically, would implementation of the project cause the LOS for roadways and/or intersections to decline below the following thresholds or further degrade already degraded segment(s);

  - Metropolitan Bakersfield General Plan, below LOS "C";

- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks;
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- Result in inadequate emergency access;
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts and bicycle racks).

A project is considered to have a significant transportation impact where it causes the LOS to drop below LOS "C" on local roadways and intersections and LOS "D" of state facilities and intersections. A project is also considered to have a significant impact if it adds substantial traffic volumes to a roadway segment or intersection that is already operating at unacceptable LOS.

Project Impacts

Impact 4.16-1: The project would not conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit.

The proposed Project components are described in detail in Section 3.0*, Project Description.* The proposed Project would allow for development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. South Union Avenue, Houghton Road, and the DiGiorgio Road alignment provide the primary access to and from the Project area.

Project Trip Generation and Design Hour Volumes

The trip generation and design hour volumes indicated in Table 4.16-6, *Project Trip Generation*, were calculated using the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition, 2012. Project traffic was estimated for weekday AM and PM peak hour traffic. Rate equations and directional splits for ITE Land Use Code 130 (Industrial Park) and 820 (Shopping Center) were used to estimate trip generation for the Project based on 314.30 acres of development. The ITE Land Use Code of 130 represents a conservative estimate for future traffic generated from the project site because it reflects the maximum vehicle trip generation for the various uses that would be permitted for the potential land uses and zoning of the proposed project (McIntosh and Associates, 2018).

Table 4.16-6. Project Trip Generation

ITE Code	Development Type	Variable / Acres	Daily Trips	AM Peak Hour Trips		PM Peak Hour Trips	
			ADT	In Split/ Trips	Out Split/ Trips	In Split/ Trips	Out Split/ Trips
130	Light Industrial / Service Industrial	267.30 acres	16,351	1,819	373	502	1,778
820	General Commercial	47 acres	15,702	257	165	877	912
20% Reduction to Account for "Pass By"				(44)	(37)	(175)	(183)
	Totals	314.30 acres	32,053 trips	2,029	501	1,203	2,508

Source: May 29, 2018 Response Letter to Kern County Planning from McIntosh & Associates regarding the November 2016 Traffic Impact Study for 99 Houghton.

The Circulation Element of the Metropolitan Bakersfield General Plan is the primary guidance document detailing the planning tools essential for achieving the local transportation goals and policies. The Circulation Element consists of the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and other local public utilities and facilities, all correlated with the Land Use Element of the Metropolitan Bakersfield General Plan.

It is not possible to build transportation projects fast enough to keep pace with development in all instances. Both the Metropolitan Bakersfield Circulation Plan and the Kern County Circulation Plan operate on the theory that existing roads will be widened as land use intensity increases. The County is uniquely dependent on State Highway construction and retrofits to satisfy inter-city road travel and assumes that future development will be the trigger for the development of new roads. As such, it is the policy of the County to protect all surveyed section and mid-section lines, through right-of-way dedications in the Valley and Desert Regions of the County for arterial and collector highways. The Circulation Element road standards for arterial and collector highways are identified below. Modifications to these standards are considered on a case-by-case basis.

- Arterial (Major Highway) Minimum 110-foot right-of-way:
- County Standard 110 feet
- Collector (Secondary Highway) Minimum 90-foot right-of-way:
- County Standard 90 feet

In reviewing the total number of trips estimated for the development of the proposed Project site, it is anticipated that implementation of the proposed Project would not exceed the capacity of the identified circulation system when the roadways are built to the identified standards. Roadway dedications are required for all development and are implemented through compliance with the Kern County Land Division Ordinance, Zoning Ordinance and Development Standards. The proposed Project does not include any amendments to the existing Circulation Element. As such, impacts to

the existing road network are considered less than significant through implementation of local and state right-of-way dedication requirements.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.16-2: The Project Would not Conflict with an Applicable Congestion Management Program, Including, but not Limited to Level of Service Standards and Travel Demand Measures, or Other Standards Developed by the County Congestion Management Agency for Designated Roads or Highways.

Unlike future road right-of-way dedications, which can be protected in advance of development, LOS for adjacent and surrounding road segments or roadway intersections are directly impacted by the type of development proposed in a given area. The proposed Project is located within the administrative boundaries of the Metropolitan Bakersfield General Plan. As previously stated, for all roads subject to the Metropolitan Bakersfield General Plan, it is the objective and policy to maintain a minimum LOS "C" or better.

LOS standards are primarily addressed through improvements to intersections such as the installation of signal lights and the addition of turning lanes among other site- specific transportation related improvements. Mitigation is required if development causes affected roadways to fall below LOS "C".

Additionally, State law requires that urbanized counties prepare an annual CMP. City and County eligibility for new gas tax subventions is contingent upon their participation in the congestion management program. The County has designated Kern COG as the County's Congestion Management Agency. To qualify for funding provided through the State Transportation Improvement Program (STIP) or the Federal Transportation Improvement Program (FTIP), the regional transportation agency must keep a current Regional Transportation Plan (RTP) that contains the CMP. Also, the CMP offers local jurisdictions the opportunity to find cooperative solutions to the multi-jurisdictional problems of air pollution and traffic congestion. Requiring projects to maintain a LOS "C" ensures the County is in compliance with the adopted CMP.

The following information was included in the Traffic Study (refer to Appendix M, *Traffic Impact Study*).

Trip Distribution and Assignment

The proposed Project trip distribution and assignment assumptions within the study area are illustrated on Figure 4.16-2a, *Total Project Generated AM Peak Hour Turning Movements*, and Figure 4.16-2b, *Total Project Generated PM Peak Hour Turning Movements*. Project traffic

distribution was estimated based on Kern COG traffic model output and a review of existing development and proposed growth within the study area.

Future Year 2025 Without Project Traffic Volumes

Future Year 2025 peak hour turning movements without Project traffic are illustrated in Figure 4.16-3a, *Future Year 2025 AM Peak Hour Turning Movements Without Project*, and Figure 4.16-3b, *Future Year 2025 PM Peak Hour Turning Movements Without Project*.

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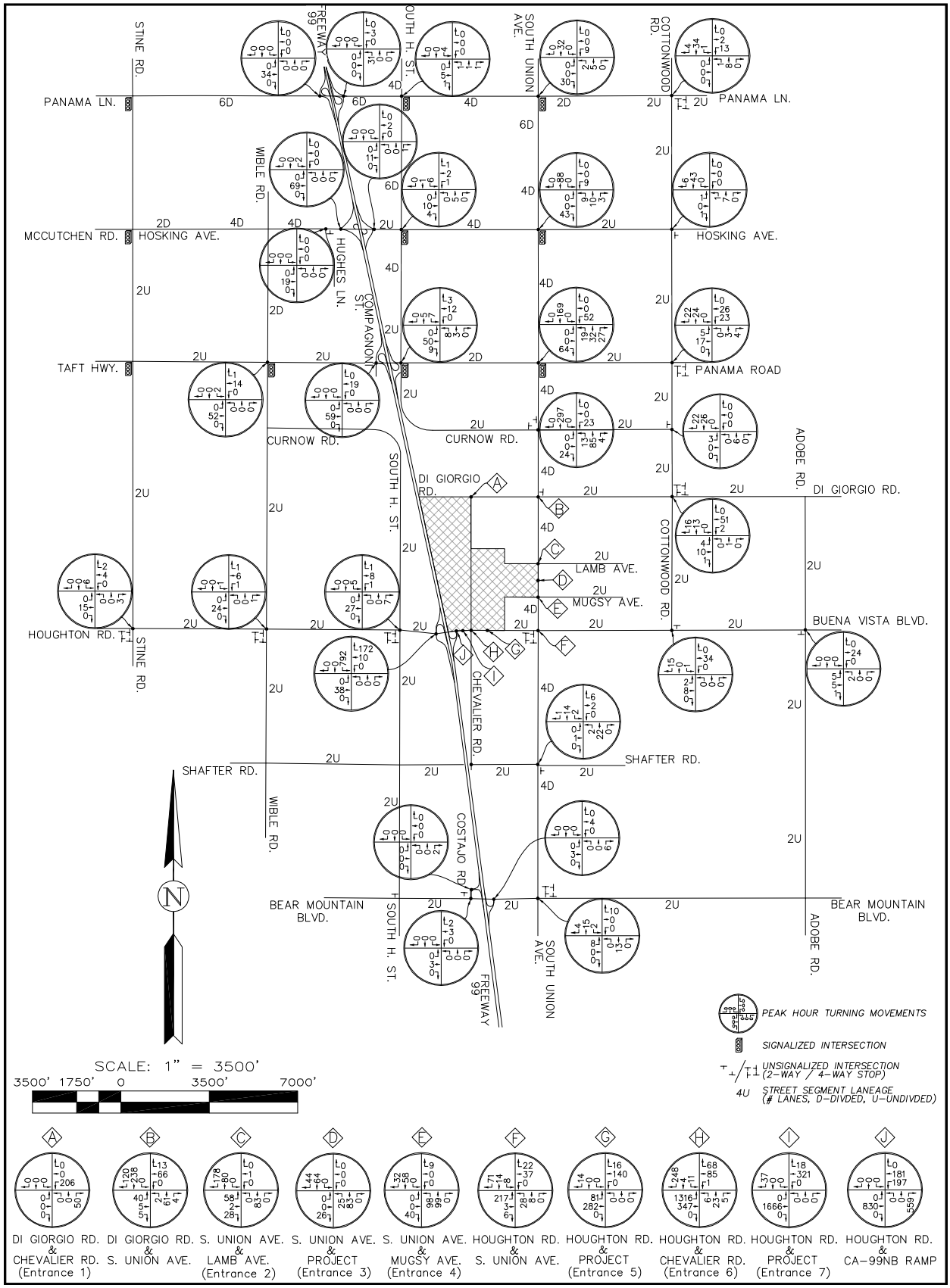


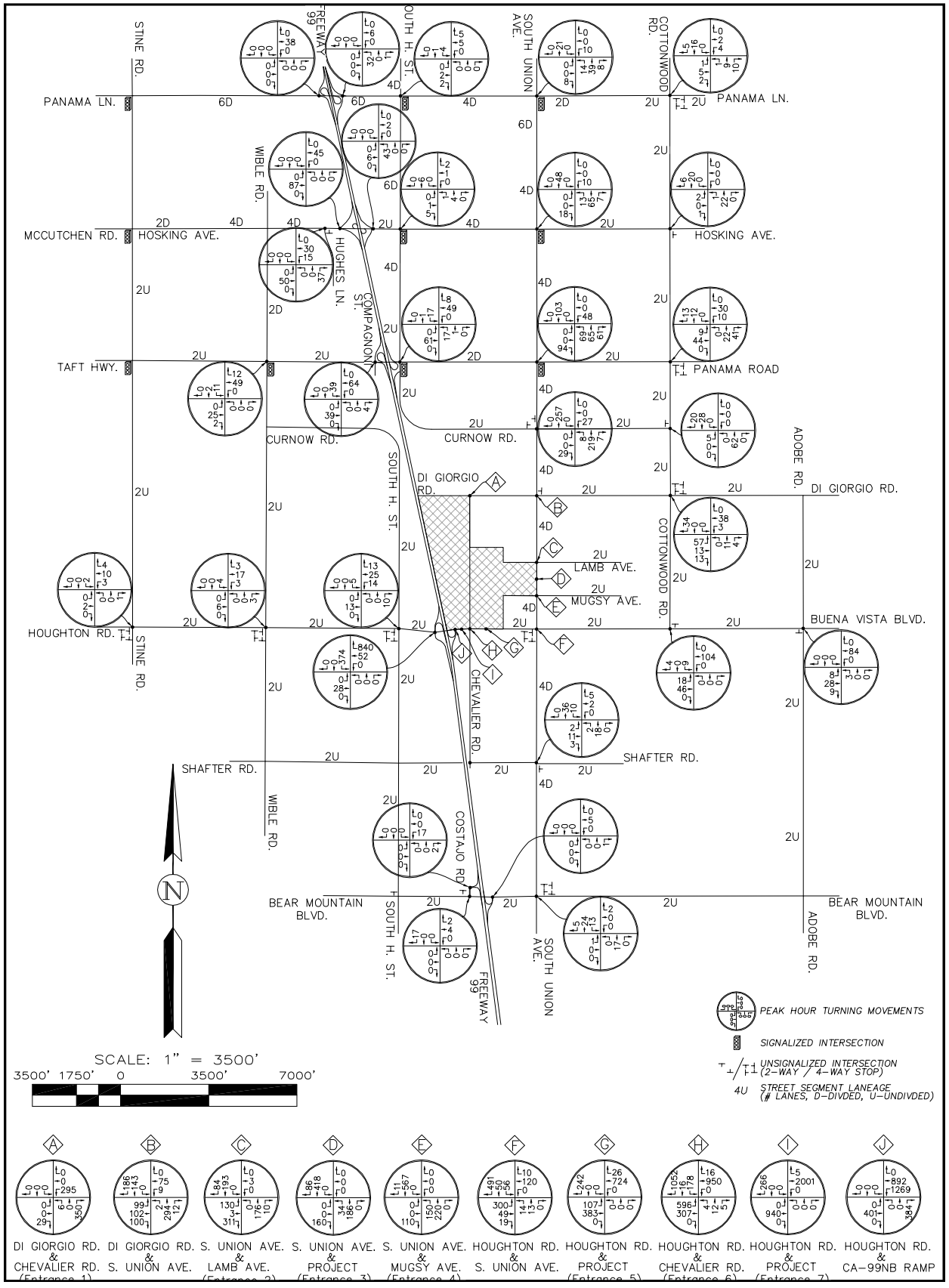
Source: McIntosh & Associates, 2016

99 HOUGHTON INDUSTRIAL PARK PROJECT

CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07 • AGRICULTURAL PRESERVE #13 EXCLUSION

Total Project Generated AM Peak Hour Turning Movements

Figure 4.16-2a



Source: McIntosh & Associates, 2016

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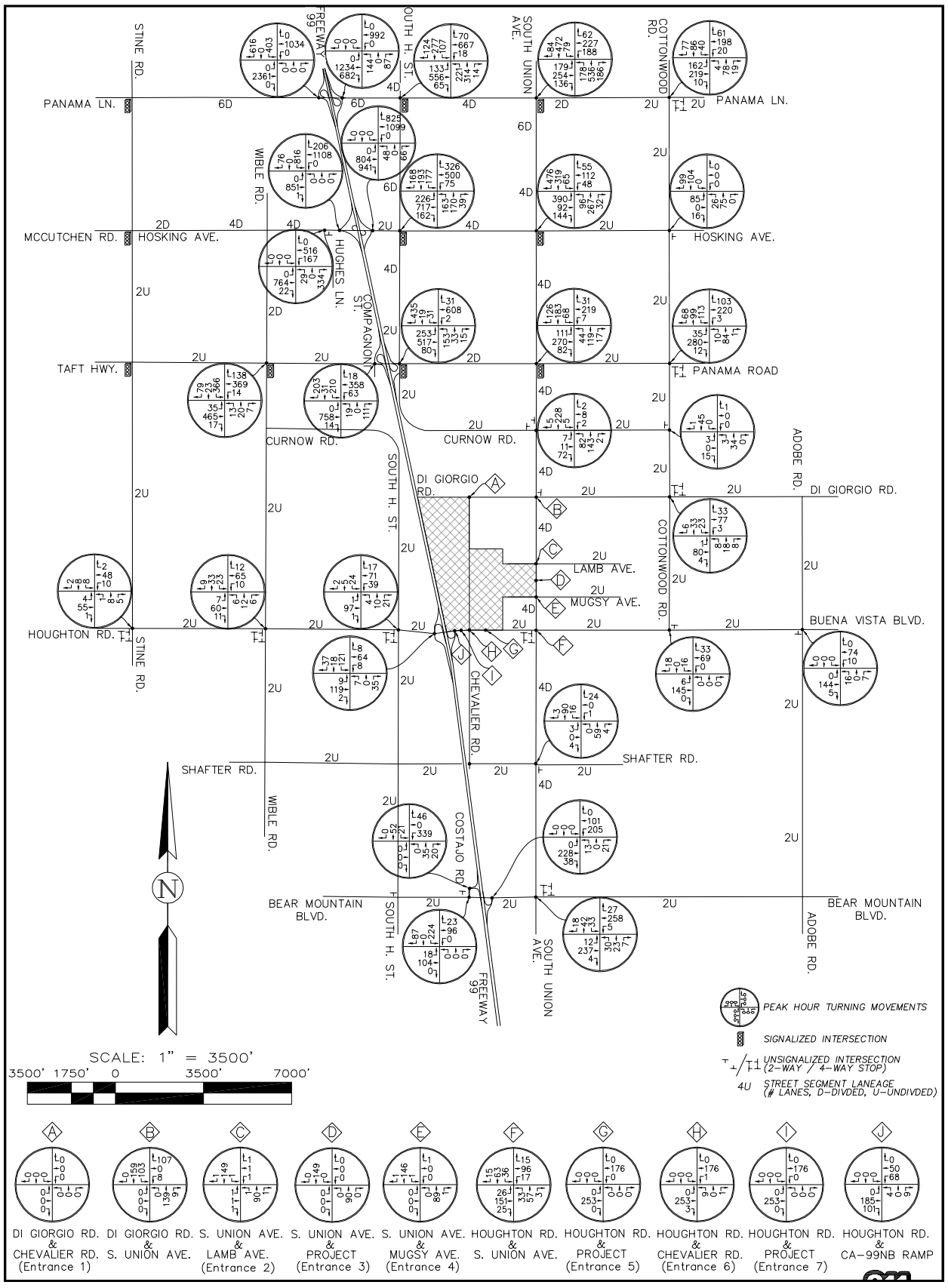
Total Project Generated PM Peak Hour Turning Movements

Figure 4.16-2b



Source: McIntosh & Associates, 2016

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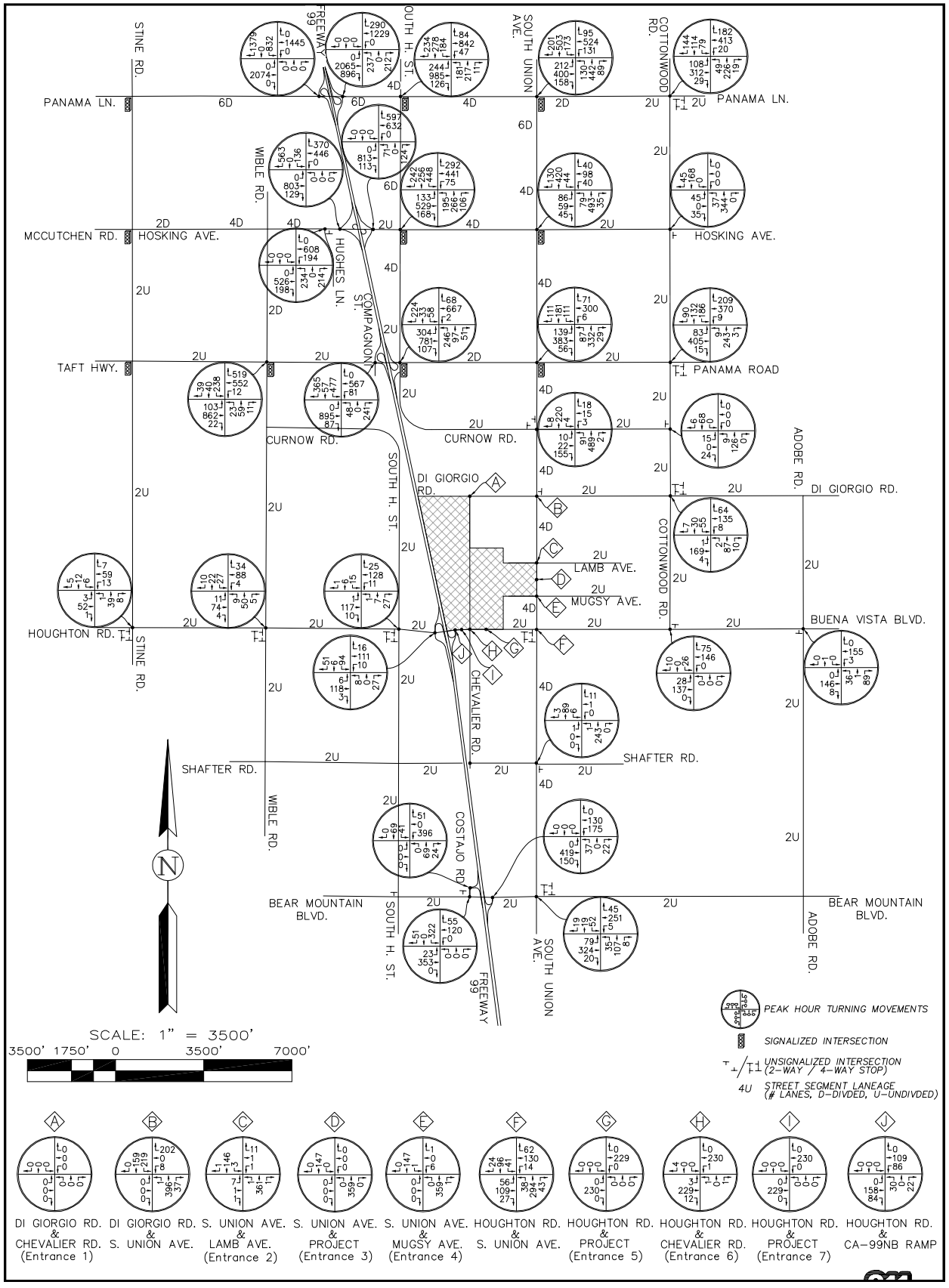
Future Year 2025 AM Peak Hour Turning Movements Without Project

Figure 4.16-3a



Source: McIntosh & Associates, 2016

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Future Year 2025 PM Peak Hour Turning Movements Without Project

Figure 4.16-3b

Future Year 2025 Without Project Intersection LOS

Table 4.16-1, *Intersection Level Of Service*, outlines the AM and PM peak hour LOS of the study intersections under Future Year 2025 Without Project conditions. The Metropolitan Bakersfield General Plan considers LOS "C" acceptable within the general plan area; therefore, as indicated in Table 4.16-1, the anticipated growth in traffic volumes by the Year 2025 would cause the following study intersections to operate at a deficient LOS (LOS "D", "E", or "F") under Future Year 2025 Without Project conditions:

- Panama Lane and South H Street (PM peak hour LOS "D")
- Panama Lane and SR-99 Southbound Ramp (PM peak hour LOS "E")
- Panama Lane and South Union Avenue (AM peak hour LOS "D" and PM peak hour LOS "E")
- Panama Lane and Cottonwood Road (PM peak hour LOS "F")
- Hosking Avenue and Hughes Lane (PM peak hour LOS "F")
- Hosking Avenue and South H Street (AM peak hour LOS "E" and PM peak hour LOS "F")
- Hosking Avenue and South Union Avenue (AM peak hour LOS "F")
- Taft Highway/SR-119 and Compagnoni Street / SR-99 Southbound Ramp (AM peak hour LOS "D" and PM peak hour LOS "F")
- Taft Highway/SR-119 and South H Street (AM peak hour LOS "F" and PM peak hour LOS "E")
- Panama Road and Cottonwood Road (PM peak hour LOS "F")

Future Year 2025 Without Project Traffic Signal Warrants

The results of the signal warrant analysis under Future Year 2025 Without Project conditions are indicated in Table 4.16-7, *Traffic Signal Warrants – Future Year 2025 Without Project Conditions*.

Table 4.16-7. Traffic Signal Warrants – Future Year 2025 Without Project Conditions

Intersection	Warrant(s) Satisfied[1]	Notes
Panama Lane and Cottonwood Road	1 and 3	Signalization of this intersection is included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF).
Hosking Avenue and Hughes Lane	1 and 3	Signalization of this intersection is included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee (RTIF) Program.
Hosking Avenue and SR-99 Northbound Ramp	1 and 3	Signalization of this intersection is included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF).
Hosking Avenue and SR-99 Southbound Off-Ramp	1 and 3	Signalization of this intersection is included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF).
Panama Road[2] and Cottonwood Road	1 and 3	Signalization of this intersection is included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF).

Table 4.16-7. Traffic Signal Warrants – Future Year 2025 Without Project Conditions

Intersection	Warrant(s) Satisfied[1]	Notes

[1] Warrants 1A: ADT – Minimum Vehicular Traffic; 1B: ADT – Interruption of Continuous Traffic; 1A and 1B: ADT – Combinations of Warrants 1A and 1B; and 3: Peak Hour (70% Factor) Warrant

[2] Taft Highway/ SR-119 becomes Panama Road at South Union Avenue.

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

As indicated in Table 4.16-7, the traffic signal warrant is satisfied at the following intersections under Future Year 2025 Without Project conditions:

- Panama Lane and Cottonwood Road
- Hosking Avenue and Hughes Lane
- Hosking Avenue and SR-99 Northbound Ramp
- Hosking Avenue and SR-99 Southbound Ramp
- Panama Road and Cottonwood Road

Future Year 2025 Without Project Roadway V/C

The V/C ratios were calculated for roadways with published ADT information and future traffic projections. Ultimate capacity is based on functional classification. A V/C of greater than 0.80 corresponds to a LOS "D" or below. Future traffic would cause the following studied roadway segments to operate at a deficient LOS (LOS "D", "E," or "F") in their existing configurations under Future Year 2025 Without Project conditions:

- Panama Lane - South Union Avenue to Cottonwood Road (V/C=1.02, LOS "F")
- Taft Highway/SR-119 – Compagnoni Street/SR-99 Southbound Ramp to SR-99 Northbound Ramp (V/C = 0.85, LOS "D")
- Taft Highway/SR-119 – SR-99 Northbound Ramp to South H Street (2015), (V/C = 1.17, LOS "F")
- Taft Highway/SR-119/Panama Road - South H Street to South Union Avenue (V/C= 1.53, LOS "F")
- Taft Highway/SR-119/Panama Road - South Union Avenue to Cottonwood Road (V/C 1.20, LOS "F")
- Panama Road - East of Cottonwood Road (V/C 1.15, LOS "F")
- Bear Mountain Road/SR-223 – SR-99 Northbound Ramp to South Union Avenue (V/C 1.19, LOS "F")
- Bear Mountain Road – East of South Union Avenue (SR-204) (V/C 1.24, LOS "F")

Future Year 2025 With Project Traffic Volumes

Future Year 2025 peak hour turning movements with Project traffic are illustrated in Figure 4.16-4a, *Future Year 2025 AM Peak Hour Turning Movement with Project*, and Figure 4.16-4b, *Future Year 2025 PM Peak Hour Turning Movement with Project.*

Future Year 2025 With Project Intersection LOS

Table 4.16-1, *Intersection Level of Service*, outlines the AM and PM peak hour LOS of the study intersections under Future Year 2025 With Project conditions. The Metropolitan Bakersfield General Plan considers LOS "C" acceptable within the general plan area; therefore, as indicated in Table 4.16-1, the anticipated growth in traffic volumes by the Year 2025 would cause the following study intersections to operate at a deficient LOS (LOS "D", "E", or "F") under Future Year 2025 With Project conditions:

- Panama Lane and SR-99 Southbound Ramp (PM peak hour LOS "E")
- Panama Lane and South H Street (PM peak hour LOS "D")
- Panama Lane and South Union Avenue (AM and PM peak hour LOS "D")
- Hosking Road and South H Street (PM peak hour LOS "D")
- Taft Highway/SR-119 and Compagnoni Street/SR-99 Southbound Ramp (PM peak hour LOS "D")

Panama Road and Cottonwood Road (PM peak hour LOS "D")

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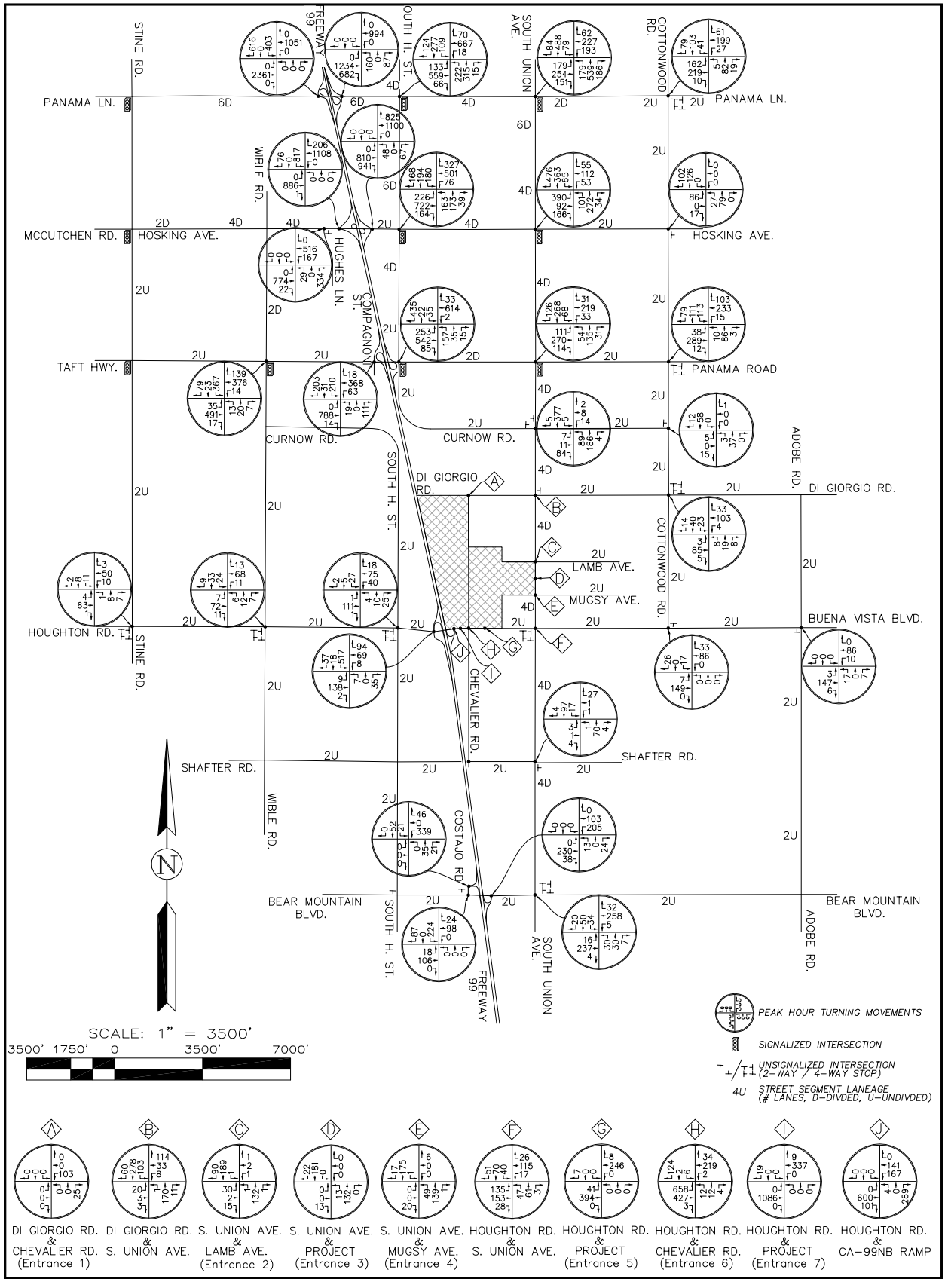

Source: McIntosh & Associates, 2016

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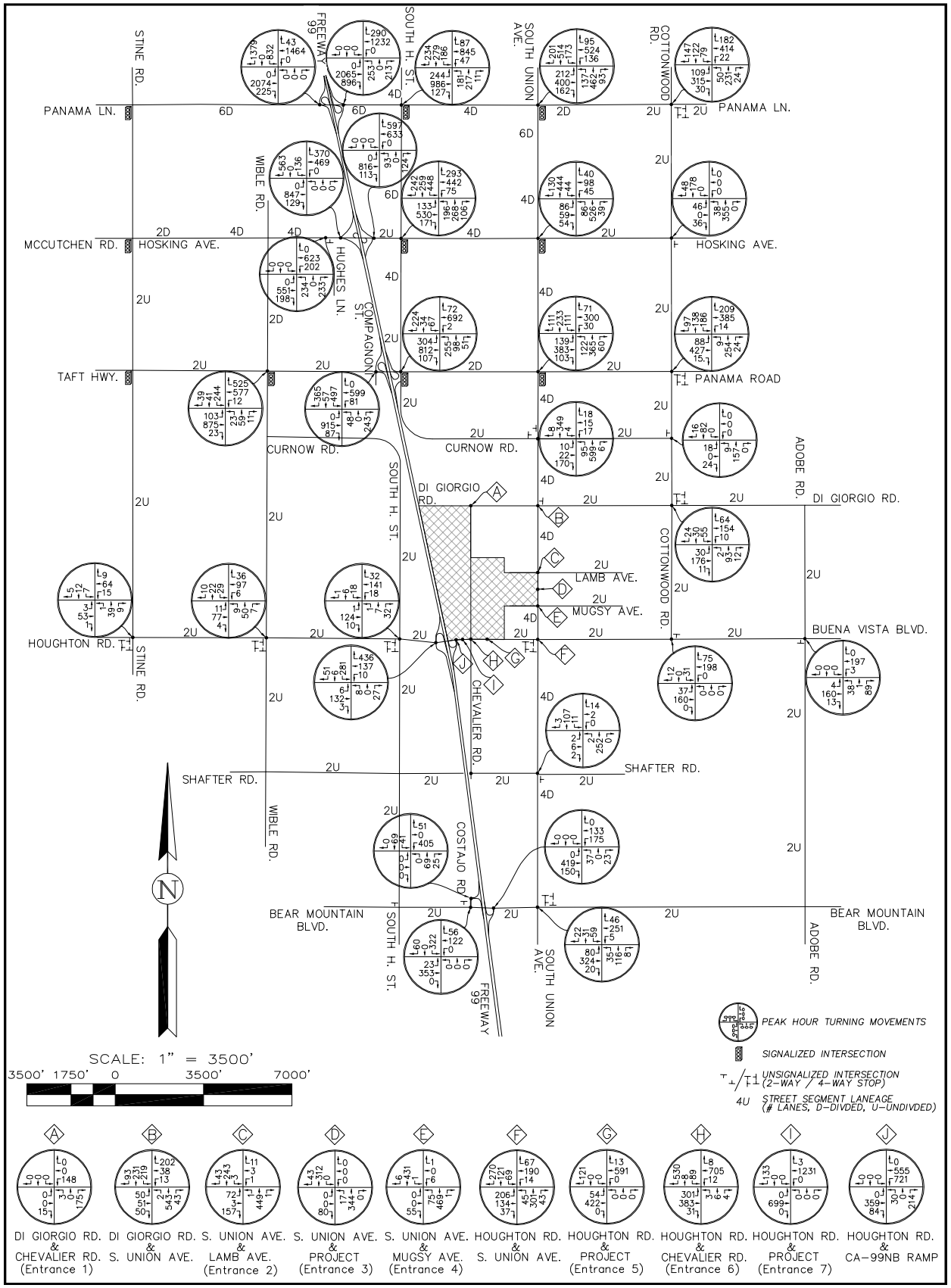
Future Year 2025 AM Peak Hour Turning Movements With Project

Figure 4.16-4a



Source: McIntosh & Associates, 2016

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CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07 • AGRICULTURAL PRESERVE #13 EXCLUSION

Future Year 2025 PM Peak Hour Turning Movements With Project

Figure 4.16-4b

- DiGiorgio Road and South Union Avenue (PM peak hour LOS "E")
- Houghton Road and Chevalier (#6) Road (PM peak hour LOS "F")
- Houghton Road and South Union Avenue (PM peak hour LOS "D")

Future Year 2025 With Project Traffic Signal Warrants

The results of the signal warrant analysis under Future Year 2025 With Project conditions are indicated in Table 4.16-8, *Traffic Signal Warrants – Future Year 2025 With Project Conditions*. Only one traffic signal warrant is satisfied under Future Year 2025 With Project conditions.

Table 4.16-8. Traffic Signal Warrants – Future Year 2025 With Project Conditions

Intersection	Warrant(s) Satisfied*	Notes
Houghton Road and Chevalier Road	1 and 3	Signalization of this intersection is not included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF).

* Warrants 1A: ADT – Minimum Vehicular Traffic; 1B: ADT – Interruption of Continuous Traffic; 1A and 1B: ADT – Combinations of Warrants 1A and 1B; and 3: Peak Hour (70% Factor) Warrant

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

Future Year 2025 With Project Roadway V/C

The V/C ratios were calculated for roadways with published ADT information and future traffic projections. Ultimate capacity is based on functional classification. A V/C of greater than 0.80 corresponds to a LOS "D" or below. Future traffic would cause the following studied roadway segments to operate at a deficient LOS (LOS "D", "E" or "F") in their existing configurations under Future Year 2025 With Project conditions:

- Taft Highway/SR-119 - South H Street to South Union Avenue (V/C = 0.82, LOS "D")
- Houghton Road – SR-99 Southbound Ramp to SR-99 Northbound Ramp (V/C = 1.10, LOS "F")
- Houghton Road – SR-99 Northbound Ramp to Project Entrance #7 (V/C = 2.44, LOS "F")
- Houghton Road – Project Entrance #7 to Chevalier Road (Project Entrance #6) (V/C 2.35, LOS "F")
- Houghton Road - Chevalier Road (Project Entrance #6) to Project Entrance #5 (V/C 1.35, LOS "F")
- Houghton Road – Project Entrance #5 to South Union Avenue (V/C 1.09, LOS "F")
- Chevalier Road – DiGiorgio Road to Houghton Road (V/C = 0.85, LOS "D")

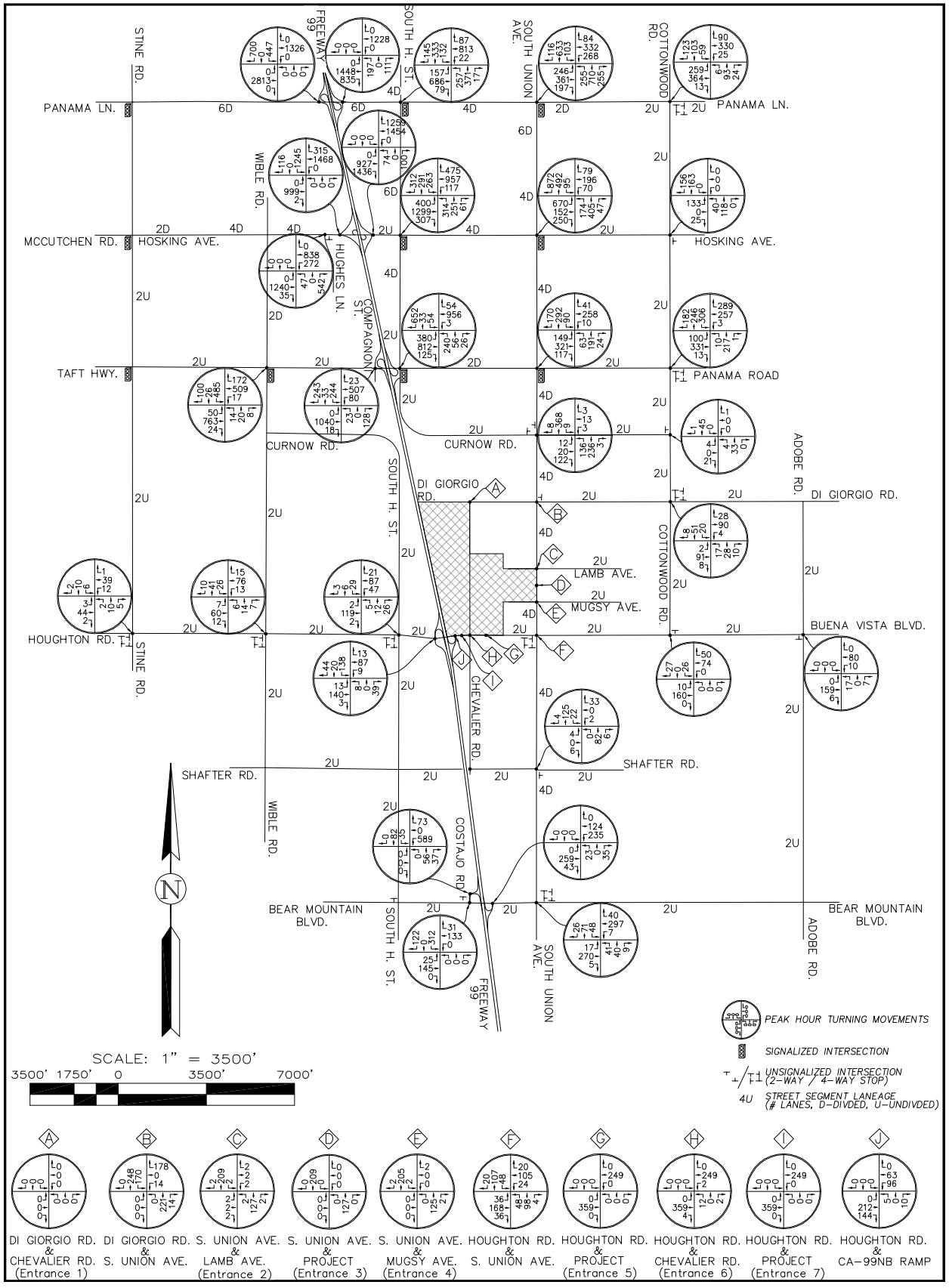
Future Year 2035 Without Project Traffic Volumes

Future Year 2035 peak hour turning movements without Project traffic are illustrated in Figure 4.16-5a, *Future Year 2035 AM Peak Hour Turning Movement Without Project*, and Figure 4.16-5b, *Future Year 2035 PM Peak Hour Turning Movement Without Project.*

Future Year 2035 Without Project Intersection LOS

Table 4.16-1, *Intersection Level of Service*, outlines the AM and PM peak hour LOS of the study intersections under Future Year 2035 Without Project conditions. The Metropolitan Bakersfield General Plan considers LOS "C" acceptable within the general plan area; therefore, as indicated in Table 4.16-1, the anticipated growth in traffic volumes by the Year 2035 would cause the following study intersections to operate at a deficient LOS (LOS "D", "E", or "F") under Future Year 2035 Without Project conditions:

- Panama Lane and SR-99 Southbound Off-Ramp (PM peak hour LOS "F')
- Panama Lane and South H Street (AM peak hour LOS "D" and PM peak hour LOS "E")
- Panama Lane and South Union Avenue (AM peak hour LOS "E" and PM peak hour LOS "F")
- Panama Lane and Cottonwood Road (AM peak hour LOS "E" and PM peak hour LOS "F")
- Hosking Avenue and Hughes Lane (AM peak hour LOS "F" and PM peak hour LOS "D")
- Hosking Avenue and South H Street (AM and PM peak hour LOS "F")
- Hosking Avenue and South Union Avenue (AM peak hour LOS "F" and PM peak hour LOS "D")
- Taft Highway/SR-119 and Wible Road (AM peak hour LOS "E" and PM peak hour LOS "F")
- Taft Highway/SR-119 and Compagnoni Street/SR-99 Southbound Ramp (PM peak hour LOS "F")
- Taft Highway/SR-119 and South H Street (AM peak hour LOS "F" and PM peak LOS "E")



Source: McIntosh & Associates, 2016

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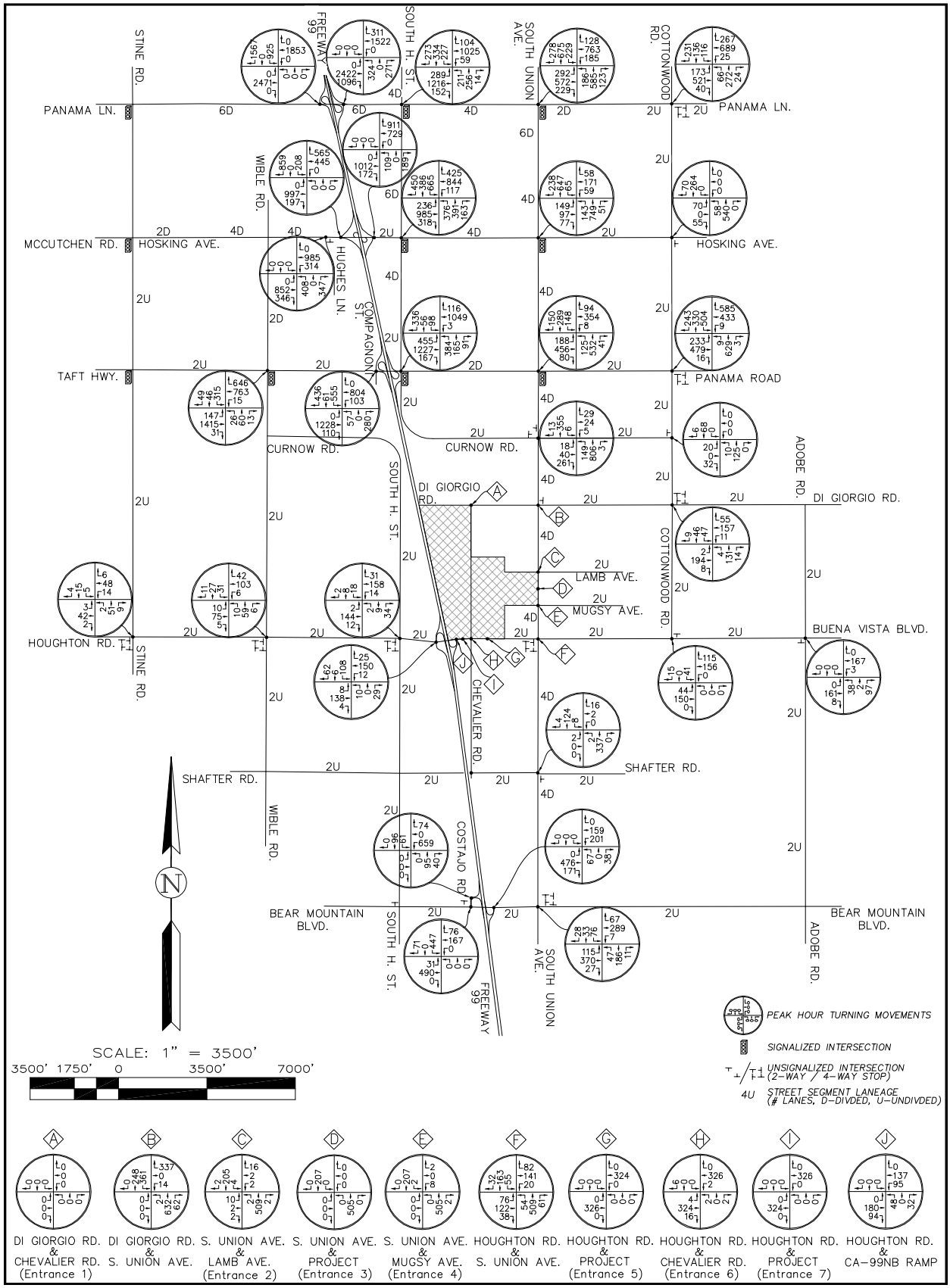
Future Year 2035 AM Peak Hour Turning Movements Without Project

Figure 4.16-5a



Source: McIntosh & Associates, 2016

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Future Year 2035 PM Peak Hour Turning Movements Without Project

Figure 4.16-5b

- Taft Highway/SR-119/Panama Road and South Union Avenue (PM peak hour LOS "D")
- Panama Road and Cottonwood Road (AM and PM peak hour LOS "F")
- Costajo Road and SR-99 Southbound Ramp (AM peak hour LOS "D" and PM peak hour LOS "F")
- Bear Mountain Boulevard/SR-233 and Costajo Road (PM peak hour LOS "F")
- Bear Mountain Boulevard/SR-223 and South Union Avenue (PM peak hour LOS "E")

Future Year 2035 Without Project Traffic Signal Warrants

The results of the signal warrant analysis provided in the 2016 Traffic Study (refer to Appendix M, *Traffic Study*) determined that there are no traffic warrants under Future Year 2035 without Project conditions.

Future Year 2035 Without Project Roadway V/C

The V/C ratios were calculated for roadways with published ADT information and future traffic projections. Ultimate capacity is based on functional classification. A V/C of greater than 0.80 corresponds to a LOS "D" or below. Future traffic would cause the following studied roadway segments to operate at a deficient LOS (LOS "D", "E" or "F') in their existing configurations under Future Year 2035 Without Project conditions:

- Panama Lane - West of SR-99 Southbound Ramp – (V/C = 0.94, LOS "E")
- Panama Lane - East of Cottonwood Road – (V/C = 0.93, LOS "E")
- Taft Highway/SR-119 – West of Wible Road – (V/C = 1.03, LOS "F")
- Taft Highway/SR-119 - Wible Road to Compagnoni Street/SR-99 Southbound Ramp (V/C = 1.08, LOS "F")
- Taft Highway/SR-119/Panama Road – South H Street to South Union Avenue (V/C= 0.94, LOS "E")
- Bear Mountain Road – SR-99 Northbound Ramp to South Union Avenue (V/C = 1.36, LOS "F")
- Bear Mountain Road - East of South Union Avenue (V/C = 1.43, LOS "F")
- South H Street - Berkshire Road to Hosking Avenue (V/C = 0.96, LOS "E")
- South H Street - Hosking Avenue to Taft Highway/SR-119 (V/C = 1.09, LOS "F")
- Cottonwood Road – North of Panama Lane (V/C = 0.81, LOS "D")

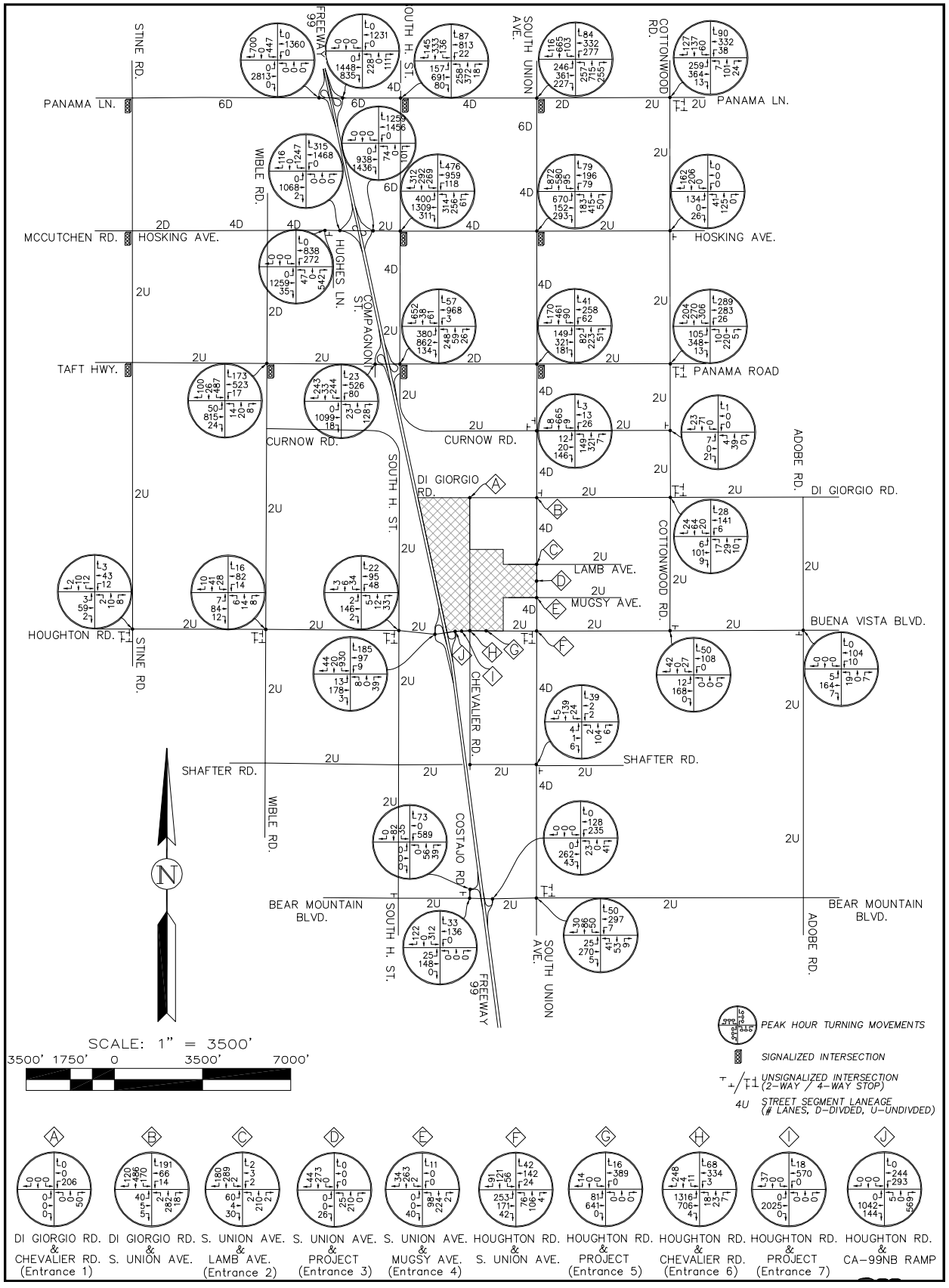
Future Year 2035 With Project Traffic Volumes

Future Year 2035 peak hour turning movements without Project traffic are illustrated in Figure 4.16-6a, *Future Year 2035 AM Peak Hour Turning Movements with Project*, and Figure 4.16-6b, *Future Year 2035 PM Peak Hour Turning Movements with Project*.

Future Year 2035 With Project Intersection LOS

Table 4.16-1, *Intersection Level of Service*, outlines the AM and PM peak hour LOS of the study intersections under Future Year 2035 With Project conditions. The Metropolitan Bakersfield General Plan considers LOS "C" acceptable within the general plan area; therefore, as indicated in Table 4.16-1, the anticipated growth in traffic volumes by the Year 2035 would cause the following study intersections to operate at a deficient LOS (LOS "D", "E", or "F") under Future Year 2035 With Project conditions:

- Panama Lane and SR-99 Southbound Ramp (PM peak hour LOS "F")
- Panama Lane and South H Street (AM peak LOS "D" and PM peak "LOS "E")
- Panama Lane and South Union Avenue (AM peak hour LOS "D")
- Hosking Avenue and Hughes Lane (AM and PM peak hour LOS "D")
- Hosking Avenue and South H Street (AM and PM peak hour LOS "E")
- Taft Highway/SR-119 and South H Street (AM peak hour LOS "D" and PM peak hour LOS "E")
- Panama Road and Cottonwood Road (AM peak hour; LOS "D" and PM peak hour LOS "E")
- Curnow Road and South Union Avenue (PM peak hour LOS "F")
- Lamb Avenue and South Union Avenue (#2) (PM peak hour LOS "D")
- Houghton Road and SR-99 Southbound Ramp (AM peak hour LOS "F" and PM peak hour LOS "D")
- Houghton Road and SR-99 Northbound Ramp (AM and PM peak hour LOS "F")
- Houghton Road and Project Entrance #7 (PM peak hour LOS "F")



Source: McIntosh & Associates, 2016

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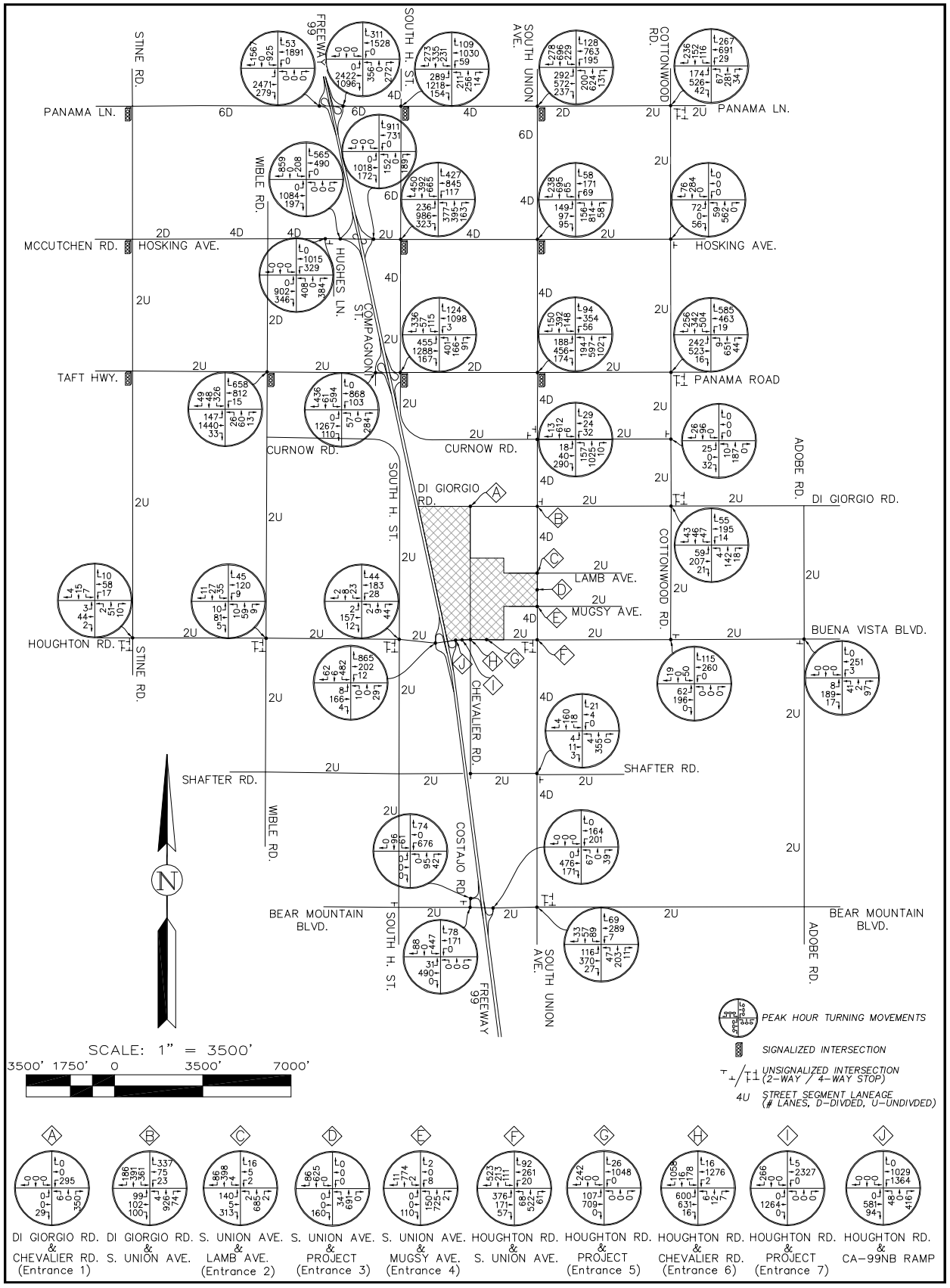
Future Year 2035 AM Peak Hour Turning Movements With Project

Figure 4.16-6a



Source: McIntosh & Associates, 2016

99 HOUGHTON INDUSTRIAL PARK PROJECT

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Future Year 2035 PM Peak Hour Turning Movements With Project

Figure 4.16-6b

- Houghton Road and Chevalier Road (#6) (AM and PM peak hour; LOS "F")
- Houghton Road/Buena Vista Boulevard and South Union Avenue (PM peak hour LOS "F")
- SR-99 Southbound Ramp and Costajo Road (AM peak hour LOS "D" and PM peak hour LOS "F")
- Bear Mountain/SR-233 and Costajo Road (PM Peak hour LOS "F")
- Bear Mountain/SR-233 and South Union Avenue (PM peak hour LOS "E")

Future Year 2035 With Project Traffic Signal Warrants

The results of the signal warrant analysis under Future Year 2035 With Project conditions are indicated in Table 4.16-9, *Traffic Signal Warrants – Future Year 2035 With Project Conditions*.

Table 4.16-9. Traffic Signal Warrants – Future Year 2035 With Project Conditions

Intersection	Warrant(s) Satisfied[1]	Notes[2]
Hosking Road and Cottonwood Road	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
South Union Avenue and Curnow Road	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
South Union Avenue and Mugsy Avenue	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
South Union Avenue and DiGiorgio Road	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
South Union Avenue and Lamb Avenue	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
South Union Avenue and Project Entrance #3	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
Houghton Road and SR-99 Southbound Ramps	1 and 3	None
Houghton Road and SR-99 Northbound Ramps	1 and 3	None
Houghton Road and Project Entrance #7	1 and 3	None
Houghton Road and Project Entrance #5	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
Houghton Road/Buena Vista Blvd and South Union Avenue	1 and 3	None
Costajo Road and Bear Mountain Boulevard/SR-223	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.
Bear Mountain Boulevard/SR-223 and South Union Avenue	1 and 3	Acceptable service levels can be achieved without the addition of a traffic signal.

[1] Warrants 1A: ADT – Minimum Vehicular Traffic; 1B: ADT – Interruption of Continuous Traffic; 1A and 1B: ADT – Combinations of Warrants 1A and 1B; and 3: Peak Hour (70% Factor) Warrant

[2] Signalization of intersections are not included in the Phase IV Metropolitan Bakersfield Regional Transportation Impact Fee Program (RTIF)

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

Future Year 2035 With Project Intersection Improvements

Intersection improvements needed by the Year 2035 to maintain or improve the operational LOS of the street system in the vicinity of the Project are indicated in Table 4.16-10, *Future Intersection Improvements and Local Mitigation*. As mitigation for the Project, it is recommended that the Project pay fees in accordance with the RTIF program. For mitigation improvements not covered by the RTIF, it is recommended that the Project pay the proportionate share for the local mitigation improvements. Table 4.16-10 identifies which RTIF intersection improvements are not covered by the program.

Table 4.16-10. Future Intersection Improvements and Local Mitigation

Intersection	Total Improvements Required by 2035 Without Project[1]	Total Improvements Required by 2035 With Project[2]	Local Mitigation (Improvements not covered by RTIF)
Panama Lane & South H Street	Add 1 ET & 1 NT	No additional improvements required	
Panama Lane & South Union Avenue	Add 1 ET, 1 EL, 2 WT, 1 WL, 1 WR, 1 NT, 1 NL, 1 SL, 1 ST, & 1 SR	No additional improvements required	
Panama Lane & Cottonwood Road	Provide Signal; Add 1 EL, 1 ER, 1 ET, 1 WL, 1 WR, 1 WT, 1 NL, 1 SL, & 1 SR & NR	No additional improvements required	
Hosking Avenue & Hughes Lane	Provide Signal; Add 1 ET, 1 WT, 1 WL & 1 NR	No additional improvements required	
Hosking Avenue & South H Street	Add 1 EL, 1 ET, 1 ER, 1 WL, 1 WT, 1 NL, 2 NT, 1 NR, 1 SL, 2 ST & 1 SR	No additional improvements required	
Hosking Avenue & South Union Avenue	Add 2 ET, 1 EL, 1 ER, 1 WT, 1 NL, 1 NT, 1 NR, 1 ST, 2 SR & Overlapping SR	No additional improvements required	
Taft Highway/SR-119 & Wible Road	Add 1 ET, 1 WT, 1 NL, 2 SL, & 1 SR	No additional improvements required	
Taft Highway/SR-119 & SR-99 Southbound Ramp/ Compagnoni Street	Add 2 ET, 2 WT, 1 NR, Convert SL to ST/L & 1 SR	No additional improvements required	
Taft Highway/ SR-119 & South H Street	Add 1 EL, 2 ET, 2 WT, 1 WR and 1 SR	Add 1 NL	NL
Taft Highway/ SR-119/ Panama Road & South Union Avenue	Add 1 ET and 1 WT	No additional improvements required	
Taft Highway/ SR-119/ Panama Road & Cottonwood Road	Provide signal; Add 2 EL, 2 ET, 1 ER, 2 WT, 1 WL, 2 WR, 1 NL, 1 NR, 2 NT, 2 ST, 1 SL, & 1 SR	No additional improvements required	
Curnow Road & South Union Avenue	No additional improvements required	Add 1 ER	ER
DiGiorgio Road & Chevalier Road/Project Entrance #1	No additional improvements required	Construct entrance with 1 ET/R, 1 WT/L, & 1 NL/R	ET/R, WT/L, NL/R
DiGiorgio Road & South Union Avenue	No additional improvements required	Construct east approach with 1 EL, 1 ET/R; & 1 SR & 1 WL	EL, ET/R, SR & WL
South Union Avenue & Lamb Avenue/Project Entrance #2	No additional improvements required	Add 1 ER	ER

Table 4.16-10. Future Intersection Improvements and Local Mitigation

Intersection	Total Improvements Required by 2035 Without Project[1]	Total Improvements Required by 2035 With Project[2]	Local Mitigation (Improvements not covered by RTIF)
South Union Avenue & Project Entrance #3	No additional improvements required	Construct entrance with 1 ER; Add 1 NL	ER, NL
South Union Avenue & Mugsy Road/Project Entrance #4	No additional improvements required	Construction east approach	East approach
Houghton Road & SR-99 Southbound Ramp/ Costajo Road	No additional improvements required	Provide Signal; Add 1 EL, 1 WL, 1 NL, & 2 SL	Signal, EL, WL, NL, 2SL,
Houghton Road & SR-99 Northbound Ramp	No additional improvements required	Provide Signal; Add 2 ET, 2 WL, 2 WT & Overlapping NR	Signal, 2 ET, 2 WL, 2 WT, Overlapping NR
Houghton Road & Project Entrance #7	No additional improvements required	Add 1 ET, 1 WT, 1 WR & 1 SR	1 ET, 1 WT, 1 WR & SR
Houghton Road & Chevalier Road/Project Entrance #6	No additional improvements required	Provide Signal; Construct entrance; Add 2 EL, 2 ET, 1 ER, 1 WL, 1 WT, 1 WR, 1 NT, 2 SL, 1 ST, 1 SR, & Overlapping SR	Signal, 2 EL, 2 ET, ER, WL, WT, WR, NT, SL, ST, SR, & Overlapping SR
Houghton Road & Project Entrance #5	No additional improvements required	Construct entrance with 1 SR; Add 1 EL & 1 WR	EL, WR
Houghton Road/ Buena Vista Boulevard & South Union Avenue	No additional improvements required	Provide Signal; Add 2 EL, 1 ET, 1 WL, 1 WT, 1 NL, 1 SL, & 1 SR	Signal, EL, ET, WL, WT, NL, SL, SR
Bear Mountain Boulevard/ SR-223/ Costajo Road & SR-99 Southbound Ramp	No additional improvements required	Add 1 NR	NR

[1]Improvements listed include any improvements needed in 2025 without project and 2035 without project.

[2]Improvements listed include any improvements needed at "opening day," 2025 with project, and 2035 with project.

*NL needed at 2035 w/o only if Project is not built at 2025+Project

Notes:
RTIF = Regional Transportation Impact Fee
NL = Northbound Left Lane, **NT** = Northbound Through Lane, **NR** = Northbound Right Lane, **EL** = Eastbound Left Lane, **ET** = Eastbound Through Lane, **ER** = Eastbound Right Lane, **SL** = Southbound Left Lane, **ST** = Southbound Through Lane, **SR** = Southbound Right Lane, **WL** = Westbound Left Lane, **WT** = Westbound Through Lane, **WR** = Westbound Right Lane

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

Future Year 2035 With Project Roadway V/C

The V/C ratios were calculated for roadways with published ADT information and future traffic projections. Ultimate capacity is based on functional classification. A V/C of greater than 0.80 corresponds to a LOS "D" or below. Future traffic would cause the following studied roadway segments to operate at a deficient LOS (LOS "D", "E" or "F") in their existing configurations under Future Year 2035 With Project conditions:

- Panama Lane – West of SR-99 Southbound Ram (V/C – 0.95, LOS "E")
- Bear Mountain Boulevard/SR-223 – SR-99 Northbound Ramp to South Union Avenue (V/C = 1.36, LOS "F")
- Bear Mountain Boulevard/SR-223 - East of South Union Avenue (V/C = 1.44, LOS "F")
- Chevalier Road – DiGiorgio Road to Houghton Road (V/C = 0.85, LOS "D"

It should be noted that the roadway segments along Bear Mountain Boulevard/SR-223 and Panama Lane segment indicated above, currently operation at LOS "E" and Future Year 2035 With Project Conditions are similar to Future Year 2035 Without Project Conditions, with these segments operating at LOS "F" under both scenarios.

Future Year 2035 With Project Roadway Improvements

Roadway improvements needed by the Year 2035 to maintain or improve the operational LOS of the street system in the vicinity of the Project are indicated in Table 4.16-11, *Future Roadway Improvements and Local Mitigation*. As mitigation for the Project, it is recommended that the Project pay fees in accordance with the RTIF program. For mitigation improvements not covered by the RTIF, it is recommended that the Project pay the proportionate share for the local mitigation improvements.

Table 4.16-11. Future Roadway Improvements and Local Mitigation

Roadway	Improvements Required by 2035 Without Project	Improvements Required by 2035 With Project	Project Share for Local Mitigation
Panama Lane – South Union Avenue to Cottonwood Road	Improve 4-lane Collector	No additional improvements required	0.55%
Panama Lane – East of Cottonwood Road	Improve to 4-Lane Collector	No additional improvements required	1.48%
Taft Highway/ SR-119 – West of Wible Road	Improve to 4-lane, undivided	No additional improvements required	6.28%
Taft Highway/SR-119 –Wible Road to Compagnoni Street/SR-99 SB Ramp	Improve to 4-Lane Collector	No additional improvements required	7.0%
Taft Highway/SR-119/ Panama Road – South H Street to South Union Avenue	Improve to 4-Lane Arterial	No additional improvements required	11.83%
Taft Highway/SR-119/ Panama Road – Compagnoni Street/ SR-99 SB Ramp to East of Cottonwood Road	Improve to 4-lane Collector	No additional improvements required	10.72%
DiGiorgio Road – West of Chevalier Road (Project Entrance #1)	No additional improvements required	Construction 2-lane Collector	100%
DiGiorgio Road – Chevalier Road (Project Entrance #1) to South Union Avenue	No additional improvements required	Construction 2-lane Collector	100%
Cottonwood Road – North of Panama Lane	Improve to 4-Lane Collector	No additional improvements required	2.5%
Houghton Road – SR-99 SB Ramp to SR-99 NB Ramp	No additional improvements required	Improve to 4-Lane Collector	75.62%
Houghton Road – SR-99 NB Ramp to Chevalier Road	No additional improvements required	Improve to 6-Lane Arterial	82.14%
Houghton Road – Project Entrance #5 to South Union Avenue	No additional improvements required	Improve to 4-Lane Collector	62.15%
Chevalier Road – DiGiorgio Road to Houghton Road	No additional improvements required	Construct 2-Lane Collector	100%

-- = No percentage provided.

Source: Traffic Impact Study for 99 Houghton, McIntosh & Associates, November 2016.

If the existing operational LOS of a facility is below "C" prior to the addition of project generated traffic and the addition of project traffic substantially degrades the LOS further, then mitigation to

restore the facility to at least its existing operational LOS is deemed appropriate. The following intersection would improve their 2035 LOS levels with the proposed project, but LOS would remain below a "C":

- Panama Lane and S. Union Avenue (AM peak hour), has a LOS "E" under 2035 Future Without Project conditions, and a LOS "D" under 2035 Future with Project conditions;
- Hosking and Hughes (AM peak hour), has a LOS "F" under 2035 Future Without Project conditions, and a LOS "D" under 2035 Future with Project conditions;
- Hosking and South H. Street (AM Peak hour and PM Peak hour), have a LOS "F" under 2035 Future Without Project Conditions, and a LOS "E" under 2035 Future with Project conditions;
- Taft Highway/SR-119 and South H. Street (AM Peak hour), has a LOS "F" under 2035 Future Without Project conditions, and a LOS "D" under 2035 Future with Project conditions;
- Taft Highway/Panama Road and Cottonwood Road (AM Peak hour), has a LOS "F" under 2035 Future Without Project conditions, and a LOS "D" under 2035 Future with Project conditions; and
- Taft Highway/Panama Road and Cottonwood Road (PM Peak hour), has a LOS "F" under 2035 Future Without Project conditions, and a LOS "E" under 2035 Future with Project conditions.

Therefore, all study roadways would operate at an acceptable LOS (LOS "C" or better) under Future Year 2035 With Project conditions (in their mitigated configurations). Thus, with implementation of the recommended roadway improvements, implementation of the proposed Project would result in less than significant impacts on study area roadway segments under Future Year 2035 With Project conditions.

The following CMP intersections are included in the study area:

Existing

- Panama Lane and SR-99 Southbound Off-Ramp
- Panama Lane and SR-99 Northbound Off-Ramp
- Taft Highway/SR-119 and Wible Road
- Taft Highway/SR-119 and SR-99 Southbound Off-Ramp/Compagnoni Street
- Taft Highway/SR-119 and South H Street
- Taft Highway/SR-119/Panama Road and South Union Avenue
- Houghton Road and SR-99 Southbound Ramps/Costajo Street
- Houghton Road and SR-99 Northbound Ramps
- SR-99 Southbound Ramp and Costajo Street
- Bear Mountain Boulevard/SR-223 and Costajo Street

- Bear Mountain Boulevard/SR-223 and SR-99 Northbound Ramp
- Bear Mountain Boulevard/SR-223 and South Union Avenue
- Hosking Avenue and SR-99 Southbound Off-Ramp
- Hosking Avenue and SR-99 Northbound Off-Ramp

Future Year 2025 With Project CMP Intersection LOS

The AM and PM peak hour LOS of the study intersections, including the CMP intersections, under Future Year 2025 With Project conditions are outlined above. Based on established thresholds of significance, the addition of Project-generated trips would not result in significant impacts on CMP intersections and no mitigation is required.

Future Year 2035 With Project CMP Intersection LOS

The AM and PM peak hour LOS of the study intersections, including the CMP intersections, under Future Year 2035 With Project conditions are outlined above. Based on established thresholds of significance, the addition of Project-generated trips is anticipated to result in a significant impact at the following CMP study intersections under Future Year 2035 With Project conditions:

- Taft Highway/SR-119 and South H Street
- Houghton Road and SR-99 Southbound Ramps/Costajo Street
- SR-99 Southbound Ramp and Costajo Street

Mitigation measures, which involve improvements to the impacted CMP intersections, are recommended to reduce or eliminate traffic impacts for Future Year 2025 and 2035 With Project conditions.

Future Year 2025 With Project CMP Traffic Signal Warrants

The results of the signal warrant analysis under Future Year 2025 With Project conditions are outlined above. As indicated above, the traffic signal warrant is satisfied at the following CMP intersection under Future Year 2025 With Project conditions:

- Houghton Road and Chevalier Road (Warrants 1 and 3)

Future Year 2035 With Project CMP Traffic Signal Warrants

The results of the signal warrant analysis under Future Year 2035 With Project conditions are outlined above. As indicated above, the traffic signal warrant is satisfied at the following three CMP intersections under Future Year 2035 With Project conditions:

- Houghton Road and SR-99 Northbound Ramps (Warrants 1 and 3)
- Houghton Road and SR-99 Southbound Ramps/Costajo Street (Warrants 1 and 3)
- Bear Mountain Boulevard/SR-223 and South Union Avenue

Mitigation measures, which involve improvements to the impacted CMP intersections, are recommended to reduce or eliminate traffic impacts for Future Year 2025 and 2035 With Project conditions.

Conclusion

The proposed Project would contribute its pro-rata share for supplemental mitigation not covered under any regional transportation impact fee. The estimated supplemental mitigation amount, as determined by the Kern County Public Works Department, must be paid to the Kern County Public Works Department prior to recordation of any parcel map(s) or issuance of any grading or building permit if a parcel map is not required.

Mitigation Measures

MM 4.16-1: Supplemental Road Improvements. Prior to final approval of any Master Precise Development Plan or recordation of any parcel map, the project proponent will provide to the County a written statement of intent, which will detail the approach used to satisfy obligations for supplemental road improvements. This written statement of intent and method proposed will be approved by the Kern County Public Works Department- Development Review. The applicant will have three approaches to fulfill the road improvement responsibilities:

1. Lump Sum Payment: Any lump sum payment will be made prior to final approval of any Master Precise Development Plan, parcel map recordation or issuance of grading or building permits. All monies will be paid to the Kern County Roads Department. At the time of payment, the Kern County Roads Department will conduct a review of the distributed share amount and make adjustments, if required, based on increases to the construction cost index, other changes in standards or technology for required signalization or improvements, or updated development projects or proposals. The Kern County Roads Department may request, at a cost to be borne by the applicant, a supplemental traffic analysis to determine the correct lump sum payment.

2. Construction of Road Improvements: If, in an approved summary of intent, the Project Applicant seeks to construct road improvements in lieu of a lump sum payment, the improvements will be constructed and accepted by the County prior to issuance of the Certificate of Occupancy for the related building permits. Deviations from this sequence of events may be approved by the Kern County Roads Department.

3. Combination of Approach A and Approach B: The Project Applicant may choose to provide construction for certain roadway improvements and payment for others. This approach must be used in communication with the Kern County Roads Department.

4. All monies designated for roadway improvements shall initially be identified and calculated during processing of the Master Precise Development Plan or parcel map, whichever comes first. All final payments and or construction of

roadway improvements shall be completed at the issuance of any grading or building permit.

MM 4.16-2: Construction Traffic Control Plan. Prior to the issuance of construction or building permits, the project proponent shall:

1. Prepare and submit a Construction Traffic Control Plan to Kern County Public Works Department- Development Review and the California Department of Transportation offices for District 9, as appropriate, for approval. The Construction Traffic Control Plan must be prepared in accordance with both the California Department of Transportation Manual on Uniform Traffic Control Devices and Work Area Traffic Control Handbook and must include, but not be limited to, the following issues:

    a. Timing of deliveries of heavy equipment and building materials;

    b. Directing construction traffic with a flag person;

    c. Placing temporary signing, lighting, and traffic control devices if required including pedestrians and bicyclist; including, but not limited to, appropriate signage along access routes to indicate the presence of heavy vehicles and construction traffic;

    d. Ensuring access for emergency vehicles to the project sites;

    e. Temporarily closing travel lanes or delaying traffic during materials delivery, transmission line stringing activities, or any other utility connections;

    f. Maintaining access to adjacent property; and,

    g. Specifying both construction-related vehicle travel and oversize load haul routes, minimizing construction traffic during the AM and PM peak hour, distributing construction traffic flow across alternative routes to access the project sites, and avoiding residential neighborhoods to the maximum extent feasible.

2. Obtain all necessary encroachment permits for the work within the road right-of-way or use of oversized/overweight vehicles that will utilize county-maintained roads, which may require California Highway Patrol or a pilot car escort. Copies of the approved traffic plan and issued permits shall be submitted to the Kern County Planning and Natural Resources Department and the Kern County Public Works Department-Development Review.

3. Enter into a secured agreement with Kern County to ensure that any County roads that are demonstrably damaged by project-related activities are promptly repaired and, if necessary, paved, slurry-sealed, or reconstructed as per requirements of the state and/or Kern County.

4. Submit documentation that identifies the roads to be used during construction. The project proponent shall be responsible for repairing any damage to non-county-maintained roads that may result from construction activities. The project proponent shall submit a preconstruction video log and inspection report regarding roadway conditions for roads used during construction to the Kern County Public Work Department-Development Review and the Kern County Planning and Natural Resources Department.

5. Within 30 days of completion of construction, the project proponent shall submit a post-construction video log and inspection report to the County. This information shall be submitted in DVD format. The County, in consultation with the project proponent's engineer, shall determine the extent of remediation required, if any.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.16-3: The Project Would Cause an Increase in Operation-Related Safety Hazards or result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that would result in substantial safety risks.

By increasing traffic on area roadways, there is the potential to increase safety hazards by increasing vehicle turning movements and increasing potential for vehicle/pedestrian or vehicle/bicycle conflicts. However, with implementation of the mitigation measures MM 4.16-1 through MM 4.16-3, traffic controls will be included to help calm and control traffic where necessary, including signals, signage, sidewalks, crosswalks, and bicycle lanes, among other safety features. Therefore, impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.16.4: The Project Would Cause an Increase in Construction-Related Safety Hazards or Would Substantially Increase Hazards Due to a Design Feature (e.g., Sharp Curves or Dangerous Intersections) or Incompatible Uses (e.g., Farm Equipment).

No obstacles to sight distance are expected to result from Project construction. No sharp roadway curves currently exist in the proposed Project area, nor would such curves be created by the proposed Project. However, the maneuvering of construction-related vehicles and equipment among the general-purpose traffic on area roadways could cause safety hazards. This impact is considered potentially significant but can be reduced to a less than significant level with implementation of mitigation measure MM 4.16-2.

Mitigation Measures

Implement mitigation measure MM 4.16-2.

Level of Significance After Mitigation

Impacts would be less than significant.

Impact 4.16.5: The Project Would Result in Inadequate Emergency Access.

Anticipated construction-related traffic and circulation impacts would be considered a temporary nuisance that would cease upon completion of Project construction. Preparation of a detailed Traffic Management Plan (TMP) would be required prior to construction of the proposed Project. The TMP would delineate all road closures, provisions to maintain access to adjacent residential properties at all times, prior notices, adequate sign-postings, detours, provisions for pedestrian and bicycle transportation and permitted hours of construction activity. Proper detours and warning signs would be established along the proposed Project perimeter to ensure public safety. The TMP shall be devised so that construction would not interfere with emergency response or evacuation plans. With implementation of the TMP and mitigation measures, less than significant impacts are anticipated. Therefore, no significant impacts to vehicular and emergency access would occur during construction activities.

South Union Avenue, Houghton Road, and the DiGiorgio Road alignment provide the primary access to and from the proposed Project area. The design of the proposed access locations would allow for adequate vehicular and emergency access to public roadways. Project implementation would result in a less than significant impact in this regard.

Mitigation Measures

Implement MM 4.16-2.

Level of Significance After Mitigation

Impacts would be less than significant.

Impact 4.16.6: The Proposed Project Would Conflict with Adopted Policies, Plans or Programs Supporting Alternative Transportation (e.g., bus turnouts and bicycle racks).

As indicated in the Metropolitan Bakersfield General Plan Environmental Impact Report, as development and population increases within the Metropolitan Bakersfield area, the demand for alternative transportation (i.e., bus transit service, bikeways and pedestrian facilities) would increase. The Metropolitan Bakersfield General Plan Bikeway Master Plan is implemented to link schools, civic centers, service areas, parks, employment centers, and regional bike paths. As the proposed Project vicinity is mostly undeveloped land, or land currently under construction, there are no pedestrian and bicycle facilities in the area. However, as the proposed Project area becomes developed, adherence to General Plan roadway standards and policies would allow for adequate pedestrian and bicycle circulation.

Transit service within the Metropolitan Bakersfield area consists of approximately one percent of the total travel. In accordance with the goals and policies of the Metropolitan Bakersfield General Plan, the Project Applicant shall work with the GET and Kern Transit to locate bus stops as close as possible to the proposed Project site in an effort to provide residents with sufficient access to public transit service. Bus stops would most likely be placed on major arterials. Therefore, development of the proposed Project would not result in a significant impact to transit service in the proposed Project vicinity.

The County requires installation of sidewalks in conjunction with development. Sidewalks would be required to allow for safe and convenient pedestrian movement and would connect with sidewalks planned for adjacent developments. The proposed Project would construct internal roads to the County's roadway standards, which would include sidewalks on both sides of the streets. Therefore, with the proposed Project designed to City and County standards, there would be no impacts to pedestrian and bicycle circulation.

Development of the Project site in accordance with the goals and policies of the Metropolitan Bakersfield General Plan and site plan review by the County, GET and Kern Transit would serve to enhance alternative modes of transportation within the Project area. This would be a long-term beneficial impact.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

The analysis of cumulative impacts in this section included all of the cumulative projects discussed in Chapter 3, Project Description. Projections of future traffic conditions incorporate regional population and employment growth that is expected to occur by the future analysis year, independent of the proposed Project. Because of this, future condition scenarios (2035) without the proposed Project capture the effects of cumulative projects. Future condition scenarios (2035) with the proposed Project capture the effects of both cumulative projects and those of the proposed Project.

Cumulative projects plus anticipated growth in traffic volumes by the Year 2035 will cause 21 intersections to operate below acceptable LOS (without the proposed Project). Additionally, by 2025, future traffic conditions without the Project would result in five (5) intersections meeting signal warrants under future peak hour traffic loads. By 2035, future traffic conditions without the Project would result in an additional zero (0) intersections meeting signal warrants under future peak hour traffic loads. Future cumulative projects and ambient growth would cause 17 studied roadway segments to operate below acceptable LOS in their existing configurations for Future Year 2035 Without Project conditions (LOS "D" or below for the Metropolitan Bakersfield General Plan).

The proposed Project would add 32,053 vehicle trips per day to the existing and future year conditions. With the addition of this Project traffic, six of the intersections that will operate at

acceptable LOS under future traffic loads (2035) will drop below acceptable LOS when Project traffic is added to future peak hour traffic (2035 with project). The proposed Project traffic would also result in 14 intersections meeting signal warrants under future peak hour traffic loads. In addition, three studied roadway segments would operate below acceptable LOS (LOS "C" for Metropolitan Bakersfield General Plan) in their existing configurations under Future Year 2035 With Project conditions. When added to future cumulative conditions, the Project-generated traffic would result in the continued worsening of existing intersections that are at or above operating capacity. However, many of the improvements identified above will be necessary even without the addition of Project-generated traffic. The proposed Project shall contribute its proportionate share of costs to construct necessary improvements required due to future traffic growth projections in the study area.

Additionally, the proposed Project is located approximately 1.10 miles southeast of the Bakersfield City limits, within the Metropolitan Bakersfield General Plan in Kern County. Therefore, it is anticipated that trips generated will utilize the Metropolitan Bakersfield transportation system. The cumulative impacts of the existing and proposed growth in the Metropolitan Bakersfield area on the transportation system has been the subject of various studies since the development of the Transportation Impact Fee (TIF) in 1992. The Kern County Public Works Department and City of Bakersfield Public Works Department have worked with Kern COG since that time to identify major improvements and seek funding for completion of the appropriate segments to ensure roadway capacity. In 1997, the Metropolitan Bakersfield Major Transportation Investment Strategy (MTIS) was completed to identify overall transportation needs and develop a long-term improvement plan. Mass transit options including increased bus systems, transportation systems management, and commuter/light rail transit were considered in the study. However, the MTIS concluded that in Metropolitan Bakersfield, stand-alone mass transit solutions would not provide the same benefits that improvements to the roadway network would provide. The inefficient roadway system, lacking connectivity, was the primary transportation element in need of significant improvement.

The physical constraints that affect the alignment and design of an efficient regional transportation system include:

- the Kern River cutting diagonally across Bakersfield from northeast to the southwest that inhibits both north-south and east-west travel;
- SR-99, which divides Bakersfield east and west;
- SR-58, which divides the east side of Bakersfield into north and south;
- the mainline of both the BNSF and the UPRR run through Bakersfield, dividing the west from the northwest, the northeast from the southwest, and splitting central Bakersfield;
- existing development that breaks up continuity and numerous canals and branch rail lines, which must be crossed to provide a functional roadway network.

To address these challenges, in 2000–2001, Kern County, the City of Bakersfield, Caltrans, and Kern COG jointly commissioned the Bakersfield System Study to perform a comprehensive evaluation of the region's roadway network. The results of that study are reflected in the current adopted circulation element of the Metropolitan Bakersfield General Plan. It identifies a regional network of freeways, parkways, arterials, and collectors that when fully implemented are proposed to provide regional mobility and reduced congestion. Estimates for full buildout of all the necessary regional

improvements, along with additional facilities such as Seventh Standard Road, the South Beltway, and the Snow Road interchange with SR-99, range from $2 to $3 billion in today's dollars. Although construction of regional roadways has occurred with money from TIF, development-constructed improvements, and federal and state highway money, the freeways have not been completed.

The accelerated growth from 2002 to 2004 in the Metropolitan Bakersfield area of 4.7 percent per year resulted in housing construction and amendments to the plan that required road network improvements that are still in the design stage. Environmental clearance, design, right-of-way (ROW) acquisition and construction of a new freeway requires 10 to 15 years to complete. Given the size and scope of required improvements, the impacts from project amendments in the noncore area of the Metropolitan Bakersfield area are significant and cannot be accommodated by the TIF program or the localized supplemental funding proposed by the Bakersfield System Study. While a regional network has been identified, the issues of timing (when the actual improvements will be completed) and funding (guaranteed sources of money that will increase to match inflation) are still considered potentially significant.

Kern County and the City of Bakersfield have commenced a comprehensive update of the Metropolitan Bakersfield General Plan that will include a complete review of the circulation element and propose solutions to resolve the cumulative impacts past 2030. As an interim solution, the Kern County Public Works Department, in consultation with the City of Bakersfield, has reviewed the proposed regional network along with the known funding sources. The proposed future circulation system includes all existing and future arterials, based on the sectional grid system, constructed to their ultimate six-lane width. It also includes a freeway system composed of all existing and currently proposed facilities, constructed to a width of up to 10 lanes as needed. The proposed future freeway system includes the following facilities:

- West Beltway
- Westside Parkway (Completed)
- Centennial Corridor
- Fruitvale Avenue at SR-65 connection/extension
- Snow Road at SR-99 interchange
- South Beltway
- North Beltway (north of Seventh Standard Road)

The issues to be examined include a realistic assessment of the design and available funding over the next 30 years against the background that the County does not have a dedicated sales tax for transportation funding, the funding from the STIP is limited by competition among agency requests across California, federal money (Thomas Road Improvement Program) will not build complete infrastructure, and local matching funds were limited.

Funding for Regional Transportation Improvements

Local Sales Tax

State law provides that a countywide sales tax on goods and services can be applied with two-thirds voter approval for use in operation, maintenance, and construction of transportation projects. The County is then deemed a self-help county and receives priority consideration during state and federal funding allocations. Currently, 19 counties in California are self-help counties. Kern COG estimates that a countywide 0.5-cent sales tax would generate $931.6 million over a 20-year period, while a 1-cent tax would generate $1.8 billion over the same time period. Such funding is then used to match funding for state and federal allocations and to finance local projects that will reduce critical congestion points. Kern County voters failed to pass a proposed 0.5-cent sales tax in 1989 and 2006. There are no legal limits on the number of times the measure may be qualified for the ballot.

Other Local Sources

Supplemental impact fees for regional impacts could be assessed on all new proposals in the metropolitan Bakersfield area under the jurisdiction of the County. An example of this approach is San Joaquin County, which assesses two different fees to address regional and local connectively improvements.

Additional funding could be generated by conditioning development proposals to create geographical funding districts such as bridge and thoroughfare districts or capital facilities districts that would assess new homes for regional improvements. Given the regional nature of the circulation system, identifying the facilities and appropriate segments for assessment that would comply with legal requirements for equity and nexus could be difficult.

In addition to matching funding of over $100 million that the City of Bakersfield has allocated from revenue, Kern County has approved a financing plan that will generate $148 million for transportation projects. Presented to the Board of Supervisors on December 4, 2007, the plan proposes to issue bonds that will provide a framework for debt financing. The financing plan includes the following projects that have been identified in priority order with estimated cost and time periods when bond proceeds will be needed:

1. Seventh Standard Road Corridor from SR-99 to Santa Fe Way (SR-43)	$34.3 million, 12 months
2. Local Transportation Projects	$ 42.3 million, 12 months
3. Thomas Road Improvement Program, County Match	$ 72.0 million, 6 years
Total	**$148.6 million**

This funding could provide immediate construction dollars to implement projects to relieve critical congestion points and ensure timely implementation of TRIP. In addition, the proposed financing plan includes setting aside funds ranging in amounts from $9.5 million to $17.5 million annually to defray future capital costs associated with the transportation projects.

Conclusion

All roadway segments would operate at acceptable LOS under cumulative conditions. In addition, required mitigation measures would result in acceptable LOS for all intersections. Roadway and intersection improvements require participation in the RTIF Program. However, given the uncertainty of the timing and/or ultimate implementation of the recommended improvements which require pro-rata, fair share funding from various sources, along with those improvements necessary within Metropolitan Bakersfield, the proposed Project's contribution would result in significant and unavoidable impacts.

Mitigation Measures

Implement mitigation measure MM 4.16-2.

Level of Significance after Mitigation

Cumulative impacts would be significant and unavoidable.

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Section 4.17

Utilities

Section 4.17
Utilities

4.17.1 Introduction

This section addresses impacts of the proposed Project pertaining to demand for operational utilities (i.e., water, sewer/wastewater, stormwater control, solid waste disposal, electricity, and natural gas). For each of the utilities addressed in this section, existing infrastructure and levels of service are described, as are improvements that would be required to accommodate the proposed Project. A Public Services Report was prepared by McIntosh & Associates in October 2008 (refer to Appendix N, *Original Technical Studies*). A subsequent Public Services Report was prepared by McIntosh & Associates in June 2017 (Appendix J, *Public Services Report*), and most recently, a Water Supply Assessment was prepared by Yarne & Associates, Inc. in January 2019 [Appendix H, *99 Houghton Industrial Park SB 610 Water Supply Assessment (WSA*)].

4.17.2 Environmental Setting

Water Resources

The existing water purveyor for the proposed Project, who currently provides irrigation water solely for agricultural purposes, would not service the Project site with domestic water. Instead, potable water would be provided to the Project site by the California Water Service Company (Cal Water). Cal Water supplies water service to 1.7 million Californians through 435,000 connections in a total of 24 Districts. The proposed Project is located approximately 0.5 miles from the southern boundary of the Cal Water Bakersfield District (District) near the intersection of State Route (SR-99) and West Curnow Road. In 2015, an Urban Water Management Plan (UWMP) was prepared for the District, but because the proposed Project site is outside the current District boundaries, it was not specifically included in the UWMP. Because the proposed Project was not included in the UWMP, a WSA was prepared to address water service requirements. The information in the WSA was based on the 2015 UWMP, which is the most recent UWMP for the District, as well as information from Cal Water that was compiled from the most recent 2016-2017 data. This information has been used for the analysis in the RDEIR.

Cal Water would require approval from the California Public Utility Commission (CPUC) to expand its service area to include the proposed Project. Cal Water plans on submitting an application to the CPUC and receiving approval for the service extension in mid to late 2019.

Sewer Services

The Metropolitan Bakersfield area is served by five major wastewater treatment facilities: the City of Bakersfield Treatment Plant No. 2, the City of Bakersfield Treatment Plant No. 3, the North of River Sanitary District (NORSD) Treatment Plant, the Mount Vernon/Panorama District Plant and the Lamont Public Utility District Plant (located outside the Metropolitan Bakersfield boundary).

The proposed Project site area has never been served by a sewer system. Currently, neighboring residential and commercial properties are served by individual, privately-owned septic systems. A private package sewer treatment plant is proposed to provide services for the Project site.

Solid Waste

Solid waste is a mixture of items discarded as useless or unwanted arising from residential, commercial, industrial, institutional, agricultural, industrial and mining activities. These wastes include construction and demolition-generated (C&D) waste as well as inert wastes. The general waste classifications utilized by the Kern County Waste Management Department are:

- Non-hazardous solid waste consists mostly of household garbage, commercial wastes, agricultural waste and litter.
- Special waste, which is any waste that requires special handling, includes infectious waste, pesticide containers, sewage sludge, oilfield waste, household hazardous waste, and asbestos waste.
- Designated waste is a waste that consists of or contains pollutants that could be released at concentrations in excess of applicable water quality objectives and standards or hazardous waste that has been granted a variance from hazardous waste management requirements.
- Hazardous waste is a waste that, because of its quantity, concentration, physical, chemical, or infectious characteristics, may either (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly managed.
- Industrial wastes are hazardous and non-hazardous by-products produced by oil and gas extraction, pesticide, paper, petrochemical, rubber, plastics, electronics, and other industries.

Not all of the above-defined wastes may be disposed of at a landfill. State law regulates the disposal of wastes at landfills. Refer to the following section for a description of appropriate disposal methods of waste generated at the proposed Project site.

Kern County is responsible for meeting the California Integrated Wastewater Management Act of 1989, Assembly Bill 939 (AB 939). AB 939 requires that cities and counties reduce the amount of solid waste being sent to landfills by 50 percent by January 1, 2000, and it requires cities and counties to prepare AB 939 solid waste planning documents. These documents include the Source Reduction and Recycling Element (SRRE), the Household Hazardous Waste Element (HHWE), and the Non-Disposal Facility Element (NDFE). All three of these documents have been approved for Kern County, as well as an Integrated Waste Management Plan approved February 1998 by the California Integrated Waste Management Board [California Integrated Waste Management Board (CIWMB) 2009]. The Kern County Integrated Waste Management Plan is the long-range planning document for landfill facilities.

C&D waste is heavy, inert material. These are processed and reused in construction and improvement projects. Three sites, all in the City of Bakersfield have been approved to accept these wastes. Since C&D waste is heavier than paper and plastic, it is more difficult for the counties and cities to reduce the tonnage of disposed waste. For this reason, C&D waste has been specifically targeted by the State of California for diversion from the waste stream. Projects that will generate C&D waste should emphasize deconstruction and diversion planning, rather than demolition. Deconstruction is the planned, organized dismantling of a prior construction project, which allows maximum use of the

deconstructed materials for recycling in other construction projects and sends a minimum of the deconstruction material to landfills.

The Kern County Waste Management Department administers or sponsors the following recycling programs that contribute towards meeting the State-mandated solid waste diversion goals:

- Recycling programs at landfills to recycle or divert a wide variety of products, such as wood waste, cathode ray tubes, tires, inert materials, appliances, etc.
- Kern County and the City of Bakersfield operate drop-off recycling centers for household recyclables located within the unincorporated metropolitan area and within the City. County and City drop-off recycling centers may be used by both County and City residents.
- Financial assistance for the operation of the City of Bakersfield Green Waste Facility.
- Kern County Special Waste Facility provides disposal of household hazardous waste services to all Kern County residents.
- Cosponsors semi-annual Bulky Waste Collection Events, which are held in the Bakersfield area and are available to both County and City residents.
- Participates, jointly with the City of Bakersfield, on a Christmas Tree Recycling campaign.
- Cosponsors, jointly with the Community Clean Sweep, a Telephone Book Recycling program.
- Sponsors the Community Clean Sweep to conduct summer workshops called "Trash to Treasure", which educates children on recycling and other Kern County Waste Management Department programs.
- Operates, in collaboration with the Community Clean Sweep, an innovative elementary school education program called "Clean Kids Hit the Road Puppet Show".
- Provides recycling trailers to churches, schools and non-profit organization.

Solid waste generated from the proposed Project would be collected by solid waste hauler Price Environmental Services, Inc. For additional details regarding solid waste services, refer to Appendix J, Public Services Report.

Landfills

Refuse collected by the franchise hauler is transported to one of two landfills, the Metropolitan Bakersfield Sanitary Landfill (MBSL) at Bena, located approximately 18 miles east of downtown Bakersfield, or Shafter-Wasco Sanitary Landfill. The Kern County Waste Management Department (KCWMD) opened the MBSL in 1992.

According to the City of Bakersfield Solid Waste Division, refuse from the proposed Project would be deposited at the Bena Landfill located at 2951 Neumarkel Road in Caliente, California and the Shafter-Wasco Sanitary Landfill located at 17621 Scofield Avenue in Shafter, California. Refuse collection services for the proposed Project is operated and managed by Price Environmental Services, Inc.

Bena Landfill has reported the remaining capacity at 22,174,654 tons and the landfill is projected to accommodate solid waste for 26.8 years and is currently scheduled for closure in 2038. Shafter-

Wasco Landfill has reported the remaining capacity at 3,671,755 tons and is projected to accommodate solid waste for 16.4 years.

Should the California Integrated Waste Management Board (CIWMB) grant additional permits to develop the remainder of the site and waste diversion stabilizes at 50 percent, the potential total capacity for the Bena Landfill site exceeds 60 years. The Shafter-Wasco Sanitary Landfill is estimated to reach capacity by July 2024.

Electrical Services

Most of the County's electrical energy is consumed by residential, commercial, industrial, agricultural, and transportation uses. Electric power supply and distribution for the proposed Project area is furnished by Pacific Gas & Electric (PG&E). Two PG&E substations, Old River Substation and Panama Substation presently serve the proposed Project area. Existing PG&E electrical distribution facilities are located on the south side of DiGiorgio Road, on the northeast side of SR-99, along the north side of Houghton Road, and on the west side of South Union Avenue with a little intrusion into the area from South Union Avenue and Houghton Road.

Four pole-mounted electrical transformer locations were observed on the proposed Project site. PG&E is the owner of the transformers and should be contacted for their removal prior to Project site development.

Natural Gas

Natural gas is primarily consumed by the City's residential land uses for heating and cooking purposes. The entire proposed Project site is within PG&E's service territory; therefore, natural gas will be provided by PG&E. Currently, there is approximately 5,000 linear feet of PG&E Transmission Line 300B located in the northeast corner of the proposed Project. There is also a six-inch diameter gas distribution line located on the east side of the proposed Project.

4.17.3 Regulatory Setting

At the federal level, the United States Environmental Protection Agency (U.S. EPA) promulgates regulations that protect surface waters under the Water Pollution Control Act Amendments of 1972, commonly referred to as the Clean Water Act. These federal regulations, published in the Federal Register and codified in Code of Federal Regulations Title 40, establish wastewater treatment policies, effluent requirements for surface water disposal, and requirements for biosolids management and disposal. Regulations also set forth pretreatment requirements for preventing pollutants from entering publicly owned treatment works at levels that could interfere with treatment operation or solids management.

Federal

Clean Water Act (CWA)

At the federal level, the United States Environmental Protection Agency (U.S. EPA) promulgates regulations that protect surface waters under the Water Pollution Control Act Amendments of 1972,

commonly referred to as the Clean Water Act. These federal regulations, published in the Federal Register and codified in Code of Federal Regulations Title 40, establish wastewater treatment policies, effluent requirements for surface water disposal, and requirements for biosolids management and disposal. Regulations also set forth pretreatment requirements for preventing pollutants from entering publicly owned treatment works at levels that could interfere with treatment operation or solids management.

Safe Drinking Water Act

The Safe Drinking Water Act of 1974 (SDWA) gave the U.S. EPA the authority to set standards for contaminants in drinking water supplies. The U.S. EPA was required to establish primary regulations for the control of contaminants that affected public health and secondary regulations for compounds that affect the taste, odor, and aesthetics of drinking water. Under the provisions of SDWA, the California Department of Health Services (DHS) has primary enforcement responsibility. Title 22 of the California Administrative Code establishes DHS authority and stipulates State drinking water quality and monitoring standards.

State

California Department of Resources Recycling and Recovery (CalRecycle) Formerly California Integrated Waste Management Board (CIWMB)

CalRecycle is the State agency designated to oversee, manage, and track California's 76 million tons of waste generated each year. It is one of the six agencies under the umbrella of the California Environmental Protection Agency. CalRecycle develops regulations to control and manage waste, for which enforcement authority is typically delegated to the local government. The board works jointly with local government to implement regulations and fund programs.

Assembly Bill (AB) 939 and Senate Bill (SB) 1016

The California Integrated Waste Management Act of 1989, or Assembly Bill (AB) 939, established the Integrated Waste Management Board, required the implementation of integrated waste management plans, and mandated that local jurisdictions divert at least 50 percent of all solid waste generated (from 1990 levels), beginning January 1, 2000, and divert at least 75 percent by 2010. Projects that would have an adverse effect on waste diversion goals are required to include waste diversion mitigation measures to assist in reducing these impacts to less-than-significant levels. With the passage of Senate Bill (SB) 1016 (the Per Capita Disposal Measurement System) in 2006, only per capita disposal rates are measured to determine if a jurisdiction's efforts are meeting the intent of AB 939.

Assembly Bill (AB) 341

In response to reducing commercial solid waste that is landfilled, the State Legislature passed AB 341 declaring that it is the policy goal of the State that not less than 75 percent of solid waste generated be source separated, reduced, recycled, or composted by the year 2020. AB 341 sets forth the requirements of the statewide mandatory commercial recycling program which defines that a business, including any commercial or public entity, generating four cubic yards or more of commercial solid waste per week are required to recycle. Businesses are required to take one or any

combination of the following actions in order to reuse, recycle, or otherwise divert solid waste from disposal:

- Subscribe to a source separated recycling service with a regional franchise hauler authorized to provide service for the area in which the business is located;
- Subscribe to a mixed solid waste recycling service with a regional franchise hauler authorized to provide service for the area in which the business is located;
- Self-recycle and certify compliance with Kern County Ordinance No. G-8337.

Assembly Bill (AB) 1826

AB 1826, created to drive the recycling of yard trimmings and food scraps, became effective April 2016. The bill requires businesses generating a specified amount of organic solid waste per week to arrange for recycling for that material. This bill will also require the contract or work agreement between a business and a gardening or landscaping service to require the organic waste generated by those services to comply with the requirements of the law. Business within the County would be required to comply with any codes/regulations promulgated from AB 1826.

California Green Building Standards Code

Construction- and demolition-generated (C&D) waste is heavy, inert material. This material creates significant problems when disposed of in landfills. Since C&D debris is heavier than paper and plastic, it is more difficult for counties and cities to reduce the tonnage of disposed waste. For this reason, C&D waste debris has been specifically targeted by the State of California for diversion from the waste stream.

The California Green Building Standards Code (Standards Code) will apply to the construction related activities of this project. The purpose of the Standards Code is to improve public health, safety, and general welfare by enhancing the design and construction of buildings using building concepts that have a positive environmental impact and encouraging sustainable construction practices. Provisions of the Standards Code shall apply to the design and construction of building structures subject to State regulation.

Per Code Section 708.3 – Construction Waste Reduction, Disposal, and Recycling of the Standards Code, a commercial entity is to recycle and/or salvage for reuse a minimum of 50 percent of the nonhazardous construction and demolition debris, or meet a local construction and demolition waste management ordinance, whichever is more stringent.

State Water Resources Control Board

The National Pollution Discharge Elimination System (NPDES) was established per the 1972 amendments to the Federal Water Pollution Control Act, or CWA, to control discharges of pollutants from point sources (Section 402). Amendments to the CWA created a new section to the Act, which is devoted to stormwater permitting (Section 402[p]), with individual states designated for administration and enforcement of the provisions of the CWA and the NPDES permit program. The SWRCB issues both general construction permits and individual permits under this program.

Biosolids generated during wastewater treatment are regulated by the State under SWRCB Water Quality Order No. 2004-0012-DWQ, titled the "Final General Waste Discharge Requirements for Land Application of Biosolids for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities." This order, implemented under the federal biosolids rules set forth in 40 CFR Part 503, applies to all land application of Class A and Class B biosolids as well as "exceptional quality" biosolids-derived mixtures consisting of 50% or more biosolids. The order establishes permitting, monitoring, and reporting requirements. Local ordinances, described below, would also regulate the disposal of biosolids in Kern County.

Central Valley Regional Water Quality Control Boards

The primary responsibility for the protection of water quality in California rests with the State Water Resources Control Board (SWRCB) and nine regional water quality control boards (RWQCBs). The SWRCB sets Statewide policy for the implementation of State and Federal laws and regulations. The RWQCBs adopt and implement Water Quality Control Plans (Basin Plans) that recognize regional differences in natural water quality, actual and potential beneficial uses, and water quality problems associated with human activities. The jurisdiction of the Central Valley RWQCB extends from the Oregon border, over the valley and foothills, through the Central Valley, to the border with Los Angeles County.

California Department of Water Resources (DWR)

The DWR is a department within the California Resources Agency. The DWR is responsible for the State's management and regulation of water usage.

California Water Code Section 13260

California Water Code Section 13260 requires any person who discharges waste, other than into a community sewer system, or proposes to discharge waste that could affect the quality of waters of the State, to submit a report of waste discharge to the applicable RWQCB. Any actions of the proposed Project that would be applicable under California Water Code Section 13260 would be reported to the Central Valley Regional Water Quality Control Boards (Central Valley RWQCB).

Porter-Cologne Water Quality Control Act

The Porter Cologne Act, passed in 1969, acts in concert with the Federal CWA. The act established the SWRCB and divided the State into nine regions, each overseen by an RWQCB. The SWRCB is the primary State agency responsible for protecting the quality of the State's surface and groundwater supplies; however, much of its daily implementation authority is delegated to the nine RWQCBs. The Project Area is under the jurisdiction of the Central Valley RWQCBs.

The Porter Cologne Act provides for the development and periodic review of water quality control plans (basin plans) that designate beneficial uses of California's major rivers and groundwater basins and establish narrative and numerical water quality objectives for those waters. Basin plans are primarily implemented by using the NPDES permitting system to regulate waste discharges so that water quality objectives are met. Basin plans, updated every three years, provide the technical basis for determining waste discharge requirements, taking enforcement actions, and evaluating clean water grant proposals. The act also assigns responsibility for implementing CWA Sections 401, 402, and

303(d) to the SWRCB and RWQCBs. There are two basin plans in the Central Valley RWQCB region, the Water Quality Control Plan for the Sacramento and San Joaquin Rivers and the Water Quality Control Plan for the Tulare Lake Basin.

Assembly Bill (AB) 1881

AB 1881 expanded previous legislation related to landscape water use efficiency. AB 1881, the Water Conservation in Landscaping Act of 2006, enacted landscape efficiency recommendations of the California Urban Water Conservation Council (CUWCC) for improving the efficiency of water use in new and existing urban irrigated landscapes in California. AB 1881 required the DWR to update the existing Model Local Water Efficient Landscape Ordinance and local agencies to adopt the updated model ordinance or an equivalent. The law also requires the California Energy Commission to adopt performance standards and labeling requirements for landscape irrigation equipment, including irrigation controllers, moisture sensors, emission devices, and valves to reduce the wasteful, uneconomic, inefficient, or unnecessary consumption of energy or water.

Assembly Bill (AB) 2882

AB was passed in 2008 and encourages public water agencies throughout California to adopt conservation rate structures that reward consumers who conserve water. AB 2882 clarifies the allocation-based rate structures and establishes standards that protect consumers by ensuring a lower base rate for those who conserve water.

Sustainable Groundwater Management Act of 2014

In 2014, California enacted the Sustainable Groundwater Management Act (SGMA; Water Code Section 10720 et seq.). SGMA, and related amendments to California law, require that all groundwater basins designated as high or medium priority in the DWR California Statewide Groundwater Elevation Monitoring (CASGEM) Program, and that are subject to critical overdraft conditions, must be managed under a new Groundwater Sustainability Plan (GSP) or a coordinated set of GSPs, by January 31, 2020. High or medium priority basins that are not subject to a critical overdraft must be regulated under one or more GSPs by 2022. Where GSPs are required, one or more local Groundwater Sustainability Agencies (GSAs) must be formed to implement applicable GSPs. A GSA has the authority to require registration of groundwater wells, measure and manage extractions, require reports and assess fees, and to request revisions of basin boundaries, including establishing new subbasins. GSAs must have been formed for high and medium priority basins by June 2017. All of the Kern County Subbasin has been included in exclusive GSA's as mandated by SGMA.

The 2.8 million acres of valley portion of Kern County has been designated a high priority and the 250,000 acres of the Indian Wells Valley sub-basin which includes the City of Ridgecrest and China Lake Naval Weapons Station has been classified a medium priority basin. Both are under mandatory requirements to form a GSA (or multiple GSA's) and create a GSP that achieves sustainability in 20 years.

Each GSP must include a physical description of the covered basin, such as groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on

historical and projected water demands and supplies, monitoring and management provisions, and a description of how the plan will affect other plans, including city and county general plans Under the Act, the GSA is authorized to restrict pumping, levy assessments and fees and undertake water quality and quantity projects to rebalance the basin. The DWR must adopt regulations for the preparation of a GSP by January 2016. Emergency regulations for the preparation of the GSP's were approved by the California Water Commission on May 18, 2016. As defined by the Act, "sustainable groundwater management" means that groundwater use within basins managed by a GSP will not cause any of the following "undesirable results:" (a) chronic lowering of groundwater levels (not including overdraft during a drought, if a basin is otherwise managed); (b) significant and unreasonable reductions in groundwater storage; (c) significant and unreasonable seawater intrusion; (d) significant and unreasonable degradation of water quality; (e) significant and unreasonable land subsidence; and (f) surface water depletions that have significant and unreasonable adverse impacts on beneficial uses (Water Code Section 10721(w)).

Kern County is a member of the following GSA's: Cuyama Basin Groundwater Sustainability Agency, Indian Wells Valley Groundwater Authority and Kern Groundwater Authority which manages a portion of the valley sub-basin. The Valley portion of Kern County also is managed by the Kern River Groundwater Sustainability Agency which is comprised of the City of Bakersfield, Kern Delta Water District and Improvement District No. 4 of the Kern County Water Agency. An additional nine GSA's have been formed to sustainably manage their respective portions of the Kern County subbasin.

Note: Effective December 11, 2018, the County of Kern withdrew from the Kern Groundwater Authority. The Kern County Water Agency (KCWA) was brought in as a cooperative member of Joint Powers Agreement to manage the white spaces. Five GSA's are preparing GSP's to manage the Kern subbasin per a Kern County Subbasin Coordination Agreement.

Recycled Water Policy

On February 3, 2009, by Resolution No. 2009-0011, the SWRCB adopted a Recycled Water Policy in an effort to move towards a sustainable water future. In the Recycled Water Policy states "we declare our independence from relying on the vagaries of annual precipitation and move towards sustainable management of surface waters and groundwater, together with enhanced water conservation, water reuse and the use of stormwater."

The following goals were included in the Recycled Water Policy:

- Increase use of recycled water over 2002 levels by at least one million acre-feet per year by 2020 and at least two million acre-feet per year by 2030.
- Increase the use of stormwater over use in 2007 by at least 500,000 acre-feet per year by 2020 and at least one million acre-feet per year by 2030.
- Increase the amount of water conserved in urban and industrial areas by comparison to 2007 by at least 20 percent by 2020.
- Included in these goals is the substitution of as much recycled water for potable water as possible by 2030.

The Recycled Water Policy provides direction to the RWQCBs regarding issuing permits for recycled water projects, addresses the benefits of recycled water, addresses a mandate for use of recycled water and indicates the SWRCB will exercise its authority to the fullest extent possible to encourage the use of recycled water.

The Recycled Water Policy also indicates that some groundwater basins contain salts and nutrients that exceed or threaten to exceed water quality objectives established in basin plans and states that it is the intent of this Recycled Water Policy that all salts and nutrients be managed on a basin-wide or watershed-wide basis through development of regional or sub-regional management plans. Finally, the Recycled Water Policy addresses the control of incidental runoff from landscape irrigation projects, recycled water groundwater recharge projects, anti-degradation, control of emerging constituents and chemicals of emerging concern and incentives for use of recycled water.

In accordance with the provisions of the Recycled Water Policy, a Constituents of Emerging Concerns (CEC) Advisory Panel was established to address questions about regulating CECs with respect to the use of recycled water. The CEC Advisory Panel's primary charge was to provide guidance for developing monitoring programs that assess potential CEC threats from various water recycling practices, including groundwater recharge/reuse and urban landscape irrigation. On June 25, 2010, the CEC Advisory Panel provided recommendations to the SWRCB and California Department of Public Health in their Final Report "Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water – Recommendations of a Scientific Advisory Panel". The SWRCB used those recommendations to amend the Recycled Water Policy in 2013 (SWRCB Resolution No. 2013-003).

The April 2013 amendment provides direction to the RWQCBs on monitoring requirements for CECs in recycled water. The monitoring requirements pertain to the production and use of recycled water for groundwater recharge reuse by surface and subsurface application methods, and for landscape irrigation. The amendment identifies three classes of constituents to monitor:

- Human health-based CECs: CECs of toxicological relevance to human health.
- Performance indicator CECs: An individual CEC used for evaluating removal through treatment of a family of CECs with similar physicochemical or biodegradable characteristics.
- Surrogates: A measurable physical or chemical property, such as chlorine residual or electrical conductivity, that provides a direct correlation with the concentration of an indicator compound. Surrogates are used to monitor the efficiency of CEC treatment.

Only groundwater recharge reuse facilities will be required to monitor for CECs and surrogates. Surface application and subsurface application facilities will have different mandatory CECs and a different monitoring schedule. Monitoring is not required for recycled water used for landscape irrigation projects that qualify for streamlined permitting unless monitoring is required under the adopted salt and nutrient management plan. Streamlined permitting projects must meet the criteria specified in the Policy including: compliance with Title 22, application at agronomic rates, compliance with any applicable salt and nutrient management plan, and appropriate use of fertilizers.

Senate Bills 610 (Chapter 643, Statutes of 2001) and 221 (Chapter 642, Statutes of 2001)

SB 610 and SB 221 are companion measures that seek to promote more collaborative planning among local water suppliers and cities and counties. They require that water supply assessments occur early in the land use planning process for all large-scale development projects. If groundwater is the supply source, the required assessments must include detailed analyses of historic, current, and projected groundwater pumping and an evaluation of the sufficiency of the groundwater basin to sustain a new project's demands. They also require an identification of existing water entitlements, rights, and contracts and a quantification of the prior year's water deliveries. In addition, the supply and demand analysis must address water supplies during single and multiple dry years presented in 5-year increments for a 20-year projection. Under SB 221, approval by a county of a subdivision of more than 500 homes requires an affirmative written verification of a sufficient water supply.

California Water Conservation Executive Orders

Beginning in January 2014, Governor Jerry Brown issued three Executive Orders (EOs), B-26-14, B-28-14, B-29-15, B-37-16, and B-40-17 regarding water supply, water demand, and water use within the State during severe drought conditions. EO B-29-15, issued April 1, 2015, sets limitations not only for existing land uses and water supply systems, but also for new construction. Some of these restrictions include:

- The Water Board shall prohibit irrigation with potable water of ornamental turf on public street medians. (EO B-29-15, Save Water, Action #6)
- The Water Board shall prohibit irrigation with potable water outside of newly constructed homes and buildings that is not delivered by drip or microspray systems. (EO B-29-15, Save Water, Action #7)
- The California Energy Commission shall adopt emergency regulations establishing standards that improve the efficiency of water appliances, including toilets, urinals, and faucets available for sale and installation in new and existing buildings. (EO B-29-15, Increase Enforcement Against Water Waste, Action #16)

In addition, EO B-29-15 requires that DWR update the State Model Water Efficient Landscape Ordinance through expedited regulation by the end of 2015. This ordinance will increase water efficiency standards for new and existing landscapes through more efficient irrigation systems, greywater usage, on-site stormwater capture, and by limiting the portion of landscapes that can be covered in turf (EO B-29-15, Increase Enforcement Against Water Waste, Action #11).

On November 13, 2015, Governor Brown issued EO B-36-15, which upheld the previous EOs, and directed the SWRCB to extend of urban water use restrictions through October 31, 2016 based on drought conditions known through January 2016. The SWRCB issued Emergency Regulations on February 2, 2016, in compliance with EO B-36-15. These emergency regulations maintain the current tiers of required water reductions; however, additional adjustments in response to stakeholders; equity concerns were included in the Emergency Regulations.

In addition, DWR and the U.S. Bureau of Reclamation finalized the 2016 Drought Contingency Plan that outlines State Water Project and Central Valley Project operations from February through November 2016. The 2016 Drought Contingency Plan was developed in coordination with staff from State and federal agencies. The 2016 Drought Contingency Plan communicates overarching goals for 2016 water management and the potential operations needed to achieve those goals.

In May 2016, Governor Brown issued EO B-37-16, which upheld the previous EOs, and directs local agencies to provide new permanent water use targets for each urban water supplier and concrete improvements to drought preparedness. The order bolstered the State's drought resilience and preparedness by establishing longer-term water conservation measures that include permanent monthly water use reporting, new urban water use targets, reducing system leaks and eliminating clearly wasteful practices, strengthening urban drought contingency plans and improving agricultural water management and drought plans. Local agencies are required to publicly disclose the projections and calculations used to determine their conservation standards, and to continue monthly water conservation reporting. EO B-37-16 calls for wise water use and less water waste to become permanent changes to prepare for more frequent and persistent periods of limited water supply. On April 7, 2017, EO B-40-17 lifted the drought emergency in all California counties except Fresno, Kings, Tulare, and Tuolumne counties. EO B-40-17 builds on EO B-37-16, which continues to remain in effect, to continue to make water conservation a way of life in California.

Local

Metropolitan Bakersfield General Plan

The Metropolitan Bakersfield General Plan Public Services and Facilities Elements include relevant goals and policies related to utilities. Refer to Table 4.17-1, *Metropolitan Bakersfield General Plan Goals and Policies for Utilities*, below.

Table 4.17-1. Metropolitan Bakersfield General Plan Goals and Policies for Utilities
Goals and Policies: Public Services and Facilities Element
General Utilities
Policy #5: Require all new development to pay its pro rata share of the cost of necessary expansion in municipal utilities, facilities and infrastructure for which it generates demand and upon which it is dependent.
Water Distribution
Goal #1: Ensure the provision of adequate water service to all developed and developing portions of the planning area.
Policy #3: Require that all new development proposals have an adequate water supply available.
Sewer Services
Goal #3: Provide trunk sewer availability to and treatment/disposal capacity for all metropolitan urban areas, to enable cessation or prevention of the use of septic tanks where such usage crates potential public health hazards or may impair groundwater quality, and to assist in the consolidation of sewerage systems. Provide sewer service for urban development regardless of jurisdiction.
Solid Waste
Goal #1: Ensure the provision of adequate solid waste disposal services to meet the demand for these services in the Planning area.

Table 4.17-1. Metropolitan Bakersfield General Plan Goals and Policies for Utilities
Goals and Policies: Public Services and Facilities Element
Storm Drainage
Goal #1: Ensure the provision of adequate storm drainage facilities to protect Planning area residents from flooding resulting from stormwater excess.
Street Lighting
Goal #1: Provide uniform and adequate public lighting for all developed and developing portions of the Planning area.
Policy #4: Require developers to install street lighting in all new development in accord with adopted city standards and county policies.

4.17.4 Impacts and Mitigation Measures

Thresholds of Significance

The Kern County California Environmental Quality Act (CEQA) Implementation Document and Kern County Environmental Checklist state that a project could potentially have a significant effect if it:

- Exceeds wastewater treatment requirements of the applicable Regional Water Quality Control Board;
- Requires or results in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which would cause significant environmental effect;
- Requires or results in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects;
- Has insufficient water supplies available to serve the Project from existing entitlement and resources and new or expanded entitlement is needed;
- Results in a determination by the wastewater treatment provider which serves or may serve the Project that it does not have adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments;
- Is served by a landfill that does not have sufficient permitted capacity to accommodate the Project's solid waste disposal needs; and/or
- Does not comply with federal, state, and local statues and regulations related to solid waste.
- Exceeds the capacity of the electrical and natural gas facilities within the project area.

Impact 4.17-1: The Project Would Exceed Wastewater Treatment Requirements of the Applicable Regional Water Quality Control Board.

With the future urban development of the site, the proposed Project would result in an increase in wastewater in the form of stormwater runoff. The discharge of materials other than stormwater from a particular site is prohibited. With urban development projects, the pollutants of concern include silt and sediment, oil and grease, floatable trash, nutrients (including fertilizers), heavy metals, pathogens

(such as coliform bacteria) and other substances. Referred to as "controlled pollutants", discharge of these substances into waters of the United States, are prohibited.

Future proposed developments that involve grading and construction would contribute to an increase in pollution discharge. Individual development projects would be required to mitigate short-term construction impacts pursuant to the National Pollutant Discharge Elimination System (NPDES) criteria and standards on a project-by-project basis. The purpose of the NPDES permit is to ensure the Project area will eliminate or reduce construction-related sediments and pollutants during stormwater runoff. Construction sediment erosion can be adequately controlled through the application of standard construction Best Management Practices (BMPs). The goal of BMPs is to capture and treat "first flush" stormwater run-off generated by surrounding and on-site watersheds. Water quality management BMPs for grading and construction scenarios may include the use of sand bags and straw bales for run-off diversion and velocity reduction, mulch topping, hydro-seeding and siltation fencing to prevent soil loss and measures to minimize vehicular leaking and spilling. Implementation and compliance with the NPDES requirements would reduce construction-related impacts to water quality to less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-2: The Project Would Require or Result in the Construction of New Water or Wastewater Treatment Facilities or Expansion of Existing Facilities, the Construction of Which Would Cause Significant Environmental Effects.

The implementation of the proposed Project would result in the generation of wastewater on the property. The proposed Project is located outside of the Metropolitan Bakersfield boundary and is not served by a sewer system. The proposed Project would require the construction of a new wastewater package plant facility that could cause significant environmental effects. Based on the wastewater generation rate for general commercial and industrial uses utilized by the County of Kern, the proposed Project would result in the generation of a normal, unpeaked flow of approximately 1.46 million gallons per day, with a peak flow maximum generation of approximately 2.91 million gallons per day of wastewater. Implementation of applicable mitigation measures would reduce impacts to less than significant.

Additional infrastructure would be required to accommodate the proposed Project. A water service line would be extended from an existing 12" Cal Water main located on the east side of Wible Road at the intersection with Engle Road (CR 918), then east along an alignment along the section line, currently a disturbed unimproved dirt dairy access road within the County's road reservation, to the intersection of S. H St. and DiGiorgio Road (CR 704), then continue east and across S.R. 99 to the northwest corner of the proposed project site along DiGiorgio Road. If needed by Cal Water, a second water main extension would begin at the current end of the 12" water main located on the south side of Shafter Road at the east side of the General Shafter Elementary School, continue east along Shafter

Road in an existing right-of-way to the intersection with Costajo Road, then continue east and across S.R. 99 to the intersection with Chevalier Road in existing right-of-way, then continue north in existing right-of-way to the south side of the proposed project north of Houghton Road. A treated water service line would be constructed from the southwest corner of the proposed WWTP westerly under S.R. 99, continuing to the Kern Island Canal and the Kern Island Recharge Basins located near the northwest corner of S. H Street and Houghton Road as an outfall location for excess treated recycled water. It should be noted, although the specific volumes are unknown at this time, the developer intends to work with KDWD to accept any unused recycled water for either blending with irrigation canal water for agricultural irrigation or recharging groundwater at the nearby groundwater recharge basin. This would not require any new infrastructure beyond that already analyzed in the RDEIR but would assist in groundwater recharge.

As development progresses within the Project site water distribution infrastructure would be installed. Water infrastructure within the interior of the proposed Project would occur in areas that would be disturbed as part of the Project and none of these improvements would have an effect on an environmental resource beyond those disclosed in any other section of this RDEIR. The proposed improvements would be required to comply with all applicable development standards required by Kern County. This would ensure that impacts associated with the expansion of water facilities would be less than significant.

Mitigation Measures

MM 4.17-1: All special equipment for the proposed Project, such as package treatment plants, their appurtenances, and their effluent disposal areas and methods shall be designed, located, and constructed in coordination with the Kern County Public Works Department, so as to preclude contamination, pollution, nuisance, and structural and mechanical instability.

MM 4.17-2: **Package Treatment and Disposal Facilities.** Proposals and plans for package treatment and disposal facilities shall be subject to the review and approval of:

1. The State and County Environmental Health Services Departments for design and contamination aspects;

2. The Regional Water Quality Control Board for elements of pollution and nuisance; and

3. The Kern County Public Works Department for structural and mechanical integrity. Special structures, such as pump stations, pressure lines and sags, etc. shall be subject to the approval of the Kern County Public Works Department and the maintaining District.

MM 4.17-3: **Wastewater Package Plant Facility.** The new wastewater package plant facility shall be constructed according to State specifications, with coordination of Kern County Public Works and Kern County Environmental Health Services Departments and shall be operated in such a way as to not contaminate the underlying unconfined aquifer.

MM 4.17-4: **Water System.** All facilities of the water system shall be designed and constructed to comply with Kern County Development Standards and approved by the Kern County Public Works Department.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-3: The Project Would Require or Result in the Construction of New Stormwater Drainage Facilities or Expansion of Existing Facilities.

The development of industrial uses and associated landscaping and roadways would alter the drainage pattern within the proposed Project site through the introduction of impervious surfaces. Water that is anticipated to drain off-site would be required by the County to drain to storm drain structures, including detention or retention basins. Drainage collection facilities within the proposed Project would be constructed as development occurs and would be designed in accordance with local improvement standards and specifications. A stormwater drainage study may be needed to determine the size of a retention basin and optimal pipeline sizes that are needed to accommodate stormwater from the proposed project. This master drainage system would be designed to contain on-site waters within conveyance structures by appropriate means and that are acceptable to Kern County. Drainage waters shall be prevented from flowing onto adjacent properties or topping over the street system. Site improvement standards for drainage areas would be determined by the County of Kern as a function of the Precise Development Plan, Conditional Use Permit, or land division procedure. This would ensure that all drainage facilities are designed to accommodate runoff stormwater.

Mitigation Measures

Implementation of Mitigation Measure MM 4.7-8, as described in Section 4.7, *Geologic and Seismic Hazards Implement*

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-4: The Project Would Have Insufficient Water Supplies Available to Serve the Project from Existing Entitlement and Resources and New or Expanded Entitlement is Needed.

Kern Delta Water District (KDWD) supplies surface water for agricultural irrigation from the Kern Island Canal via an irrigation ditch. The project site has two agricultural wells that supply groundwater. It is estimated that 50% of the irrigation supply is from wells and the other 50% from KDWD surface waters. These sources; however, would not serve the Project site with domestic water. The proposed Project would be served by the Cal Water Bakersfield District upon approval of the application to the CPUC for the service extension to the Project site. Water supply for the District comes from groundwater; untreated local surface water purchased from the City of Bakersfield and treated by Cal Water; and treated local surface water and imported water purchased from KCWA.

Past water demand within the District was calculated between 2015 to 2017 based on seven use categories that included single family, multi-family, commercial, industrial, institutional/ governmental, other, and loses. In 2015 total system demand was 55,033 AFY, and 57,559 AFY, and 62,218 AFY, in 2016 and 2017, respectively. It should be noted that in May of 2015, the Emergency Regulations adopted by the State Water Resources Control Board were in effect and later extended by Executive Order B-37-16. The Bakersfield District was ordered to reduce potable water use by 32 percent over this period and reduced water use approximately by approximately 32.1 percent. However, in 2017 with the end of the drought water use increased at a greater percentage than the year before by approximately 4,659 AFY compared to 2,526 AFY.

Projected water uses within the District is predicated on unrestricted demands under normal weather conditions and is shown in Table 4.17-2 *Bakersfield District Projected Water Demand*, through 2040. Projected water demands are based on customer category and are estimated based on anticipated demand of future services that are based on historical growth rates in the District and the UWMP. In addition, anticipated water demand accounts for weather-normalized historical use, adjusted for future expected water savings from water efficiency requirements of plumbing codes and District conservation programs. The projected average annual growth rate in services across all customer categories is approximately 0.9 percent.

Table 4.17-2. Bakersfield District Projected Water Demand

Use	(AFY)				
	2020	2025	2030	2035	2040
Single Family	49,340	52,107	54,974	57,574	60,273
Multi-Family	3,748	3,859	40,020	4,166	4,334
Commercial	11,976	12,209	12,486	12,651	12,825
Industrial	49	50	50	50	50
Institutional/Governmental	6,690	7,281	7,898	8,492	9,130
Other	216	219	221	221	221
Losses	5,763	6,153	6,543	6,892	7,257
Total	**77,781**	**81,878**	**86,191**	**90,019**	**94,088**

Source: Yarne & Associates, 2019

Cal Water determined water use rates for industrial uses similar in classification to those of the proposed Project on a gallon per day per square foot of development (gallons/day/ft2). The WSA evaluated water use rates for industrial businesses that are similar to those that would occur under the proposed Project. The use rates ranged from 0.0042 to 0.1590 gallons/day/ft^2 and result in an average consumption of 0.0816 gallons/day/ft^2. Based on the total proposed Project square footage, 4,101,174, the resulting demand is approximately 334,660 gallons/day

Commercial office space water usage was estimate using a representative office complex at 0.00834 gallons/day/ft2. Because the specific square footage for the commercial component of the proposed Project is not known, the areas were estimated to be 65 % retail (0.20) + 15% restaurants (1.10) + 20% (office space) (0.00834) = 0.297 gallons/day/ft2. This results in an estimated commercial water use for the proposed Project is of 151,720 gallons/day. Taken in sum with the Industrial development the total water use at build out in 2025 would be approximately 486,380 gallons/day or 544.5 AFY.

As indicated in the WSA, prepared by Yarne & Associates, during the 6-year period from 2010 to 2015 the average annual agricultural water demand on the Project site was 977.2 acre-feet per year

(AFY). Existing groundwater recharge on the site is estimated to be, on average, 25% of the irrigated amount. Based on this, the total water lost to evapotranspiration after being applied for irrigation is approximately 732 AFY. Considering the proposed Project, at build out, would use approximately 544.5 AFY, the proposed Project would require approximately 187.5 AFY less water than the existing uses. The following discussion outlines existing and projected future water supplies compared to Project demand.

The 544.5 AFY equates to approximately 0.66% of projected 2025 Bakersfield District demand (81,191 AFY). In 2040, the proposed Project demand would be approximately 0.57% of the projected 2040 Bakersfield District demand (94,088 AFY). In addition, water demand within the District is project to increase by approximate 26,799 AFY between 2015 and 2025 (81,878 - 55,079). The proposed Project would account for approximately 2.0% of that increase.

The proposed Project includes a wastewater treatment facility to meet Title 22 requirements and use recycled water for landscape irrigation and other non-potable uses. The initial irrigation water requirement for landscaped areas of the proposed Project is estimated to be 39 AFY and at project build out would be approximately 86.7 AFY. This would be supplied entirely by recycled water, which would further reduce the proposed Project's water demand.

The effect of substituting recycled water for potable water further reduces the proposed Project's water demand. Conservatively, estimating that the 39 AFY for landscape irrigation are not included in the estimated project build out demand and that later uses substitute recycled water for potable water (47.7 AFY), this would result in a further reduction of water use by the proposed Project compared to existing agricultural. Accordingly, the proposed Project would reduce water demand, by 187.5 AFY + 47.7 = 235.2 AFY.

The proposed project also was evaluated to determine water use for normal year, single dry year, and multiple dry year periods. Table 4.17-3 *Multiple Dry Years Supply and Demand Comparison* shows the projected supply and demand totals for multiple dry years based on the conservative assumption that demand will increase slightly for a 3-year drought period even though the most recent drought experience (2012 – 2016) shows the opposite. Demand in 2015 decreased by 27.6% compared to demand in 2013 as discussed above. Although treated surface water supplies were reduced due to lower quantities of surface runoff and storage, the difference was made up by groundwater. Importantly, due to very effective conservation programs and public responsiveness ground water pumping decreased by 12,109 AF - the amount pumped in 2014 was 45,499 AF and in 2015 it was 33,390 AF.

Table 4.17-3: Multiple Dry Years Supply and Demand Comparison (AF)

		2020	2025	2030	2035	2040
First Year	Supply Totals	79,717	83,915	88,335	92,259	96,429
	Demand Totals	79,717	83,915	88,335	92,259	96,429
	Difference	0	0	0	0	0
Second Year	Supply Totals	79,717	83,909	88,329	92,252	96,422
	Demand Totals	79,717	83,909	88,329	92,252	96,422
	Difference	0	0	0	0	0

Third Year	**Supply Totals**	79,717	82,851	87.215	91,089	95,207
	Demand Totals	79,717	82,851	87,215	91,089	95,207
	Difference	**0**	**0**	**0**	**0**	**0**
Source: Yarne & Associates						

Cal Water coordinates on an ongoing basis with other water agencies in Kern County to optimize use of surface and groundwater water supplies. Cal Water concludes that for the next 21 years (2019 – 2040), the Bakersfield District will have adequate water supplies to meet projected demands associated with the proposed Project and those of all existing customers and other anticipated future customers for normal, single dry year and multiple dry year conditions (Yarne & Associates, 2019). While adequate water supply is anticipated, MM 4.17-4 related to water supply and the following mitigation measure will help ensure water use is within a reasonable range for future Project uses.

MM 4.17-5: **Water Meters.** Water meters shall be installed on all facilities. Once operations of the first facility constructed on-site have commenced, the Master Developer or subsequent future land owners shall be required to submit annual reports to the Kern County Planning Department and the Kern County Environmental Health Services Department detailing the annual water usage on-site.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-5: The Project Would Result in a Determination by the Wastewater Treatment Provider Which Serves or May Serve the Project That it Does Not Have Adequate Capacity to Serve the Project's Projected Demand in Addition to the Provider's Existing Commitments.

As noted above, no sewer lines are currently located on-site and no wastewater is conveyed from the proposed Project site. Currently, neighboring residential and commercial properties are served by individual, privately-owned septic systems. A private package sewer treatment plant is proposed to provide services for the Project site. Implementation of applicable mitigation measures and service fees would reduce impacts to water facilities to less than significant levels.

Mitigation Measures

Implement Mitigation Measures MM 4.17-1 through MM 4.17-3.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-6: The Project Would be Served by a Landfill That Has Sufficient Permitted Capacity to Accommodate the Project's Solid Waste Disposal Needs.

Implementation of the proposed Project would result in an increase demand for solid waste services and generate additional solid waste disposed of at landfills. As noted above, the City of Bakersfield

Solid Waste Division has indicated that solid waste generated by the proposed Project would go to the Bena Landfill and the Shafter-Wasco Sanitary Landfill. Although C&D waste impacts are short-term and cease upon construction completion, C&D waste disposed of at either landfill would decrease the remaining capacity available. This is considered a potentially significant impact; however, recycling of C&D waste would reduce the amount of waste disposed of at landfills and contribute to the recycling goals set forth by Kern County and AB 939. For any C&D waste disposed of at a landfill, the Kern County Waste Management Department charges a fee of up to $54.50 per ton for the disposal of construction waste. Implementation of the required mitigation measures below would reduce impacts to less than significant in this regard.

Based on an average generation rate for light- and medium-industrial properties of 6 pounds (lb) of refuse per square foot annually, and general commercial/highway commercial properties of 7 lb of refuse per square foot annually, the proposed Project would result in the generation of approximately 37 tons of refuse per day or approximately 13,519 tons per year. The total waste generated during the course of one year of construction (255 working days) is estimated at approximately 12,883 tons, and the daily total is estimated at 50.5 tons (McIntosh & Associates 2017).

As a worst-case situation, it is assumed that all of the project-generated refuse would be deposited at the Bena Landfill. Based on growth projections, 22,174,654 tons of capacity is available at the Bena Landfill, and it is anticipated to have capacity for approximately 26.8 years. Based on the remaining capacity and the anticipated life of the landfill, the average amount of solid waste deposited at the landfill is approximately 827,412 tons per year or 2,267 tons per day over 26.8 years. The solid waste generated by the proposed project would increase refuse deposited at the Bena Landfill by approximately 1.63 percent. This increase in considered a nominal impact on the remaining capacity of the Bena Landfill, and the Landfill would have the available capacity to serve the proposed Project. As identified under Section 4.15, *Public Services*, the proposed Project is subject to the Public Facilities Mitigation Program and mitigation measures have been included that would result in less than significant impacts in this regard.

Mitigation Measures

MM 4.17-6: **Recycling On-Site.** During construction, demolition debris and construction wastes shall be recycled to the extent feasible.

1. An on-site recycling coordinator will be designated by the Project Applicant/ Developer to facilitate recycling of all construction waste through coordination with the on-site contractors, local waste haulers, and/or other facilities that recycle construction/demolition wastes.

2. The name and phone number of the coordinator will be provided to the Kern County Waste Management Department prior to issuance of building permits

3. The on-site recycling coordinator will also be responsible for ensuring that wastes requiring special disposal are handled according to state and County regulations that are in effect at the time of disposal.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-7: The Project Would Comply with Federal, State, and Local Statues and Regulations Related to Solid Waste.

Refer to Section 4.11, *Land Use and Planning*, Table 4.11-2, for a brief explanation of how the proposed Project complies with the goals and policies of the Metropolitan Bakersfield General Plan. The proposed Project would be required to comply with all federal, state, and local statues and regulations related to solid waste. Implementation of the required mitigation measures would help local jurisdictions comply with Assembly Bill 939. Therefore, implementation of the proposed Project would result in less than significant impacts in this regard.

Mitigation Measures

Implement Mitigation Measure MM 4.17-6.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.17-8: The Project Would Exceed the Capacity of the Electrical and Natural Gas Facilities Within the Project Area.

Electrical Services

The proposed Project site is currently served by PG&E's Old River Substation and Panama Substation. According to PG&E, based on the rough size of proposed facilities, the proposed Project would result in a demand for approximately 20 Megawatts (Mw); however, more information is needed. Estimates for electric demands are based on the square footages of the proposed facilities. PG&E has indicated the existing electrical facilities are not adequate to accommodate the proposed Project. PG&E anticipates the Project would result in impacts to existing electric facilities, and that the Old River and Panama Substation be overloaded, as well as distribution facilities in the area. These facilities would need to be upgraded and new distribution and substation equipment would be required to serve the proposed Project. Potential impacts may be reduced if main lines adjacent to roadways are brought to the ultimate width at the initiation of proposed Project construction and if utility easements are made readily available as needed; however, more information is needed to determine specifically what will be required.

Construction of the proposed Project would require temporary electrical power supply for certain equipment and lighting. The proposed Project would also require electricity for street lighting along the roadway. County development standards require street lights at intersections, and at mid-block, where streets are greater than 600 feet in length, with the exception of some industrial areas in which street lights are required only at intersections. For new development, the County does not install street lights, thus, the County requires a developer to install lights and dedicate them to the County.

Street lights installed at the proposed Project are expected to be provided by PG&E at the company's Rate Schedule LS-1 Class A rate (LS-1A). In utilizing the LS-1A rate PG&E would install, own, and maintain the entire street lighting system. The connections would be constructed in accordance with the requirements of the County and PG&E. Therefore, implementation of recommended mitigation measures will ensure that adequate electricity is provided to the Project site; therefore, resulting in a less than significant impact.

Natural Gas

As noted above, the entire proposed Project is in PG&E gas service territory. Approximately 5,000 linear feet of PG&E Transmission Line 300B is located in the northeast corner of the proposed Project. According to PG&E, the proposed Project's gas needs will be supplied by the PG&E distribution system, either by the six-inch pipeline located on the east side of the Project site, on the west side of South Union Avenue, or a new distribution line throughout the development from the adjacent regulating stations. The PG&E Transmission Line 300B would not provide natural gas to the proposed Project. The average estimated gas consumption is calculated at 0.5 million cubic feet per hour (MCFH) for every 2,500 square feet of commercial building space. Therefore, the proposed Project would consume approximately 922.60 MCFH of natural gas (0.5 MCFH per 2,500 SF x 4,613,004 SF). PG&E would prefer that the request for service include all gas appliances in order to calculate a more accurate load.

It is anticipated that new distribution pipelines would be required to accommodate the proposed Project. Where necessary, natural gas pipelines would be installed to serve the proposed Project at the expense of the Project Applicant/Developer. The Project Applicant/Developer would be required to consult with PG&E early in the planning stages to ensure adequate facilities are incorporated into the Project design. New connections would be constructed by the proposed Project in accordance with the requirements of the County of Kern and PG&E. PG&E would not allow new users to connect to the existing natural gas facilities unless there is adequate capacity and supplies to accommodate the proposed Project. Implementation of the recommended mitigation measures will ensure that adequate natural gas supplies and facilities exist prior to Project construction; therefore, resulting in a less than significant impact in this regard.

With respect to safety, the on-site transmission pipeline is under high pressure, and like others, has the potential to rupture, resulting in uncontrolled releases of natural gas. A pipeline rupture could result in environment contamination and human health effects in the residential areas, once they are developed. For safety reasons, State regulations prohibit the construction of any structures directly over the pipeline, and a right-of-way (ROW) is usually established. The width of the ROW is negotiated between the property owner and the pipeline operator and usually ranges between 20 to 50 feet. Shared ROWs may span 60 to 70 feet. Vegetation around and over pipelines may be restricted. Compliance with Federal, State and applicable local regulations would reduce future potential impacts health and safety related to pipelines to less than significant levels.

Mitigation Measures

MM 4.17-7: **Electrical Services.** Prior to approval of a Master Precise Development Plan or modification to an existing precise development plan on-site, the Master Developer or future land owner shall coordinate with Pacific Gas and Electric Company

(PG&E) staff early in the planning stages to ensure that adequate facilities are incorporated into the Project design.

1. Prior to issuance of grading and building permits the Project proponent shall coordinate with PG&E staff to determine the specific requirements regarding any potential electric service or facility issues needed to adequately accommodate the proposed Project. The Project proponent shall comply with and adhere to all requirements identified by PG&E to full mitigate impacts to electric services and facilities, as needed as Project construction progresses.

MM 4.17-8: **Natural Gas.** Prior to approval of a Master Precise Development Plan or modification to an existing precise development plan on-site, the Master Developer or future land owner shall coordinate with Pacific Gas and Electric Company (PG&E) staff early in the planning stages to ensure that adequate facilities are incorporated into the Project design.

1. Prior to issuance of grading and building permits the Project proponent shall coordinate with PG&E staff to determine the specific requirements regarding any potential natural gas service or facility issues needed to adequately accommodate the proposed Project. The Project proponent shall comply with and adhere to all requirements identified by PG&E to fully mitigate impacts to natural gas services and facilities, as needed as Project construction progresses.

MM 4.17-9: **PG&E Notification.** The Project proponent shall notify PG&E six months prior to any construction activities in the immediate vicinity of PG&E Transmission Line 300B.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

Significant cumulative impacts to public services would occur if the cumulative projects would overburden the public service agencies and if utility providers were unable to provide adequate services. The cumulative projects would substantially increase the demand for public service providers and utility servers. However, public agencies and utilities have the opportunity to respond to an inquiry for information regarding potential increase in demand on their services. Development fees are assessed on a project-by-project basis to mitigate for the increase in demand on public services and utilities. Incorporation of the mitigation measures would reduce impacts from the proposed Project, in conjunction with other projects in the area, to a less than significant cumulative level.

Mitigation Measures

Implement Mitigation Measures MM 4.17-1 through MM 4.17-9.

Level of Significance after Mitigation

Impacts would be less than significant.

Section 4.18

Wildfire

Section 4.18
Wildfire

4.18.1 Introduction

The purpose of this section is to identify, to the extent feasible, the potential for wildland fires in connection with the proposed Project site and to identify potential risks to human health, including future residents surrounding the site, users of the proposed Project site, workers and construction workers. A Wildfire Assessment was prepared by McIntosh & Associates in April 2019. See Appendix P, *Wildfire Assessment*.

4.18.2 Environmental Setting

The proposed Project site is undeveloped and is used mainly for agricultural purposes. As discussed in *Section 4.11, Land Use and Planning*, a steel storage building associated with agricultural activities is located in the eastern portion of the site, near South Union Avenue (SR-204). There is one plugged and abandoned oil well located within the proposed Project boundaries (Big McKittrick Oil Company "Sea Cliff-Houghton" 1). In addition, one active, diesel-powered irrigation well, one idle irrigation well, and one domestic well are located on-site. As discussed in *Section 4.9, Hazards and Hazardous Materials*, a Pacific Gas and Electric (PG&E) natural gas transmission pipeline, number L-300B, traverses the site at a diagonal from northwest to southeast. Six pole-mounted electrical transformers (PMT) were observed within and adjacent to the proposed Project boundaries. Existing adjacent land uses include vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard located south/southeast of proposed Project site.

4.18.3 Regulatory Setting

Federal

There are no relevant federal regulations in regard to wildfires.

State

Senate Bill 1241

Senate Bill 1241 requires the legislative body of a city of county to adopt a comprehensive, long-term general plan that includes various elements, including a safety element for the protection of the community from unreasonable risks associated with among other things, wildland and urban fires. The safety element requires for state responsibility areas (SRA), as defined, and very high fire hazard severity zones (FHSZ) as defined in California Government Code (CGC) §51177 & 51178 that is not a SRA, to be updated as necessary to address the risk of fire in these areas pursuant to CGC §65302(g)(3).

California Environmental Quality Act

CEQA, PRC §21000, et seq., was amended in 2018 to address numerous legislative changes to CEQA, to clarify certain portions of existing CEQA Guidelines, and to update the CEQA Guidelines to be consistent with recent court decisions.

Impacts of wildfire to development and a development's contribution to the potential creation of wildfire risk at the Wildland-Urban Interface (WUI) are now addressed as a separate "Environmental Factor" to be addressed in the initial study checklist in Appendix G. The Natural Resources Agency expanded the requirements of SB 1241 to also include development projects "near" the SRA and Very High FHSZs.

California Building Standards Codes

The State of California provides minimum standards for building design through the California Building Code (CBC). The CBC is based on the International Building Code (IBC), which is used widely throughout the United States (generally adopted on a state-by-state or district-by-district basis) and has been modified to address particular California concerns. The primary codes with respect to development in or near the WUI include the California Building Code, Chapter 7A "Materials and Construction Methods for Exterior Wildfire Exposure" and the California Fire Code, Chapter 49 "Requirements for Wildland-Urban Interface Fire Areas". These codes require what materials are required to be used for construction for any Building Permit submitted after January 1, 2009 within the geographical areas with FHSZs designated as Very High, High, or Moderate in SRA's and Very High within Local Response Areas (LRA). Maps of these areas were developed in 2007 for California and each county.

Local

Kern County Wildland Fire Management Plan

The Kern County Wildland Fire Management Plan documents the assessment of wildland fire situations throughout the SRAs within the County. The Kern County Fire Department Wildland Fire Management Plan provides for systematically assessing the existing levels of wildland protection services and identifying high-risk and high-value areas that are potential locations for costly and damaging wildfires. The goal of the plan is to reduce costs and losses from wildfire by protecting assets at risk through focused pre-fire management prescriptions and increasing initial attack success. Based on this assessment, preventive measures are implemented, including the creation of wildfire protection zones.

Kern County Building and Construction Ordinance (Title 17 of the Ordinance Code of Kern County)

Chapter 17.32 Fire Code

Kern County has adopted, by reference, portions of the California Building Standards Code and the International Fire Code, with modifications and amendments. The

purpose of this code is to prescribe the minimum requirements necessary to establish a reasonable level of fire safety to protect life and property from hazards created by fire, explosion, and dangerous conditions.

The Kern County Fire Code defines a hazardous fire area as any land that is covered with grass, grain, brush, or forest and situated (e.g., in an inaccessible location) so that a fire originating upon such land would present an abnormally difficult job of suppression and would result in great and unusual damage through fire or the resulting erosion.

Chapter 17.34 Wildland-Urban Interface Code

Kern County has adopted, by reference the Urban Wildland Interface Code, published by the International Fire Code Institute, with modifications and amendments. The purpose of this code is to safeguard life and property and maintain public welfare to a reasonable degree by addressing hazards related to wildland fire exposures and fire exposures from adjacent structures, and to prevent structure fires from spreading to wildland fuels.

Metropolitan Bakersfield General Plan (MBGP)

The Metropolitan Bakersfield General Plan cites policies to provide decision-makers with long-range guidance affecting the future character of the Metropolitan Bakersfield planning area. The elements within the Metropolitan Bakersfield General Plan provide goals, policies and implementation measures in order to reduce impacts related to public safety. Applicable wildfire goals and policies relative to the proposed Project are listed in Table 4.18-1, *Metropolitan Bakersfield General Plan Goals and Policies for Wildfires*, below.

Table 4.18-1. Metropolitan Bakersfield General Plan Goals and Policies for Wildfires

Goals and Policies: Public Safety Element
Goal #1: Ensure that the Bakersfield metropolitan area maintains a high level of public safety for its citizenry.
Goal #2: Ensure that adequate police and fire services and facilities are available to meet the needs of current and future metropolitan residents through the coordination of planning and development of metropolitan police and fire facilities and services.
Goal #3: Provide for the coordinated planning and development of service areas for police and fire protection to ensure an equitable burden of responsibility between County and City in Metropolitan Bakersfield.
Goal #4: Assure that fire, hazardous substance regulation and emergency medical service problems are continuously identified and addressed in a proactive way, in order to optimize safety and efficiency.
Policy #4: Monitor, enforce and update as appropriate all emergency plans as needs and conditions in the Planning area change, including the California Earthquake Response Plan, the Kern County Evacuation Plan, and the City of Bakersfield Disaster Plan.
Policy #6: Promote fire prevention methods to reduce service protection costs and costs to the taxpayer.
Policy #9: Restrict, after appropriate public hearings, the use of fire-prone building materials in areas defined by the fire services as presenting high-conflagration risk.

4.18.4 Impacts and Mitigation Measures

Methodology

The potential impacts associated with the proposed project are evaluated on a qualitative basis through a comparison of existing conditions within the proposed Project site and the anticipated Project effects. The potential for impacts from wildfires would occur if the effect described under the criteria below occurs. The evaluation of Project impacts is based on professional judgment, analysis of the County's hazards/hazardous materials policies, and the significance criteria established by Appendix G of the State CEQA Guidelines, which the County has determined to be appropriate criteria for this Recirculated Draft EIR.

Thresholds of Significance

The Kern County CEQA Implementation Document and Kern County Environmental Checklist identify the following criteria, as established in Appendix G of the CEQA Guidelines, to determine if a project could potentially have a significant impact. Such an impact would occur if the proposed Project would:

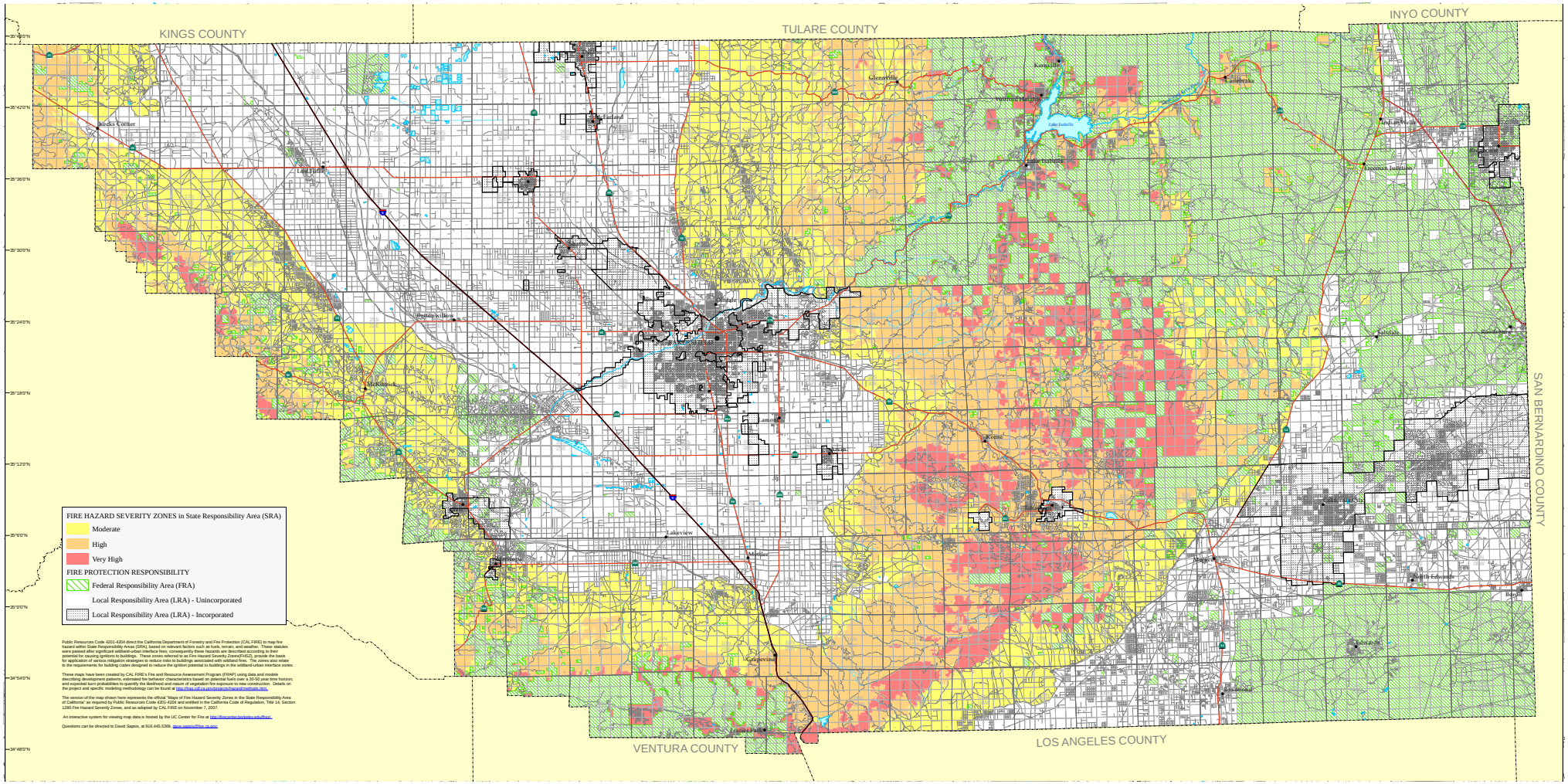
- Substantially impair an adopted emergency response plan or emergency evacuation plan;
- Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire;
- Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment;
- Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes.

The analysis of the existing environment and the impact analysis indicate that this proposed Project could result in a significant environmental impact if it would result in impacts from wildfires that would, if not mitigated, adversely affect the public health and safety of future residents, surrounding residents and workers.

Project Impacts

Impact 4.18-1: The Project Would Substantially Impair an Adopted Emergency Response Plan or Emergency Evacuation Plan.

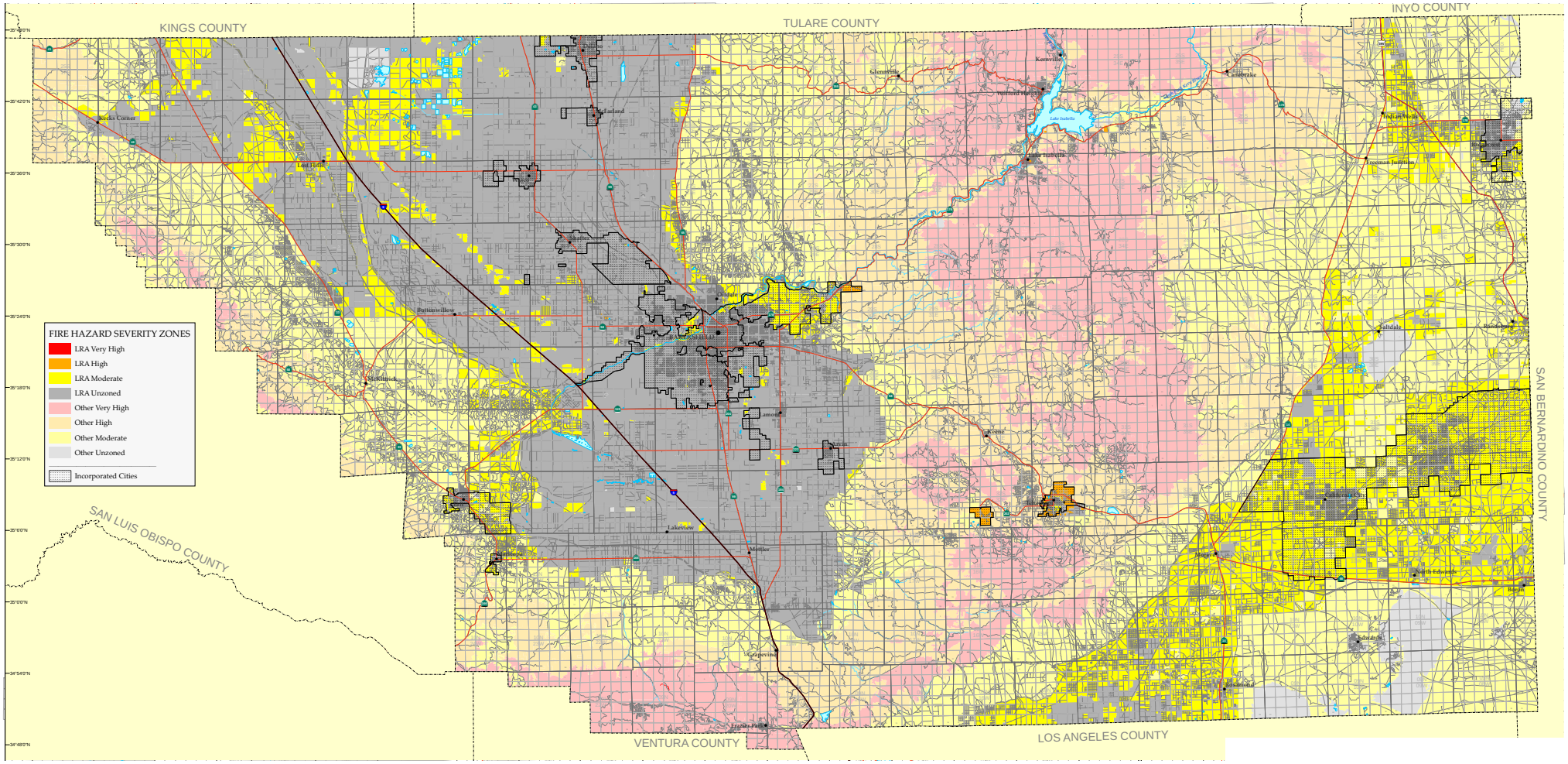
According to the Kern County Wildland Fire Management Plan, the proposed Project is located within the "Valley" Fuel Plan Management Area and the "Agricultural, non-wildland" classification for FHSZ. The Wildfire Assessment prepared by McIntosh & Associates shows that that proposed Project is not located within or adjacent to a SRA or a Very High FHSZ as shown in Figure 4.18-1, *Fire Hazard Severity Zones in SRA* and Figure 4.18-2, *Fire Hazard Severity Zones in LRA*. In



99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Fire Hazard Severity Zones in SRA

Figure 4.18-1



99 HOUGHTON INDUSTRIAL PARK PROJECT
CUP #5, CUP #6, GPA #1, ZCC #2, MAP 143-07
AGRICULTURAL PRESERVE #13 EXCLUSION

Fire Hazard Severity Zones in LRA

Figure 4.18-2

addition, there is no information in the record to date that indicates the proposed Project would interfere with the operation of any roadway, facility, or area that would be used as part of an emergency response plan or emergency evacuation plan. Thus, impacts would be less than significant and mitigation is not required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.18-2: The Project Would Due to Slope, Prevailing Winds, and Other Factors, Exacerbate Wildfire Risks, and Thereby Expose Project Occupants to, Pollutant Concentrations from a Wildfire or the Uncontrolled Spread of a Wildfire.

The proposed Project site is located adjacent to vacant land and agricultural uses to the north, agricultural uses and a small cluster of single-family residential homes to the east, SR-99 to the west, and agricultural uses and an automobile wrecking yard located south/southeast of proposed Project site. The on-site topography is flat. According to windrose data for the Project area, wind generally travels from the northwest and travels at 8.05 miles per hour (NRCS, 2003). Therefore, the general wind patterns toward the Project site are from other agricultural sites that would not be susceptible to wildland fires. This fact would reduce the impact to the Project site from the uncontrolled spread of wildfire. In addition, the proposed Project is not located within or adjacent a SRA or a Very High FHSZ as discussed in Impact 4.18-1. Thus, impacts would be less than significant.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.18-3: The Project Would Require the Installation or Maintenance of Associated Infrastructure (Such As Roads, Fuel Breaks, Emergency Water Sources, Power Lines or Other Utilities) That May Exacerbate Fire Risk or That May Result In Temporary or Ongoing Impacts to The Environment.

As discussed in *Sections 4.16 Transportation and Traffic and 4.17, Utilities*, the proposed Project would require the extension of utilities and other infrastructure, such as roadways, into the Project site. These extensions are needed to provide services for the proposed future uses. Natural gas and electricity would be supplied by PG&E. Natural gas and electric improvements would be constructed only after planning and coordination with PG&E to ensure that services could be efficiently, and safety delivered to the project site. As part of these efforts, any extension and any connections or new infrastructure would be built in accordance with the requirements of the County of Kern and PG&E. Cal Water would provide water services to the project site and would require approval from the California Public Utility Commission (CPUC) to expand its service area to include the proposed Project. Water service lines would be extended into the project site and improvements also would be made in some adjacent roadways and previously disturbed areas. The construction of new on-site roadways also would be required, and some off-site roadway and transportation improvements would be made to ensure adequate traffic service is maintained.

The proposed Project is surrounded by areas that are predominantly under agricultural production or consist of rural residential uses. or industrial and heavy commercial uses that are themselves not in wildland areas and are not susceptible to wildland fires. In addition, the addition of roads internal to the Project site would allow emergency response personnel to access the Project area, if necessary to suppress fires, if they occur. Further, the Kern County Fire Department, as part of the County's environmental review process, will review all plans to ensure they contain adequate fire suppression, fire access, and emergency evacuation.

Thus, coordination with PG&E regarding natural gas and electric improvements, improvements in the circulation system, and adherence to standard City and Fire Department policies would reduce impacts are less than significant. In addition, *Section 4.17 Utilities*, includes MM 4.17-7 through MM 4.17-9, which require, as part of the Master Precise Development Plan and any electric or natural gas utility improvements, coordination with PG&E to ensure improvements adhere to all requirements and to provide adequate time to review plans for potential conflicts with existing utility locations or demand on service. Implementation of these measures would ensure impacts remain less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Impact 4.18-4: The Project Would Expose People or Structures to Significant Risks, Including Downslope or Downstream Flooding or Landslides, as a Result of Runoff, Post-Fire Slope Instability, or Drainage Changes.

As described in *Section 4.10, Hydrology and Water Quality*, potential hazards related to downstream flooding are less than significant. The proposed Project site is not located within a 100-year flood hazard area. The proposed Project is located within the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Zone X, which is described by FEMA as an area determined to be outside the 0.2 percent annual chance floodplain. Due to this small percentage, it is not anticipated that flooding hazards would occur within the Project site. In addition, as described in *Section 4.7 Geology and Seismic Hazards*, the proposed Project area is flat and not susceptible to landslides. Thus, impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

Cumulative Impacts

The incremental effects of the proposed Project related to wildfire, if any, are anticipated to be minimal, and any effects would be site specific. Compliance with Federal, State, and local regulations would ensure that impacts from wildfires are avoided or controlled to minimize the risk to the public on a project-by-project basis, as the cumulative projects are constructed. Therefore, the proposed Project would not result in incremental effects to wildfire that could be compounded or increased when considered together with similar effects from other past, present, and reasonably foreseeable probable future projects. The proposed Project would not result in cumulatively considerable impacts to or from wildfires.

Mitigation Measures

No mitigation measures are required.

Level of Significance after Mitigation

Impacts would be less than significant.

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Chapter 5

Consequences of Project Implementation

Chapter 5
Consequences of Project Implementation

5.1 ENVIRONMENTAL EFFECTS FOUND TO BE LESS THAN SIGNIFICANT

Section 15128 of the CEQA Guidelines requires that an EIR contain a statement briefly indicating the reasons that various, possible, new significant effects of a project were determined not to be significant, and were therefore not discussed in detail in the RDEIR. The County has engaged the public to participate in the scoping of the environmental document.

The contents of this Recirculated Draft EIR were established based on an NOP/IS prepared in accordance with the CEQA Guidelines, as well as public and agency input that were received during the scoping process. The comments to the NOP/IS are found in Appendix A. Those specific issues that are found to have no impact or less-than-significant impacts during preparation of the NOP/IS do not need to be addressed further in this RDEIR. Based on the findings of the NOP/IS and the results of scoping, a determination was made that this RDEIR must contain a comprehensive analysis of all environmental issues identified in Appendix G of the CEQA Guidelines. After further study and environmental review in this Recirculated Draft EIR, the following environmental impacts (both project-specific and cumulative) were determined to be less than significant or could be reduced to less-than-significant levels with mitigation measures:

- aesthetics,
- biological resources,
- cultural resources,
- energy,
- geologic and seismic hazards,
- hazards and hazardous materials,
- hydrology and water quality,
- land use and planning,
- mineral resources,
- population and housing,
- public services,
- utilities, and
- wildfire

5.2 SIGNIFICANT ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Section 15126.2(b) of the CEQA Guidelines requires that the EIR describe any significant impacts, including those that can be mitigated but not reduced to less-than-significant levels. Potential environmental effects of the proposed Project and proposed mitigation measures are discussed in detail in Chapter 4 of this RDEIR. The impacts described in Table 5-1 *Summary of Significant Impacts of the Proposed* Project, would result in significant and unavoidable impacts, even with the incorporation of feasible mitigation measures that attempt to reduce impacts to less-than-significant levels.

Table 5-1. Summary of Significant Impacts of the Proposed Project

Resources	Project Impacts	Cumulative Impacts
Agricultural Resources	The conversion of approximately 314.30 acres of agricultural farmland is considered **significant and unavoidable.**	Although the Metropolitan Bakersfield General Plan has various Land Use policies that direct development to encourage site compatibility with surrounding uses, the cumulative loss of agricultural land results in a significant and unavoidable impact. Notwithstanding this conclusion, Project implementation, when combined with the potential loss of other agricultural lands within the Planning area, over time, would remain a **significant and unavoidable** cumulative impact.
Air Quality	Surrounding sensitive receptors could potentially be exposed to substantial ROG pollutant concentrations from the proposed Project. In addition, operational impacts would result in **significant and unavoidable** impacts of ROG, NO_x, CO, and PM_{10} emissions.	While all feasible and reasonable mitigation has been included, however, the proposed mitigation measures do not result in a reduction of ROG, NO_x, CO, and PM_{10}, below the thresholds. Therefore, the remaining unmitigated emissions and related health effects are considered **cumulatively significant and unavoidable.**
Greenhouse Gases	Project-related greenhouse gases impacts would be reduced to **less than significant** levels with incorporation of mitigation measures.	The cumulative impacts of the proposed Project on global climate change are not known with certainty; therefore, cumulative impacts on global climate change and associated health effects are considered **significant and unavoidable.**
Noise	Given a specific Project use is not currently proposed, and the fact that permitted uses within the M-1 and M-2 Zone Districts allow for operations to be conducted outside of a fully enclosed building, the proposed Project may result in exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies. Impacts are considered **significant and unavoidable.**	While all feasible and reasonable mitigation has been included, noise levels at 14 roadway segments a result of the proposed Project and at 15 roadway segments considering the project with past, present and reasonably, would be significant. In addition, noise levels at one residence in proximity to the proposed Project would exceed thresholds. Therefore, even with the implementation of all feasible mitigation, impacts would be both **significant and unavoidable and cumulatively significant and unavoidable**
Transportation and Traffic	Project-related transportation and traffic impacts would be reduced to **less than**	Given the uncertainty of the timing and/or ultimate implementation of the recommended improvements which

	significant levels with incorporation of mitigation measures.	require pro-rata, fair share funding from various sources, along with those improvements necessary within Metropolitan Bakersfield, the proposed Project's contribution would result in **significant and unavoidable impacts.**

5.3 IRREVERSIBLE IMPACTS

Section 15126.2(c) of the CEQA Guidelines defines the nature of an irreversible impact as an impact that uses nonrenewable resources during the initial and continued phases of the project. Irreversible impacts can also result from damage caused by environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to ensure that such consumption is justified.

Build-out of the proposed Project would commit nonrenewable resources during construction and ongoing utility services. During the operations of the proposed Project, oil, gas, and other nonrenewable resources would be consumed. Therefore, an irreversible commitment of nonrenewable resources would occur as a result of long-term operation under the proposed Project. However, assuming that those commitments occur in accordance with the adopted goals, policies, and implementation measures of the Metropolitan Bakersfield General Plan, as a matter of public policy, those commitments have been determined to be acceptable. The Metropolitan Bakersfield General Plan ensures that any irreversible environmental changes associated with those commitments will be minimized.

5.4 SIGNIFICANT CUMULATIVE IMPACTS

According to Section 15355 of the CEQA Guidelines, the term cumulative impacts "...refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." Individual effects that may contribute to a cumulative impact may be from a single project or a number of separate projects. Individually, the impacts of a project may be relatively minor, but when considered along with impacts of other closely related or nearby projects, including newly proposed projects, the effects could be cumulatively considerable. This RDEIR has considered the potential cumulative effects of the proposed Project along with other current and reasonably foreseeable projects. Impacts for the following have been found to be cumulatively considerable:

- agricultural resources;
- air quality;
- greenhouse gases;
- noise; and
- transportation and traffic.

5.5 GROWTH-INDUCING IMPACTS

The Metropolitan Bakersfield General Plan recognizes that certain forms of growth are beneficial, both economically and socially. CEQA associates development of new utilities and other infrastructure and public services with growth inducement. These facilities will be provided as an accommodation to proposed growth, and growth is expected to occur in the region. A project could induce population growth in an area either directly or indirectly. More specifically, the development of new homes or businesses could induce population growth directly, whereas the extension of roads or other infrastructure could induce population growth indirectly.

This proposed Project would not directly increase population or the housing stock. The Project proposes to amend the Metropolitan Bakersfield General Plan to allow for service industrial and light industrial uses. This allows for additional employment opportunities, which can lead to the relocation of people to jobs and ultimately and increase in population. However, the size of the labor force within Kern County and the current unemployment rates are considered to be sufficient for the current County population to accommodate jobs generated by the proposed Project. Additionally, the proposed Project site is in the vicinity of a Metropolitan Bakersfield General Plan designation for "intensified activity center," and anticipates development of the southern activity center and surrounding areas. Therefore, the introduction of industrial uses on the Project site would not create a growth-inducing impact.

Chapter 6

Alternatives

CHAPTER 6
ALTERNATIVES

6.1 INTRODUCTION AND OVERVIEW

The California Environmental Quality Act (CEQA) requires that an EIR include a discussion of reasonable project alternatives that would "feasibly attain most of the basic objectives of the project, but would "avoid or substantially lessen any significant effects of the project, and evaluate the comparative merits of the alternatives" (CEQA Guidelines Section 15126.6). This chapter identifies potential alternatives to the proposed Project and evaluates them, as required by CEQA.

Key provisions of the CEQA Guidelines on alternatives (Section 15126.6(a) through (f)) are summarized below to explain the foundation and legal requirements for the alternatives analysis in the RDEIR.

- "The discussion of alternatives shall focus on alternatives to the project or its location which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly" (15126.6(b)).
    - "The specific alternative of 'no project' shall also be evaluated along with its impact" (15126.6(e)).
    - "The no project analysis shall discuss the existing conditions at the time the Notice of Preparation is published, and at the time the environmental analysis is commenced, as well as what would reasonably be expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services. If the environmentally superior alternative is the 'no project' alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives" (15126.6(e)(2)).
    - "The range of alternatives required in an EIR is governed by a 'rule of reason' that require the EIR to set forth only those alternatives necessary to permit a reasoned choice. The alternatives shall be limited to ones that would avoid or substantially lessen any of the significant effects of the project" (15126.6(f)).
    - "Among the factors that may be taken into account when addressing the feasibility of alternatives are site suitability, economic viability, availability or infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries, and whether the proponent can reasonably acquire, control or otherwise have access to the alternative site (or the site is already owned by the proponent)" (15126.6(f)(1)).
    - For alternative locations, "only locations that would avoid or substantially lessen any of the significant effects of the project need be considered for inclusion in the EIR" (15126.6(f)(2)(A)).

- "An EIR need not consider an alternative whose effect cannot be reasonably ascertained and whose implementation is remote and speculative" (15126.6(f)(3)).

Per the CEQA Guidelines Section 15126.6(d), additional significant effects of the alternatives are discussed in less detail than the significant effects of the Project as proposed.

For each alternative, the analysis: 1) Describes the alternative; 2) Analyzes the impact of the alternative as compared to the proposed Project; 3) Identifies the impacts of the Project which would be avoided or lessened by the alternative; 4) Assesses whether the alternative would meet most of the basic Project objectives; and 5) Evaluated the comparative merits of the alternative and the Project.

6.2 APPLICANT PROJECT OBJECTIVES

As described in Section 3.4, the following objectives have been established for the proposed Project and will aid decision makers in the review of the Project and associated environmental impacts:

- Facilitate quality development that is consistent with and implements the goals of the Kern County General Plan and Metropolitan Bakersfield General Plan.
- To develop the site consistent with the provisions of the Kern County Zoning Ordinance, Land Division Ordinance, and Development Standards.
- Assure adequate planning for all community facilities including circulation improvements, drainage facilities, water, and wastewater facilities.
- Ensure that the project, in and of itself, does not contribute to the conversion of adjacent agricultural areas.
- Cluster commercial retail uses that provide goods and services near an interchange with SR-99 to accommodate interstate freight and reduce traffic congestion and air emissions.
- Accommodate new development that channels land uses in a phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.
- Address community circulation, both vehicular and pedestrian, utilizing available capacity with the existing circulation system, and provide fair-share system improvements to deficient intersections or road segments.
- Facilitate a planned development and related in-line tenants consistent with the market objectives of the applicant and its tenants.
- Accommodate growth within the proposed Project while balancing environmental considerations.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.

- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.
- Provide new industrial development that captures the economic demands generated by the marketplace.
- Provide new development that will assist the County of Kern in obtaining fiscal balance in the years and decades ahead.

6.3 PROPOSED PROJECT SUMMARY

The proposed Project includes a General Plan Amendment (GPA) and concurrent Change of Zoning District (ZCC) to modify the existing MBGP land use designations, and the Kern County Zoning Ordinance classifications on the 314-acre Project site. In addition, the Project includes a petition to exclude the Project site from Agricultural Preserve No. 13. The GPA and ZCC would allow for development of a light to medium industrial park containing approximately 4,613,004 square feet (net building area) of warehousing, distribution, and retail showroom uses. Table 6-1, *Existing and Proposed Land Use and Zoning*, below, provides the proposed GPA and ZCC summary for the proposed Project.

Table 6-1. Proposed Project Site and Surrounding Land Uses

Existing MBGP Land Use Designations	Proposed MBGP Amendment (Land Use Designations)	Existing Zone Classification	Proposed Zone Change (Zone Classification)	Gross Acres
R-IA (Resource-Intensive Agriculture) HC (Highway Commercial)	GC (General Commercial)	A (Exclusive Agriculture)	C-2 PD (General Commercial, Precise Development Combining)	22
	LI (Light Industrial)		M-1 PD (Light Industrial, Precise Development Combining)	108
	SI (Service Industrial)		M-2 PD (Medium Industrial, Precise Development Combining)	159
	HC (Highway Commercial)		CH PD (Highway Commercial, Precise Development Combining)	25
			Total	**314***

Numbers have been rounded to the nearest whole number.
* Petition for Exclusion from Agricultural Preserve No. 13

6.4 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Alternatives may be eliminated from detailed consideration in an EIR if they fail to meet most of the project objectives, are infeasible, or do not avoid or substantially lessen any significant environmental effects (CEQA Guidelines, Section 15126.6[c]). Alternatives that are remote or speculative, or the effects of which cannot be reasonably predicted, also do not need to be considered (CEQA Guidelines, Section 15126[f][2]). Kern County considered several alternatives to reduce impacts on agriculture, air quality, greenhouse gas emissions, noise, or transportation and traffic. Per CEQA, the lead agency

may make an initial determination as to which alternatives are feasible and warrant further consideration and which are infeasible. The following alternative was initially considered but were eliminated from further consideration in this RDEIR because it does not meet project objectives and/or are infeasible.

Alternate Site Alternative

In developing a reasonable range of alternatives, the County considered the potential for an alternate site. To meet the project objectives, the applicant would be required to find a comparable site within Kern County that would meet most of the project objectives. Key project attributes considered included a site adjacent to, or in close proximity of, a major interstate freeway, close proximity to an existing water supply conveyance system, and close proximity to dry utilities (e.g., natural gas, electricity and telecommunication lines), all of which avoid the need for substantial off-site infrastructure construction with related impacts. A further key attribute is a site that is adjacent, or within very close proximity, to existing residential land uses that provide residential and related community land uses for employees. The project site must also be of sufficient size to provide industrial and commercial land uses as well as a water treatment facility and wastewater treatment facility to achieve key objectives such as providing an industrial center that serves a regional market need in the southern metropolitan area. The site would also have to be available for acquisition (e.g., listed as for sale by one land owner). Finally, to serve as a CEQA alternative, it would also need to avoid or significantly reduce at least one project-level or cumulative impact.

There were no alternative sites that met these criteria. For example, to avoid or substantially reduce project-related agricultural impacts (including cumulative impacts or conversion of adjacent agricultural land to non-agricultural land), the alternate site location would need to be in an area with minimal land identified as prime farmland, unique farmland, or farmland of statewide importance, as well as with minimal land currently under agricultural cultivation. In addition, it would need to be proximate to residential land uses to provide appropriate workforce, thus reducing the need for new housing on nearby agricultural land. An alternate site within the Kern County would result in land that is considered prime farmland, unique farmland, or farmland of statewide importance, much of which is currently under agricultural cultivation within the San Joaquin Valley or grazing and other agricultural cultivation within the Mojave Desert. Such a site would have greater agricultural impacts than the project site, and both State and County laws and policy have long discouraged large scale urbanized conversion of agricultural lands.

Alternate sites within existing cities within the County were not considered because these cities already have or have planned for industrial and commercial land uses, and would not achieve a key project objective of developing commercial and industrial centers in close proximity to residential areas, for the workforce, as well as being located in areas proximate to backbone infrastructure.

If an alternate site were identified, development of the project on an alternate site would have similar, if not greater, environmental impacts with respect to cumulative impacts that are more generally linked to air quality and greenhouse gas emissions, noise, and transportation and traffic. Alternate sites in more remote locations, not served by or immediately adjacent to proximate highway, water, and dry utility infrastructure would generally have greater project-level and cumulative impacts than

the proposed Project, based on the need for construction of infrastructure extensions to highway, water, and dry utility infrastructure.

The alternate site alternative has been rejected from further consideration because there were no alternative sites that have the attributes required to achieve key project objectives, and because if an alternate site was available it would likely have impacts that are generally similar to, or for some resources greater than, the 99 Houghton Industrial Park Project.

It should also be noted that, while CEQA requires an EIR to identify project alternatives, it does not require the EIR to identify alternative project locations. Per the CEQA Guidelines, an EIR must include a reasonable range of "alternatives to the project, *or* to the location of the project." (14 California Code of Regulations Section 15126.6(a)(emphasis added)). Applicable case law recognizes that CEQA grants lead agencies flexibility to elect to analyze either onsite or offsite alternatives, or both (Mira Mar Mobile Community v. City of Oceanside (2004) 119 Cal.App.4th 447, 491). There is no requirement under CEQA that an EIR always explore an alternative site, or offsite, alternative (California Native Plant Society v. City of Santa Cruz (2009) 177 Cal.App.4th 957, 933). Thus, CEQA does not require this RDEIR to analyze the Alternative Site Alternative.

6.5 ALTERNATIVES ANALYZED IN THIS RDEIR

The following five alternatives have been determined to represent a reasonable range of alternatives which have the potential to feasibly attain most of the basic objectives of the Project but which may avoid or substantially lessen any of the significant impacts of the proposed Project. The "Environmentally Superior" Alternative, as required by CEQA is described in Section 6.6, *"Environmentally Superior" Alternative*. These alternatives are analyzed in detail below:

- Alternative A "No Project/No Development" Alternative
- Alternative B "Buildout Existing General Plan Designation" Alternative
- Alternative C "Reduced Density" Alternative
- Alternative D "Reduced Project Size" Alternative

Table 6-2 *Summary of Development Alternatives*, provides a summary of the relative impacts and feasibility of each Alternative. A complete discussion of each Alternative is provided below.

Table 6-2. Summary of Development Alternatives

Alternative	Description	Basis for Selection and Summary of Analysis
Proposed Project	4,613,004 ft2 of light to medium industrial park, and highway and general commercial uses	
Alternative A No Project/No Development	• No GPA, ZCC, or development. • Existing agricultural uses are maintained	• Required by CEQA • Avoids need for GPA, ZCC, and CUPs • No agricultural preserve exclusion needed • No annexation • Avoids significant impacts

Table 6-2. Summary of Development Alternatives

Alternative	Description	Basis for Selection and Summary of Analysis
		• Does not meet 9 of the 13 Project objectives
Alternative B Buildout Existing General Plan Designation	• Existing land use, R-IA and HC, and zoning, A, designations remain • Develop 15 SFR, 7.6 acres of HC, approximately 132,422 ft2	• Required by CEQA • Avoids need for GPA and ZCC • No agricultural preserve exclusion needed • No annexation • Does not meet 7 of the 13 Project objectives
Alternative C Reduced Density	• Develop entire 314.30-acre site • Reduce development to 3,850,689 ft2 of medium and light industrial facilities	• May lessen some impacts • Does not avoid significant environmental impacts • Meets Project objectives, but not to the degree of the proposed Project
Alternative D Reduced Project Size	• Develop approximately 184.58 acres – area proposed as SI • 2,171,789 ft2 of Service Industrial/Medium Industrial facilities	• May lessen some impacts • Does not avoid significant environmental impacts • Meets most Project objectives, but not to the degree of the proposed Project.

Notes:

R-IA = Intensive Agriculture: minimum 20-acre parcel size; HC = Highway Commercial – Industrial;

A = Exclusive Agriculture; GPA = General Plan Amendment; ZCC = Zone Change; SI = SI – Service Industrial; FAR = Floor Area Ratio; ft^2 = square feet; SFR = single-family residential

Table 6-3. Comparison of Alternatives					
Environmental Resource	**Project**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
Agriculture: Convert Prime, Unique or Statewide important farmland	Significant / Unavoidable	Fewer	Fewer	Similar	Fewer but still Significant/Unavoidable
Agriculture: Other changes resulting in agricultural conversion	Significant / Unavoidable	Fewer	Similar	Similar	Similar
Agriculture: Cumulative conversion of agricultural or forest land	Significant / Unavoidable	Fewer	Fewer	Similar	Fewer but still Significant/Unavoidable
Air Quality: Operational Emission of ROG, NO_x, and CO	Significant / Unavoidable	Fewer	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable
Air Quality: Cumulative net increase of nonattainment pollutants	Significant / Unavoidable	Fewer	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable
Air Quality: Exposure of sensitive receptors to ROG, NO_x, and CO	Significant / Unavoidable	Fewer	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable
Air Quality: Total Cumulative Project Emissions	Significant / Unavoidable	Fewer	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable	Fewer but still Significant/Unavoidable
Greenhouse Gas Emission: Cumulative effects	Significant / Unavoidable	Fewer	Fewer but still Significant/Unavoidable	Similar	Fewer but still Significant/Unavoidable
Noise: Expose Persons in Excess of Standards	Significant / Unavoidable	Fewer	Fewer	Fewer	Fewer
Noise: Expose Persons to Ground Borne Noise and Vibration	Significant / Unavoidable	Fewer	Fewer	Fewer	Fewer
Noise: Create Substantial Temporary Above Existing Levels	Significant / Unavoidable	Fewer	Fewer	Fewer	Fewer
Noise: Cumulative increase in noise	Significant / Unavoidable	Fewer	Fewer	Fewer	Fewer
Traffic: Cumulative increase in transportation and traffic impacts	Significant / Unavoidable	Fewer	Fewer	Similar	Fewer

Alternative A - "No Project/No Development" Alternative

The "No Project/No Development" Alternative assumes that the proposed GPA, ZCC and subsequent development would not be implemented. Under this scenario, the General Plan Land Use Designation on the Project site would remain R-IA (Resource-Intensive Agriculture) and HC (Highway Commercial); the zoning would remain A (Exclusive Agriculture). Additionally, this Alternative assumes that existing land uses on the Project site would remain unchanged, and, as such, would remain under agricultural production. Because the Project site would remain unchanged, few or no environmental impacts would occur. This Alternative serves as the baseline against which to evaluate the effects of the proposed Project and other Project Alternatives presented below.

Impacts Compared to Project Impacts

The following compares environmental impacts associated with Alternative A, the "No Project/No Development" Alternative, to those identified for the proposed Project.

Aesthetics

Under the "No Project/No Development" Alternative, the Project site would not be altered. Therefore, views across the Project site would remain unobstructed, and no additional lights are proposed. Therefore, under this Alternative no impacts to aesthetics, light and glare would occur.

Agriculture Resources

This Alternative would not alter the existing conditions within the Project site. Therefore, the site will remain under agricultural production and as fallow agricultural land. This Alternative would not require an agricultural preserve exclusion. Thus, no impacts to agricultural resources would occur.

Air Quality

Alternative A, the "No Project/No Development" Alternative, would not result in alterations to the land uses within the Project site. Therefore, any existing impacts to air quality that currently exist on-site will continue to occur, however, no new impacts to air quality would occur under this Alternative.

Biological Resources

Alternative A, the "No Project/No Development" Alternative, would not impact potential habitat for biological resources. The continued agricultural uses would not increase impacts on the biological resources currently within the Project site. No new impacts to biological resources would occur under this Alternative.

Cultural Resources

As this Alternative would not result in alterations to the ground surface within the Project site, no impacts to cultural resources would occur.

Energy Resources

Alternative A, the "No Project/No Development" Alternative, would not result in alterations to the land uses within the Project site. Therefore, any existing impacts to energy that currently exist on-site will continue to occur, however, no new impacts to energy would occur under this Alternative.

Geologic and Seismic Hazards

Under this Alternative, new structures would not be constructed. Therefore, impacts to structures as a result of geologic and seismic hazards would not occur under this Alternative.

Greenhouse Gases

Implementation of this Alternative would result the Project site remaining as cultivated and fallow agricultural land. The land use would remain the same; therefore, no impacts to greenhouse gas emissions would occur beyond what already exists.

Hazards/Hazardous Materials

Under this Alternative, the existing environmental conditions, including those that may be defined as either adverse or significant, would continue to prevail. This Alternative would continue to expose individuals to agricultural production related activities and their associated effects, and to nuisances (i.e., soil contamination, noise, dust). Therefore, no impacts to hazards/hazardous materials would occur under Alternative A, the "No Project/No Development" Alternative.

Hydrology and Water Quality

No industrial structures would be developed under this Alternative; therefore, no change in the usage of groundwater would occur, and no additional storm drain infrastructure would be required. Therefore, no impacts to hydrology and water quality would occur under this Alternative.

Land Use and Relevant Planning

This Alternative would not require a GPA or zone change, as it does not propose to develop the Project site. This Alternative would be consistent with the existing land uses identified in the Metropolitan Bakersfield General Plan. Implementation of this Alternative would not result in any improvements to the Project site; therefore, no impacts to land use would occur.

Mineral Resources

Under this Alternative this proposed Project site would remain under agricultural production and the on-site prospect well would remain. Therefore, under this Alternative no impacts to mineral resources would occur.

Noise

As no development is proposed on the Project site under this Alternative, no change in the existing noise on the Project site would occur.

Population and Housing

Under Alternative A, the "No Project/No Development" Alternative, no industrial structures would be constructed. This Alternative would not directly or indirectly induce an increase in population and would not displace houses or people because the 314.30-acre site would remain agricultural land. No impacts to population and housing would occur under this Alternative.

Public Services and Utilities

With implementation of Alternative A, the "No Project/No Development" Alternative, no industrial structures would be constructed. No changes in demand of public services and utilities would occur.

Traffic and Circulation

Development of this Alternative would not result in changes to average daily vehicle trips (ADT) as no development is proposed. Additionally, this Alternative would not result in impacts on the intersections and roadway segments surrounding the Project site. Overall, this Alternative would not result in an impact on circulation.

Wildfire

Under this alternative no development is proposed, and the existing land uses of the Project site would remain in agricultural production. The potential for the Project site to be affected by wildfire from adjacent areas would be the same and no changes or impacts associated with wildfire would occur.

Conclusion

Avoid or Substantially Lessen Project Impacts

No development would occur under this Alternative; therefore, Project related impacts under the environmental categories discussed above would not occur. Thus, all Project impacts would be avoided or lessened.

Attainment of Project Objectives

Alternative A, the "No Project/No Development" Alternative, does not meet the following Project objectives, as described in Section 6.2:

- Cluster commercial retail uses that provide goods and services near an interchange with SR-99 to accommodate interstate freight and reduce traffic congestion and air emissions.
- Accommodate new development that channels land uses in a phased, orderly manner and is coordinated with the provision of infrastructure and public improvements.
- Address community circulation, both vehicular and pedestrian, utilizing available capacity with the existing circulation system, and provide fair-share system improvements to deficient intersections or road segments.

- Facilitate a planned development and related in-line tenants consistent with the market objectives of the applicant and its tenants.
- Accommodate growth within the proposed Project while balancing environmental considerations.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.
- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.
- Provide new industrial development that captures the economic demands generated by the marketplace.
- Provide new development that will assist the County of Kern in obtaining fiscal balance in the years and decades ahead.

Comparative Merits

This Alternative would reduce impacts compared to the proposed Project in all categories. However, this Alternative was rejected because it does not fulfill 9 of the 13 objectives of the proposed Project described in Section 6.2, *Applicant Project Objectives*.

Alternative B - "Buildout Existing General Plan Designation" Alternative

Under Alternative B, the "Buildout Existing General Plan Designation" Alternative, the Project site would be developed to the maximum intensity allowed under the existing General Plan land use designation. Implementation of this Alternative would consist of development on the 314.30-acre Project site under the current land use designation of R-IA (Resource – Intensive Agriculture) and HC (Highway Commercial). The R-IA designation allows the development of dwelling units at a density of one unit per 20 acres. The HC designation allows the development of 7.6 acres for commercial uses. Therefore, this Alternative would yield 15 single-family dwelling units and approximately 132,422 square feet of highway commercial facilities. This number is based on the allowable Floor Area Ratio (FAR) of 0.4. Therefore, 7.6 acres = 331,056 square feet. The maximum allowable building square footage would be 132,422 square feet (331,056 x 0.4 = 132,422).

Impacts Compared to Project Impacts

The following compares environmental impacts associated with Alternative B, the "Buildout Existing General Plan Designation" Alternative, to those identified for the proposed Project.

Aesthetics

Development of 15 residential units and approximately 132,411 square feet of highway commercial facilities associated with this Alternative would slightly alter views of and across the Project site from surrounding uses. Views of the Project site are currently of agricultural activities. Under this Alternative, these views would be replaced with views of fields subdivided into 20-acre parcels, with

one single-family dwelling unit developed on each parcel and the remaining land would consist of approximately 132,411 square feet of highway commercial. This Alternative would result in a less than significant impact related to aesthetics, light and glare due to the limited development proposed and the limited addition of lighting.

Agriculture

As a limited amount of development would be allowed under this Alternative, minor impacts to agricultural uses would occur. However, approximately 306.71 acres of the Project site would remain under agricultural production. This acreage could potentially be broken down into 20-acre parcels, which could remain in agricultural production. In addition, this Alternative would not require an agricultural preserve exclusion. Therefore, impacts would be less than the impacts for the proposed Project.

Air Quality

Implementation of this Alternative would result in 15 residential units and approximately 132,422 square feet of highway commercial facilities; which would result in a reduction of construction activities and traffic trips. This lower intensity of development would result in a smaller amount of particulate matter greater than 10 microns (PM_{10}) being released during construction activities, compared to the proposed Project. Additionally, the smaller volume of Project-related traffic would result in lower air pollutant emissions associated with traffic. However, this Alternative would still result in a cumulatively significant impact to air quality given the increase in daily trips associated with the increased development.

Biological Resources

Alternative B, the "Buildout Existing General Plan Designation" Alternative, would result in the development of up to 15 single-family residential units, with one unit per 20 acres, and 132,422 square feet of highway commercial on 7.6 acres. Impacts to biological resources would still occur; however, they would be reduced from that of the proposed Project because of the lower intensity of development. Individual dwelling unit locations could be customized as to avoid biologically sensitive areas. The area designated for highway commercial land uses is in the southwest corner of the Project site, adjacent to Houghton Road and SR-99. Overall, this Alternative would result in reduced impacts when compared to the proposed Project; however, compliance with the Metropolitan Bakersfield Habitat Conservation Plan (MBHCP) would be required.

Cultural Resources

This Alternative would have a reduced footprint size because of the introduction of up to 15 dwelling units and a maximum of 132,422 square feet of highway commercial facilities. Therefore, the intensity of development would be less, and less ground disturbing activities would be required. However, similar mitigation measures identified for the proposed Project would be applicable to this Alternative to reduce potential impacts to undocumented cultural and paleontological resources within the areas of the site to be developed.

Energy

Implementation of this Alternative would result in the construction of 15 residential units and 132,422 square feet of highway commercial; which would result in a reduction of construction activities and traffic trips as compared to the proposed Project. The reduced intensity of project development would reduce the amount of energy needed for construction as well as operation of the proposed Project. The reduced ultimate size of the proposed Project also would reduce the overall demand for energy needed for project operation over the long-term. However, the Alternative would include residential uses but a reduction in overall population and vehicle trips. This would result in decreased energy use compared to the proposed Project. This Alternative also would be required to comply with all state and local regulations pertaining to energy reduction and use of alternative energy sources. Although conformance to the green energy requirements would still be required for this Alternative, this would result in further reduced impacts associated with Energy use.

Geologic Resources

Under this Alternative, residential structures would be introduced to the Project site. The site conditions within the development area would remain the same as the proposed Project. Therefore, the geologic resources impacts would be similar to those identified for the proposed Project, including seismic activity, soil erosion and soil conditions. Any existing regulations and mitigation measures identified for the proposed Project would be applicable to this Alternative.

Greenhouse Gases

Implementation of this Alternative would result in the construction of 15 residential units and 132,422 square feet of highway commercial; which would result in a reduction of construction activities and traffic trips as compared to the proposed Project. Additionally, the smaller volume of Project-related traffic would result in substantially lower air pollutant emissions associated with traffic. Although smaller, greenhouse gas emission impacts would need to be mitigated in order to reduce the business as usual (BAU) greenhouse gas emissions by 29 percent to be consistent with the standards established by the California Air Resources Board and the California Global Warming Solutions Act of 2006. Therefore, greenhouse gas emissions impacts would be similar to the proposed Project.

Hazards/Hazardous Materials

Similar to the proposed Project, implementation of Alternative B, the "Buildout of the Existing General Plan" Alternative, would result in potentially significant impacts on public health and safety. With the development of approximately 15 residences and 132,422 square feet of highway commercial, this Alternative would reduce the potential of the transport of hazardous materials. Alternative B, "Buildout Existing General Plan Designation" Alternative, would have a similar impact on the existing PG&E pipeline as the proposed Project. In addition, closure of the prospect well would continue to be required. With the development of 15 single-family homes and 132,422 square feet of highway commercial facilities, this Alternative would expose individuals to similar effects associated with agricultural land uses (i.e., soil contamination, noise, dust). This Alternative would replace a large number of people working on-site, with a smaller number of workers and a small number of people living within the Project boundaries; therefore, public health and safety

impacts would be similar to those of the proposed Project. The mitigation measures identified for the proposed Project would be included in this Alternative.

Hydrology and Water Quality

Development in accordance with the existing General Plan Designation would result in similar impacts to the proposed Project. No change in the usage of groundwater would occur, similar to the proposed Project**.** Implementation and compliance with the NPDES, SUSMP and BMP requirements would reduce construction-related impacts on water quality to a less than significant level.

Land Use and Relevant Planning

This Alternative would not require a GPA, ZCC, annexation into the City, or an Agricultural Preserve exclusions as it proposes to develop the Project site in accordance with the current land use designation. This Alternative would be consistent with land uses identified in the General Plan. Implementation of this Alternative would provide a maximum of 132,422 square feet of highway commercial on 7.6 acres and up to 15 dwelling units on approximately 306.71 acres. The development intensity and subsequent environmental impacts would be less than those identified for the proposed Project.

Mineral Resources

This Alternative proposes to provide up to 132,422 square feet of highway commercial facilities and up to 15 dwelling units. The existing abandoned exploration well would not necessarily be required to be altered. Therefore, overall, this Alternative would result in reduced levels of impacts on mineral resources than the proposed Project, as access to the existing wells would remain available.

Noise

Under Alternative B, the Buildout Existing General Plan Designation Alternative, the Project site would be developed with up to 15 residences on 20-acre parcels and 132,422 square feet of highway commercial facilities. Mitigation measures similar to the proposed Project would be applied to ensure short-term construction impacts remain less than significant. This Alternative would introduce new noise-sensitive land uses as a result of the development of up to 15 dwelling units. Noise from introduced traffic would be reduced for the overall project site; however, the highway commercial would experience a higher volume of ingress and egress customers to the southwest corner of the Project site. The potential for increased noise due to higher traffic volumes at the highway commercial property would be minor. The development of residential instead of industrial land uses would reduce noise impacts as compared to the proposed Project. Therefore, overall, this Alternative would result in reduced noise impacts as compared to the proposed Project.

Population and Housing

Alternative B, the "Buildout Existing General Plan Designation" Alternative, would result in a direct increase in population because it would introduce 15 new residences to Kern County. These 15 residences could increase the Kern County Population by approximately 47 people, assuming an

average of 3.096 persons per household[1], an increase compared to the proposed Project. An increase of approximately 47 people is within the Metropolitan Bakersfield General Plan forecast for anticipated population growth for the area. The introduction of approximately 132,422 square feet of highway commercial development is less than the proposed Project. Impacts under Alternative B would be slightly more than those identified for the proposed Project because of the introduction of residential land uses.

Public Services and Utilities

Alternative B, the "Buildout Existing General Plan Designation" Alternative, would result in the introduction of approximately 15 dwelling units to the Project site. Highway commercial facilities would be provided in the southwest corner of the Project site. The introduction of residents would result in additional public service requirements not needed under the proposed Project. Utility services required may be reduced because there would be an overall reduction in the size of the proposed Project and the developed area within the site. Therefore, overall impacts to public services would be greater for this Alternative than the proposed Project; however, impacts to utilities would be reduced when compared to the proposed Project.

Traffic and Circulation

Development of this Alternative would have no industrial uses and would introduce 15 dwelling units and approximately 132,422 square feet of highway commercial. This changes the site population from employees to residents and a small number of employees, resulting in an overall smaller population within the Project site and consequently fewer average daily vehicle trips (ADT) as compared to the proposed Project. Because of the smaller number of trips when compared to the proposed Project, this Alternative would result in a less than significant impact on the intersections and roadway segments surrounding the Project site. Overall, Alternative B, the "Buildout Existing General Plan Designation" Alternative, would result in a lesser impact on circulation compared to the proposed Project.

Wildfire

This Alternative proposes to provide up to 132,422 square feet of highway commercial facilities and up to 15 dwelling units. Under this alternative, surrounding land uses would not change and the change in on-site land uses would not change the findings related to wildfires. Therefore, the potential for the Project site to be affected by wildfire from adjacent areas would be the same and no changes or impacts associated with wildfire would occur.

[1] Average persons per household as determined by the Department of Finance and discussed in this EIR under Section 4.14, *Population and Housing*. 15 residences * 3.156 persons per household = approximately 47 people.

Conclusion

Avoid or Substantially Lessen Project Impacts

This Alternative would lessen impacts associated with aesthetics, biological resources, land use and relevant planning, noise, public services, utilities and traffic and circulation. However, there would still be significant and unavoidable impacts ~~to~~ on cumulative air quality. Additionally, if septic systems were proposed, then there could be additional impacts to hydrology and water quality, that were not considered with the proposed Project.

Attainment of Project Objectives

Alternative B, the "Buildout Existing General Plan Designation" Alternative, does not necessarily meet the proposed Project objectives, but would require similar mitigation measures to those that are currently proposed. Generally, Alternative B does not meet the following objectives:

- Ensure that the project, in and of itself, does not contribute to the conversion of adjacent agricultural areas.
- Address community circulation, both vehicular and pedestrian, utilizing available capacity with the existing circulation system, and provide fair-share system improvements to deficient intersections or road segments.
- Facilitate a planned development and related in-line tenants consistent with the market objectives of the applicant and its tenants.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.
- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.
- Provide new industrial development that captures the economic demands generated by the marketplace.
- Provide new development that will assist the County of Kern in obtaining fiscal balance in the years and decades ahead.

Comparative Merits

This Alternative would reduce impacts compared to the proposed Project in the categories of aesthetics, agriculture, air quality, biological resources, greenhouse gases, land use and relevant planning, noise, public services and utilities and traffic and circulation; and would have equivalent impacts in the categories of cultural resources, geologic and seismic hazards, hazards/hazardous materials, hydrology and water quality, and mineral resources.

Alternative C - "Reduced Density" Alternative

Under Alternative C, the "Reduced Density" Alternative, the Project site would be developed under the LI (Light Industrial) and SI (Service Industrial) land use designation; however, the industrial facilities would be reduced in area. This Alternative would develop the entire 314.30-acre Project site; however, the square footage of industrial facilities would be reduced by approximately 25 percent. This results in the development of approximately 3,459,753 square feet of light and medium industrial facilities. The Project site would continue to require a GPA, ZCC, annexation, and exclusion from Agricultural Preserve Number 13.

Impacts Compared to Project Impacts

The following discussion evaluates the potential environmental impacts associated with Alternative C, the "Reduced Density" Alternative, compared to impacts of the proposed Project.

Aesthetics

Under this Alternative, the aesthetic impacts would be similar to the proposed Project. This Alternative would continue to develop the entire proposed Project site, therefore, even though the size of the facilities will be reduced, the site would result in similar impacts from site illumination and conversion of open space to a permanent urban environment. Short-term construction impacts would occur under this Alternative, such impacts would be considered equivalent to the proposed Project impacts. Impacts from urban decay would be slightly less than those resulting from the proposed Project because this Alternative would result in fewer industrial and showroom facilities. On a cumulative level, implementation of this Alternative would result in a similar to the proposed Project.

Agriculture

This Alternative would result in the loss of agricultural land over the entire Project site. Agricultural land uses would not occur under this alternative. An exclusion from Agricultural Preserve Number 13 would continue to be required. Therefore, impacts would remain significant and unavoidable.

Air Quality

The "Reduced Density" Alternative would construct approximately 3,459,753 square feet of medium industrial facilities. The reduced size of the facilities would ultimately reduce the number of workers at the site and would therefore have fewer vehicle trips, compared to the proposed Project. As a result, this Alternative would slightly reduce PM_{10} and air pollutant emissions, compared to the proposed Project. Mitigation measures addressing long-term Project emissions similar to the proposed Project would be implemented under this Alternative, therefore, impacts under this Alternative would be similar to those of the proposed Project. Construction impacts to air quality would be similar to the proposed Project.

Biological Resources

This Alternative would occupy the same land as the proposed Project, even though the industrial facilities would be reduced in size. The Alternative would result in similar impacts as the proposed Project. Similar to the proposed Project, development of the site under this Alternative would be

required to fully comply with the applicable provisions of the MBHCP to mitigate for the conversion of undeveloped land to an urbanized condition. Additionally, mitigation measures similar to those recommended for the proposed Project would be required to reduce potential biological impacts, especially to burrowing owl and San Joaquin kit fox. Impacts would be the same under this Alternative as the proposed Project.

Cultural Resources

Because Alternative C, the "Reduced Density" Alternative, would occupy the same land as the proposed Project, the impacts for cultural resources would continue to be less than significant because no cultural resources were identified. Additionally, mitigation measures required for grading and construction activities for the proposed Project would apply to the same activities for this Alternative and would therefore result in less than significant impacts on undiscovered cultural resources. With regard to cultural resources, Alternative C, the "Reduced Density" Alternative, would be neither environmentally superior nor environmentally inferior to the proposed Project.

Energy

Implementation of this Alternative would result a slightly "Reduced Density" of development of on the Project site resulting in a slight reduction in the overall energy use. Although there is a similar amount of land that would be disturbed, fewer structures would be constructed and this alternative includes a reduction in overall Project square footage. This Alternative would be required to comply with all state and local regulations pertaining to energy reduction and use of alternative energy sources. Although conformance to the green energy requirements would still be required for this alterative, overall, the reduced intensity of this Alternative would reduce the amount of energy needed compared to the proposed Project.

Geologic and Seismic Hazards

Since the Project area would occupy the same area as the proposed Project, the geologic and seismic hazard impacts would be equivalent to those identified for the proposed Project, including seismic activity, soil erosion and soil conditions. Alternative C, the "Reduced Density" Alternative, would have equivalent impacts as the proposed Project and the same existing regulations and mitigation measures identified for the proposed Project would be applicable to this Alternative.

Greenhouse Gases

Implementation of this Alternative would result in 3,459,753 square feet of industrial building space to be constructed on the proposed Project site. Construction would continue to occur on the entire property; therefore, construction emissions would be similar to the proposed Project. Because this Alternative would result in slightly fewer workers, a slight reduction in traffic trips would occur as compared to the proposed Project; therefore, the long-term air quality impacts would be slightly less than the proposed Project. Greenhouse gas emission impacts would need to be mitigated in order to reduce the business as usual (BAU) greenhouse gas emissions by 29 percent to be consistent with the standards established by the California Air Resources Board and the California Global Warming Solutions Act of 2006. Therefore, greenhouse gas emissions impacts would be similar to the proposed Project.

Hazards/Hazardous Materials

Similar to the proposed Project, implementation of Alternative C, the "Reduced Density" Alternative, would result in potentially significant impacts on public health and safety. This Alternative includes the disturbance of a portion of the Project site for development of 3,459,753 square feet of industrial building space, slightly less than the proposed Project; therefore, this Alternative would slightly reduce the potential of the transport of hazardous materials. This Alternative would have a similar impact on the existing PG&E pipeline as the proposed Project. In addition, closure of the prospect well would continue to be required. This Alternative would expose individuals to similar effects associated with agricultural land uses (i.e., soil contamination, noise, dust). This Alternative would slightly reduce the number of people working on-site; however, public health and safety impacts would be similar to those of the proposed Project. The mitigation measures identified for the proposed Project would be included in this Alternative.

Hydrology and Water Quality

Development in accordance with this Alternative would result in similar amounts of impervious surfaces and, therefore, similar amounts of runoff volumes compared to the proposed Project. Water consumption would be slightly less than water usage under the proposed Project; however, the impacts would remain similar to those of the proposed Project. As with the proposed Project, this Alternative would comply with standard County provisions related to the incorporation of sufficient storm drain infrastructure to reduce the amount of surface runoff. Implementation and compliance with the NPDES, SUSMP and standard BMP requirements would reduce construction-related impacts on water quality to a less than significant level. Mitigation measures similar to the proposed Project would be applied to ensure short-term water quality construction impacts remain less than significant.

Land Use and Relevant Planning

Implementation of this Alternative would continue to require a GPA, ZCC, annexation, and an agricultural preserve exclusion on 314.30 acres to allow the development of approximately 3,459,753 square feet of light and industrial facilities. Industrial facility square footage would be reduced by 25 percent as compared to the proposed Project. Annexation into the City and agricultural preserve exclusion would still be required. Land use impacts resulting from this Alternative would be similar to the proposed Project because the entire 314.30-acre site would continue to be developed.

Mineral Resources

Although Alternative C, the "Reduced Density" Alternative, would have less intensity of development, the abandoned exploration well would continue to require reabandonment. This Alternative would result in similar impacts to mineral resources as the proposed Project due to the presence of the abandoned exploration oil well on-site.

Noise

Under this Alternative, the number of vehicles would be reduced because the square footage of industrial facilities would be reduced. Therefore, the noise from vehicle trips would be reduced in

comparison to the proposed Project. Noise from implementing the Alternative would be reduced slightly when compared to the proposed Project, because the development intensity would be reduced by approximately 25 percent. Mitigation measures similar to the proposed Project would be applied to ensure short-term construction impacts remain less than significant. Overall, with implementation of noise mitigation measures, noise impacts would be the slightly reduced when compared to the proposed Project.

Population and Housing

Alternative C, the "Reduced Density" Alternative, would reduce the proposed Project size by approximately 25 percent, resulting in the development of approximately 3,459,753 square feet of medium and light industrial facilities. The labor force needed for this Alternative would be less than the labor force needed for the proposed Project. Therefore, the impacts under Alternative C would be less than those identified for the proposed Project. Impacts would remain less than significant.

Public Services and Utilities

The demand for public services and utilities generated at the Project site would be reduced by approximately 25 percent. The reduced square footage for industrial facilities would result in fewer employees and fewer industrial businesses within the Project site, which would in turn have lesser impacts on public services and utilities. All standard mitigation measures identified under the proposed Project would be required in order to reduce impacts to a less than significant level. Therefore, this Alternative would be neither environmentally superior nor environmentally inferior to the proposed Project.

Traffic and Circulation

The reduced amount of square footage for industrial building space developed under this Alternative would result in a slightly reduced number of employees and delivery trucks, which in turn would result in a slight decrease in average daily vehicle trips (ADT) compared to the proposed Project. Slightly fewer AM and PM peak hour trips and ADT would result in slightly reduced impacts on intersections and roadway segments within the area surrounding the Project site. The temporary impacts on transportation within the area surrounding the Project site would be similar to those with the proposed Project because the proposed construction activities would be similar and short in duration. The planned improvements and mitigation measures identified for the proposed Project would still be applicable under this Alternative in order to reduce impacts to a less than significant level. Overall, impacts on traffic and circulation from this Alternative would be similar to those associated with the proposed Project.

Wildfire

This Alternative would result in a reduced development intensity of the Project Site. Under this alternative; however, surrounding land uses would not change and on-site changes to land uses would not change the findings related to wildfires. Therefore, the potential for the Project site to be affected by wildfire from adjacent areas would be the same and no changes or impacts associated with wildfire would occur.

Conclusion

Avoid or Substantially Lessen Project Impacts

This Alternative would lessen impacts associated with air quality, noise, population and housing, and traffic/circulation.

Attainment of Project Objectives

This Alternative would meet the Project objectives stated in Section 6.2.

Comparative Merits

This Alternative would reduce impacts compared to the proposed Project in the categories of air quality, and noise, ~~and traffic and circulation;~~ and would have equivalent impacts in the categories of aesthetics, agriculture, biological resources cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, land use and relevant planning, mineral resources, population and housing, public services and utilities, and traffic and circulation.

Alternative D - "Reduced Project Size" Alternative

Under Alternative D, the "Reduced Project Size" Alternative, the Project site size would be reduced by approximately 50 percent and the square footage size would be reduced accordingly. Therefore, Alternative D would develop the 159-acre portion of the Project site designated to be SI (Service Industrial) with 2,306,502 square feet of medium industrial facilities, as identified in the proposed Project. The approximately 22-acre General Commercial parcel on the north, the 9.01-acre High Commercial parcel, and the approximately 107.72-acres on the east of the Project site to be designated LI (Light Industrial) would not be developed. Therefore, this Alternative assumes that existing land uses on the northern and eastern portions of the site would remain unchanged, and would remain under their current state as fallow and cultivated land. This Alternative would continue to require the GPA, ZCC, annexation, and Agricultural Preserve Exclusion.

Impacts Compared to Project Impacts

The following discussion evaluates the potential environmental impacts associated with Alternative D, the "Reduced Project Size" Alternative, compared to impacts of the proposed Project.

Aesthetics

Under this Alternative, the aesthetic impacts would be less than the proposed Project. Implementation of this Alternative would involve less development on approximately 159 acres of the proposed Project site and the remaining approximately155.3 acres would remain under the current land uses. Overall, decreasing the amount of developed land would potentially result in less impacts from site illumination and conversion of open space to a permanent urban environment. Short-term construction impacts would occur under this Alternative; however, impacts would be considered less than significant. On a cumulative level, implementation of this Alternative would result in a similar less than significant impact as the proposed Project.

Agriculture

This Alternative would result in development on the approximately 184.58 acres of the Project site. As a result, the amount of agricultural land that would be taken out of production for the development of the industrial facilities would be less than the proposed Project. This Alternative lessens the impact on agricultural resources because the total conversion of farmland would be approximately 50 percent of the proposed Project. However, similar to the proposed Project, impacts to agricultural resources would still result in a significant and unavoidable impact on agriculture resources because of the cumulative loss of agricultural land within Kern County. Alternative D, the "Reduced Project Size" Alternative, would reduce the amount of land taken out of agricultural production; however, significant and unavoidable impacts would remain, as compared to the proposed Project.

Air Quality

The "Reduced Project Size" Alternative would construct approximately 2,306,502 square feet of medium to light industrial facilities. The reduced size of the facilities would ultimately reduce the number of workers at the site and would therefore have fewer vehicle trips, compared to the proposed Project. As a result, this Alternative has the potential to reduce operational PM_{10} emissions by enough to be below the threshold of 15 tons per year. The 50 percent reduction is not expected to reduce other air pollutant emissions below the thresholds. Therefore, this Alternative could slightly, reduce air pollutant emissions, compared to the proposed Project. In addition, mitigation measures addressing long-term Project emissions similar to the proposed Project would be implemented under this Alternative, therefore, impacts under this Alternative would be slightly reduced but would remain very similar to those of the proposed Project. Construction impacts to air quality would be reduced by about half compared to the proposed Project.

Biological Resources

This Alternative would continue to provide industrial services by constructing approximately 2,306,502 square feet of medium industrial facilities. This is a reduction of approximately 50 percent. Development of the SI (Service Industrial) area would continue to impact San Joaquin kit fox, as the majority of the kit fox sign identified for the proposed Project are located within the SI area. However, this Alternative may be able to avoid impacts to burrowing owls, as they are located outside the SI proposed boundary. Overall, impacts to biological resources would be reduced. Although total impacts on sensitive species, and habitat would be less compared to the proposed Project, similar mitigation measures would still be required to reduce impacts to a less than significant level. In addition, this Alternative would be required to comply with the MBHCP.

Cultural Resources

This Alternative would occupy 159 acres of the proposed 314.30 acres of land that the proposed Project would occupy. Because no cultural resources were identified for the Project site, impacts to cultural resources would be the same under this Alternative as under the proposed Project. Mitigation measures required for grading and construction activities would apply to the same activities for this Alternative, and would therefore result in less than significant impacts on undiscovered cultural resources. Thus, this Alternative, with regard to cultural resources, would be similar to the proposed Project.

Energy

Implementation of this Alternative would reduce the project site by approximately 50 percent and reduce the energy demand by approximately 50 percent. This Alternative also would be required to comply with all state and local regulations pertaining to energy reduction and use of alternative energy sources. Therefore, overall the reduced intensity of this Alternative would reduce the amount of energy needed compared to the proposed Project.

Geologic Resources

This Alternative would result in similar geologic impacts to the proposed Project as the surrounding geologic environmental remains the same. Therefore, any development on the Project site is subject to the same impacts due to geologic conditions. Mitigation measures comparable to those recommended for the proposed Project would be incorporated into this Alternative to minimize impacts.

Greenhouse Gases

Implementation of this Alternative would result in 2,306,502 square feet of industrial building space to be constructed on the proposed Project site. Construction would continue to occur on the entire property, therefore construction emissions would be similar to the proposed Project. Because this Alternative would result in slightly fewer workers, a slight reduction in traffic trips would occur as compared to the proposed Project; therefore, the long-term air quality impacts would be slightly less than the proposed Project. Greenhouse gas emission impacts would need to be mitigated in order to reduce the business as usual (BAU) greenhouse gas emissions by 29 percent to be consistent with the standards established by the California Air Resources Board and the California Global Warming Solutions Act of 2006. Therefore, greenhouse gas emissions impacts would be similar to the proposed Project.

Hazards/Hazardous Materials

Similar to the proposed Project, implementation of Alternative C, the "Reduced Density" Alternative, would result in potentially significant impacts on public health and safety. This Alternative includes the disturbance of a portion of the Project site for development of 2,306,502 square feet of industrial building space, slightly less than the proposed Project; therefore, this Alternative would slightly reduce the potential of the transport of hazardous materials. This Alternative would have a similar impact on the existing PG&E pipeline as the proposed Project. In addition, closure of the prospect well would continue to be required. This Alternative would expose individuals to similar effects associated with agricultural land uses (i.e., soil contamination, noise, dust). This Alternative would reduce the number of people working on-site by approximately 50 percent; however, the overall public health and safety impacts would be similar to those of the proposed Project. The mitigation measures identified for the proposed Project would be included in this Alternative.

Hydrology and Water Quality

Development in accordance with this Alternative would result in similar amounts of impervious surfaces and, therefore, slightly smaller amounts of runoff volumes compared to the proposed Project.

Water consumption would be slightly less than water usage under the proposed Project; however, the impacts would remain similar to those of the proposed Project. As with the proposed Project, this Alternative would comply with standard County provisions related to the incorporation of sufficient storm drain infrastructure to reduce the amount of surface runoff. Implementation and compliance with the NPDES, SUSMP and standard BMP requirements would reduce construction-related impacts on water quality to a less than significant level. Mitigation measures similar to the proposed Project would be applied to ensure short-term water quality construction impacts remain less than significant.

Land Use and Relevant Planning

Implementation of this Alternative would continue to require a GPA, ZCC, annexation, and an agricultural preserve exclusion. Alternative D, the Reduced Project Size Alternative, would develop 2,306,502 square feet of medium industrial facilities on approximately 159 acres, approximately 50 percent of the original Project site. Development would occur on the portion of the Project site proposed to be SI (Service Industrial). The remaining 50 percent of the Project site, approximately 155.3 acres, would continue to be used for agricultural purposes. Land use impacts from Alternative D, the Reduced Project Size Alternative, would be proportionally reduced from those of the proposed Project.

Mineral Resources

Alternative D, the "Reduced Project Size" Alternative, would develop only the portion of the Project site proposed to be SI (Service Industrial). The development would not occur in the area of the abandoned well and therefore, reabandonment would not be required under this Alternative. Alternative D, the Reduced Project Size Alternative, would result in reduced impacts on mineral resources as compared to the proposed Project.

Noise

Noise impacts from development under Alternative D, the "Reduced Project Size" Alternative, would be reduced compared to those identified for the proposed Project. The noise that would result during construction activities would be similar to the level that would occur from development of the proposed Project but may occur over a shorter duration due to the small project size. Operational noise would be reduced from the proposed Project because the total square footage of industrial space would be less than the proposed Project. Noise from vehicle trips would also be reduced proportionately to the reduction in industrial facility space. Impacts to the residence along Lamb Avenue, west of South Union Avenue, would be reduced due to the increase distance between the residence and area to be developed. Mitigation measures similar to the proposed Project would be applied and could reduce impacts to less than significant level. Overall, impacts would be proportionally reduced from those of the proposed Project.

Population and Housing

Alternative D, the "Reduced Project Size" Alternative, would reduce the proposed Project size by approximately 50 percent, resulting in the development of approximately 2,306,502 square feet of medium industrial facilities. The labor force needed for this Alternative would, be less than the labor

force needed for the proposed Project. Therefore, the impacts under Alternative D would be less than those identified for the proposed Project.

Public Services and Utilities

This Alternative would develop approximately 50 percent of the Project site. The demand for public services and utilities generated at the Project site would be reduced by approximately 50 percent. The reduced square footage for industrial facilities would result in fewer employees and fewer industrial businesses within the Project site, which would in turn have lesser impacts on public services and utilities. All standard mitigation measures identified under the proposed Project would be required in order to reduce impacts to a less than significant level. Therefore, this Alternative would result in reduced impacts on public services and utilities when compared to the proposed Project.

Traffic and Circulation

The reduced amount of square footage for industrial building space developed under this Alternative would result in a slightly reduced number of employees and delivery trucks, which in turn would result in a slight decrease in average daily vehicle trips (ADT) compared to the proposed Project. Fewer AM and PM peak hour trips and ADT would result in a proportional reduction of impacts on intersections and roadway segments within the area surrounding the Project site. The temporary impacts on transportation within the area surrounding the Project site would be similar to those with the proposed Project because the proposed construction activities would occur in a similar area and require access from the same roadways, but would be shorter in duration. The planned improvements and mitigation measures identified for the proposed Project would still be applicable under this Alternative in order to reduce impacts to a less than significant level. Overall, impacts on traffic and circulation from this Alternative would be proportionally reduced compared to those associated with the proposed Project.

Wildfire

This Alternative would result in a reduced development intensity of the Project Site by approximately 50%. Under this alternative; however, surrounding land uses would not change and on-site changes to land uses, although reduced, would not change the impacts associated with wildfires. Therefore, the potential for the Project site to be affected by wildfire from adjacent areas would be the same and no changes or impacts associated with wildfire would occur.

Conclusion

Avoid or Substantially Lessen Project Impacts

This Alternative would reduce impacts to agriculture, air quality, land use and relevant planning, noise, and traffic/circulation.

Attainment of Project Objectives

Alternative D, the "Reduced Project Size" Alternative, does not meet the following Project objectives, as described in Section 6.2.

- Cluster commercial retail uses that provide goods and services near an interchange with SR-99 to accommodate interstate freight and reduce traffic congestion and air emissions.
- Provide an industrial center at the Houghton Road and SR-99 interchange in the southern metropolitan area adjacent to the City that would provide a broad range of goods and services that serve the regional market area.
- Allow for the development of a variety of commercial and industrial centers which are differentiated by their function, intended users and level of intensity.

Comparative Merits

This Alternative would reduce the impacts compared to the proposed Project in the categories of air quality, noise, and traffic and circulation; and would have equivalent impacts in the categories of aesthetics, agriculture, biological resources cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, land use and relevant planning, mineral resources, population and housing, public services and utilities, and traffic and circulation.

6.6 ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The purpose of the Alternatives evaluation is to develop Project Alternatives that have fewer or no significant impacts compared to the proposed Project. CEQA Section 15126(d)(2) indicates that, if the "No Project/No Development" Alternative is the "Environmentally Superior" Alternative, then the EIR shall also identify an Environmentally Superior Alternative among the other Alternatives. In this case, Alternative A, the "No Project/No Development" Alternative (Existing Conditions), is the environmentally superior Alternative, as it would not result in environmental impacts associated with construction. However, Alternative A, the "No Project/No Development" Alternative, would not satisfy the Project's objectives.

Alternative B, "Buildout Existing General Plan Designation", Alternative C "Reduced Density", and Alternative D "Reduced Project Size", would each result in fewer or equivalent environmental impacts when compared to the proposed Project.

Alternative B "Buildout Existing General Plan Designation", would reduce impacts compared to the proposed Project in the categories of aesthetics, agriculture, air quality, biological resources, energy, greenhouse gases, land use and relevant planning, noise, public services and utilities and traffic and circulation; and would have equivalent impacts in the categories of cultural resources, geologic and seismic hazards, hazards/hazardous materials, hydrology and water quality, mineral resources, and wildfire. This Alternative would only partially satisfy the Project objectives, as no industrial land uses would be developed.

Alternative C "Reduced Density", would reduce impacts compared to the proposed Project in the categories of air quality, energy, noise, and traffic and circulation; and would have equivalent impacts in the categories of agriculture, biological resources cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, and land use and

planning, mineral resources, population and housing, public services and utilities, and wildfire. This Alternative would satisfy the Project objectives.

Alternative D "Reduced Project Size", would proportionally reduce the impacts compared to the proposed Project in the categories of air quality, energy, noise, traffic and circulation, agriculture, biological resources cultural resources, geologic and seismic hazards, greenhouse gases, hazards/hazardous materials, hydrology and water quality, land use and relevant planning, mineral resources, population and housing, public services and utilities, and wildfire. This Alternative could eliminate noise impacts to sensitive receptors, and could eliminate associated impacts with some air pollutant emissions. This Alternative, however, would not satisfy any of the Project objectives.

Although development of the Project site in accordance with one of these Alternatives would result in fewer environmental impacts, only one of the Alternatives would fulfill all of the proposed Project's objectives. In addition, one of the Alternatives would have the potential to avoid significant and unavoidable impacts to agricultural resources. Despite the reduced project specific impacts, implementation would not reduce significant and unavoidable cumulative impacts to agriculture, air quality, greenhouse gases, noise, or traffic.

Based on the reasons stated above, Alternative D, the "Reduced Project Size" Alternative, is the environmentally superior Alternative because it significantly reduces the amount of agricultural land impacted, while reducing other Project specific impacts.

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Chapter 7

Responses to Comments

Chapter 7.0
Responses to Comments

This Chapter is being reserved for, and will be included with, the Final Environmental Impact Report (EIR).

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Chapter 8

Organizations and Persons Consulted

Chapter 8
Organizations and Persons Consulted

Note: All of the below entities were either notified or contacted directly to ask for or directly receive consultation on their applicable area of expertise in respect to this proposed project. This may not be an all-inclusive list.

State of California

California Resource Agency

Department of Conservation

Office of Historic Preservation

Department of Parks and Recreation

Department of Water Resources

Department of Fish and Wildlife

Department of Health Services

Native American Heritage Commission

Public Utilities Commission

Department of Transportation Division of Aeronautics

Department of Transportation District 06

Department of Toxic Substances Control

Regional Water Quality Control Board Central Valley Region

Regional and Local

California Native Plant Society

Kern County Department of Agriculture

Kern County Public Works Department

Kern County Parks and Recreation

Kern County Planning and Natural Resources Department

Kern County Sheriff Department

Kern County Superintendent of Schools

Kern County Water Agency

Kern Council of Governments

Pacific Gas & Electric Company

San Joaquin Valley Unified Air Pollution Control District

Southern San Joaquin Valley Information Center

Southern California Gas Company

Southern California Edison

Native American Consultation

In accordance with Senate Bill 18 and the California Tribal Consultation guidelines, the appropriate native groups were consulted with respect to the project's potential impacts on Native American places, features, and objects. As of the writing of this report, Staff has not received any comments from consulted tribes with regard to the department's SB 18 request. Staff notes consultation with appropriate Native American groups per Senate Bill 18 requirements has occurred.

Chapter 9

Preparers

Chapter 9
Preparers

Lead Agency

Kern County Planning and Natural Resources Department

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Mr. Craig Murphy – Planning and Natural Resources Assistant Director

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Chapter 10

Bibliography

Chapter 10
Bibliography

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PLANNING AND NATURAL RESOURCES DEPARTMENT

Planning
Community Development
Administrative Operations

DATE: March 4, 2022

TO: See Attached Mailing List

FROM: Kern County Planning and Natural Resources Department
Attn: Cindi Hoover
2700 "M" Street, Suite 100
Bakersfield, CA 93301
(661)862-8629; hooverc@kerncounty.com

SUBJECT: NOTICE OF PREPARATION (NOP) OF A DRAFT ENVIRONMENTAL IMPACT REPORT (EIR) FOR THE CARBON TERRAVAULT 1 (CTV 1) CARBON CAPTURE AND SEQUESTRATION PROJECT BY CALIFORNIA RESOURCES CORPORATION (CRC)

The Kern County Planning and Natural Resources Department as Lead Agency (per CEQA Guidelines Section 15062) has determined that preparation of an Environmental Impact Report (per CEQA Guidelines 15161) is necessary for the proposed project identified below. The Planning and Natural Resources Department solicits the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use the EIR prepared by our agency when considering your permit or other approval of the project.

You are invited to view the NOP and submit written comments regarding the content of the environmental information in connection with the proposed project should you wish to do so. Due to the limits mandated by State law, your response must be received by **April 4, 2022 at 5:00 p.m**. Comments on the scope and content of the EIR can be submitted to the Kern County Planning and Natural Resources Department at the address shown above or to hooverc@kerncounty.com. A Scoping Meeting will be held on **Friday, March 18, 2021 at 1:30 p.m.**

PROJECT TITLE: Carbon TerraVault 1 (CTV 1) by California Resources Corporation (PP22405); PLN21-01378: ZCC No. 5, Map No. 118; ZCC No. 5, Map No. 119; ZCC No. 4, Map No. 120; CUP No. 13, Map No. 118; CUP No. 5, Map No. 119; CUP No. 3, Map No. 120

PROJECT LOCATION: Central Valley portion of unincorporated Kern County, West side of Elk Hills Road and north Side of Skyline Road, within the Elk Hills Oil Field, approximately 26 miles from the City of Bakersfield (pop. 413,098), approximately 8.5 miles from the City of Taft (pop 8945) and approximately 4 miles from the unincorporated community of Buttonwillow (pop. 1443), also being located within within section 12 of Township 30 South, Range 22 East, sections 7, 8, 17, 18, 22, 25, 26, 27, 35 and 36 of Township 30 South, Range 23 East, and section 31 Township 30 South, Range 24 East, Mount Diablo Base and Meridian (MDBM), County of Kern, State of California.

PROJECT DESCRIPTION: The proposed project is a Conditional Use Permit for a 5,332.34 acre carbon capture and sequestration field, associated Class VI geologic sequestration injection wells and related improvements for storage of Carbon Dioxide (CO_2). The project, Carbon TerraVault 1 (CTV 1), is a wholly

owned subsidiary of California Resources Corporation, the applicant for the project. The project comprises the following area:

Table 1: Project Assessor Parcel Numbers, Existing General Plan Designation, Existing Zoning Classification, Proposed Zone Classification, Acreage

APN	Map No.	Zoning	GP Designation	Sec/T/R	Acreage	Ag. Preserve
157-060-02 PTN	118	A (Exclusive Agriculture)	8.4 Mineral and Petroleum	12/ 30 S/R 22 E	159.50	Ag. Preserve 3 Inclusion: Yes
158-040-07	119	A (Exclusive Agriculture)	8.3 Extensive Agriculture; 8.3/2.1 Extensive Agriculture and Seismic Hazard	7/ 30 S/R 23 E	42.95	Ag. Preserve 3 Inclusion: Yes
158-040-06	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	8/30 S/R 23 E	641.20	
158-070-02	119	A-1 (Limited Agriculture)	8.3 Extensive Agriculture	17/ 30 S/R 23 E	156.44	
158-070-03 PTN	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	17/ 30 S/R 23 E	154.38	
158-070-01 PTN	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	18/ 30 S/R 23 E	319.06	
158-080-06 PTN	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	22/ 30 S/R 23 E	160.89	
158-090-03 PTN	119	A-1 (Limited Agriculture)	8.3 Extensive Agriculture	25/ 30 S/R 23 E	340.82	

158-090-02	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	26/ 30 S/R 23 E	637.78	
158-090-01	119	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum	27/ 30 S/R 23 E	637.54	
158-090-19	119	A (Exclusive Agriculture)	8.4 Mineral and Petroleum; 8.3/2.1 Extensive Agriculture & Seismic Hazard	35/ 30 S/R 23 E	637.89	Ag. Preserve 3 Inclusion: Yes
158-090-04	119	A (Exclusive Agriculture)	8.4 Mineral and Petroleum	36/ 30 S/R 23 E	683.74	Ag. Preserve 3 Inclusion: Yes
159-280-07 PTN	120	A-1 (Limited Agriculture)	8.4 Mineral and Petroleum; 8.4/2.4 Extensive Agriculture/ Steep Slope	31/ 30 S/R 24 E	160.15	
				Total Acres	5,332.34	

The proposed project site is located within the Elk Hills Oil Field which comprises approximately 75 square miles (47,800-acre) complex with surface and mineral rights privately held by CRC in the San Joaquin Valley of unincorporated Kern County. The surrounding area is comprised of agricultural fields, both active and fallow, and other existing oilfields. They include the Midway – Sunset Oil Field, McKittrick Oilfield and Cymric Oil Field. Skyline Road is closed to public entry and is the southern boundary of the project. Skyline Road connects to Elk Hills Road, which connects the town of Taft, to the south, with Buttonwillow to the north. California Resource Corporation's gated and guarded entrance to the field is located at the western intersection of Skyline Drive and Elk Hills Road.

The proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project. Potential sources and locations of sources will be specifically identified and analyzed to the extent legally required by CEQA in the Draft EIR. The CO_2 would then be injected into identified geographically confined reservoirs for storage in perpetuity. This area has been identified as a location suitable for such storage and a potential to provide a contribution to the goals of California for carbon neutrality by 2045 by reducing industrial uses to no net contribution and potentially supporting direct removal of CO2 from the air. California executive order B-55-18 mandates that the state achieve carbon neutrality by 2045 and maintain net negative emissions thereafter (https://livermorelabfoundation.org/2019/12/19/getting-to-neutral/). The project, as proposed, has the capacity for up to 48 million metric tons of estimated storage and capable of sequestrating over 1.5 million metric tons of CO_2 per year.

Implementation of the project would require permits from the Federal Environmental Protection Agency (EPA) for four (4) to six (6) Class VI injection wells in compliance with the UIC program Class VI geologic

sequestration regulations. Location of the proposed Class VI injection wells will be within the proposed CUP boundary of 5,332.34 acres. All employee facilities needed to manage the project will be provided by the existing Elk Hills oil field facilities.

Implementation of the project as proposed includes the following requests:

- Zone Change Case (ZCC No. 5, Map No. 118; ZCC No. 5, Map No. 119; ZCC No 4, Map No. 120); : From A-1 (Limited Agriculture) to A (Exclusive Agriculture) on approximately 3,208 acres; and
- Issuance of three (3) Conditional Use Permits (CUP No. 13, Map No. 118; CUP No. 5, Map 119; CUP No. 3, Map No. 120) to allow for the construction and operation of a 5,332.34-acre carbon capture and sequestration field and accessory infrastructure with a CO_2 storage capacity of 48 million metric tons, within the A (Exclusive Agriculture) Zone District. Carbon Capture and Sequestration (CCS) has been determined to be a storage operation and not a manufacturing operation and under the Kern County Zoning Ordinance, Section 19.08.085. And under the authority of Section 19.06.020. Storage of CCS in either existing formations or tanks is an allowed use with a Conditional Use Permit (CUP) in the following districts:
    - A District (Exclusive Agriculture)
    - M-2 District (Medium Industrial)
    - M-3 (Heavy Industrial)

Documents can be viewed online at: https://kernplanning.com/planning/notices-of-preparation/

Signature:
Name: Cindi Hoover, Supervising Planner

Carbon TerraVault1
ZCC 5, Map 119; CUP 5, Map 119

City of Arvin
P.O. Box 548
Arvin, CA 93203

Bakersfield City Planning Dept
1715 Chester Avenue
Bakersfield, CA 93301

Bakersfield City Public Works Dept
1501 Truxtun Avenue
Bakersfield, CA 93301

California City Planning Dept
21000 Hacienda Blvd.
California City, CA 93515

Delano City Planning Dept
P.O. Box 3010
Delano, CA 93216

City of Maricopa
P.O. Box 548
Maricopa, CA 93252

City of McFarland
401 West Kern Avenue
McFarland, CA 93250

City of Ridgecrest
100 West California Avenue
Ridgecrest, CA 93555

City of Shafter
336 Pacific Avenue
Shafter, CA 93263

City of Taft
Planning & Building
209 East Kern Street
Taft, CA 93268

City of Tehachapi
Attn: John Schlosser
115 South Robinson Street
Tehachapi, CA 93561-1722

City of Wasco
764 E Street
Wasco, CA 93280

Los Angeles Co Reg Planning Dept
320 West Temple Street
Los Angeles, CA 90012

San Bernardino Co Planning Dept
385 North Arrowhead Avenue, 1st Floor
San Bernardino, CA 92415-0182

Inyo County Planning Dept
P.O. Drawer "L"
Independence, CA 93526

Santa Barbara Co Resource Mgt Dept
123 East Anapamu Street
Santa Barbara, CA 93101

Tulare County Planning & Dev Dept
5961 South Mooney Boulevard
Visalia, CA 93291

Kings County Planning Agency
1400 West Lacey Blvd, Bldg 6
Hanford, CA 93230

U.S. Bureau of Land Management
Caliente/Bakersfield
3801 Pegasus Drive
Bakersfield, CA 93308-6837

Federal Aviation Administration
Western Reg Office/
777 South Aviation Boulevard
Suite 150
El Segundo, CA 90245

San Luis Obispo Co Planning Dept
Planning and Building
976 Osos Street
San Luis Obispo, CA 93408

U. S. Fish & Wildlife Service
Division of Ecological Services
2800 Cottage Way #W-2605
Sacramento, CA 95825-1846

North West Kern Resource Cons Dist
5080 California Avenue, Suite 150
Bakersfield, CA 93309

Ventura County RMA Planning Div
800 South Victoria Avenue, L1740
Ventura, CA 93009-1740

U.S. Dept of Agriculture/NRCS
5080 California Avenue, Ste 150
Bakersfield, CA 93309-0711

California Air Resources Board
Stationary Resource Division
P.O. Box 2815
Sacramento, CA 95812

Federal Communications Comm
18000 Studebaker Road, #660
Cerritos, CA 90701

California Dept of Conservation
Geologic Energy Management Division
801 K Street, MS 20-20, Sacramento,
CA 95814

California Natural Resources Agency
Secretary Wade Crowfoot
715 P Street 20th Floor
Sacramento, CA 95814

California Air Resources Board
Industrial Strategic Division
Matthew Bohill, Chief
P.O. Box 2815
Sacramento, CA 95812

Caltrans/Dist 6
Planning/Land Bank Bldg.
P.O. Box 12616
Fresno, CA 93778

Caltrans/
Division of Aeronautics, MS #40
P.O. Box 942873
Sacramento, CA 94273-0001

Environmental Protection Agency
Region IX Office
75 Hawthorn Street
San Francisco, CA 94105

California Dept of Conservation
Geologic Energy Management Division
4800 Stockdale Highway, Ste 108
Bakersfield, CA 93309

California State University
Bakersfield - Library
9001 Stockdale Highway
Bakersfield, CA 93309

So. San Joaquin Valley Arch Info Ctr
California State University of Bkfd
9001 Stockdale Highway
Bakersfield, CA 93311

California Fish & Wildlife
1234 East Shaw Avenue
Fresno, CA 93710

California Regional Water Quality
Control Board/Central Valley Region
1685 E Street
Fresno, CA 93706-2020

California Dept of Conservation
Director's Office
801 "K" Street, MS 24-01
Sacramento, CA 95814-3528

California Energy Commission
Attn: Commissioner Douglas
715 P Street
Sacramento, CA 95814

California Public Utilities Commission
Attn: President Alice Reynolds
505 Van Ness Avenue
San Francisco, CA 94102

California Energy Commission
715 P Street
Sacramento, CA 95814

Cal Environmental Protection Agency/
Dept of Toxic Substances Control, Reg 1
Attn: Dave Kereazis, Permit Div - CEQA
8800 Cal Center Drive, 2nd Floor
Sacramento, CA 95826

California Dept of Water Resources
San Joaquin Dist.
3374 East Shields Avenue, Room A-7
Fresno, CA 93726

California State Geological Survey
Attm: Steve Bohlan
801 K Street MS 12-30, 801 K St MS 12-30, Sacramento, CA 95814

California Dept of Toxic Substance Control
Environmental Protection Agency
1515 Tollhouse Road
Clovis, CA 93612

California Dept of Water Resources
Div. Land & Right-of-Way
P.O. Box 942836
Sacramento, CA 94236

Kern County Public Works Department/
Building & Development/Development Review

Kern County Airports Department

Kern County Public Works Department/
Building & Development/Floodplain

Kern County Public Works Department/
Building & Development/Survey

Kern County
Env Health Services Department

Kern County Fire Dept
Aaron Duncan, Fire Chief

Kern County Sheriff's Dept
Administration

Kern County Library/Beale
Local History Room

Kern County Library/Beale
Andie Sullivan

Kern County Fire Dept
Kain Linville, Fire Marshall

Kern County Public Works Department/Operations &
Maintenance/Regulatory Monitoring & Reporting

Kern County Library
Buttonwillow Branch
116 Buttonwillow Avenue
Buttonwillow, CA 93206

Kern County Library
Taft Branch
27 Emmons Park Drive
Taft, CA 93268

McKittrick School Dist
P.O. Box 277
McKittrick, CA 93251

Kern High School Dist
5801 Sundale Avenue
Bakersfield, CA 93309

Kern County Water Agency
P.O. Box 58
Bakersfield, CA 93302-0058

San Joaquin Valley
Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, CA 93726

Kern Audubon Society
Attn: Frank Bedard, Chairman
4124 Chardonnay Drive
Bakersfield, CA 93306

Defenders of Wildlife
980 - 9th Street, Suite 1730
Sacramento, CA 95814

Sierra Club/Kern Kaweah Chapter
P.O. Box 3357
Bakersfield, CA 93385

Torres Martinez Desert Cahuilla Indians
Attn: Michael Mirelez, Cultural
Resources Coordinator
P.O. Box 1160
Thermal, CA 92274

Twenty-Nine Palms Band of Mission Indians
Attn: Anthony Madrigal Jr., Tribal Grants
Administrator
46-200 Harrison Place
Coachella, CA 92236

Buttonwillow Union School Dist
42600 Highway 58
Buttonwillow, CA 93206

Kern County Superintendent of Schools
Attention School District Facility Services
1300 - 17th Street
Bakersfield, CA 93301

West Side Rec & Parks Dist
P.O. Box 1406
Taft, CA 93268

West Side Mosquito
Abatement Dist.
P.O. Box 205
Taft, CA 93268

Center on Race, Poverty
& the Environment
Attn: Marissa Alexander
1999 Harrison Street – Suite 650
San Francisco, CA 94612

Native American Heritage Council
of Kern County
3401 Aslin Street
Bakersfield, CA 93312

Southern California Gas Co
35118 McMurtrey Avenue
Bakersfield, CA 93308-9477

Verizon California, Inc.
Attention Engineering Department
520 South China Lake Boulevard
Ridgecrest, CA 93555

San Manuel Band of Mission Indians
Attn: , Cultural Resources Analyst
26569 Community Center Drive
Highland, CA 92346

Tejon Indian Tribe
Attn: Collin Rambo, Cultural Resource
Management Technician
1731 Hasti Acres Dr., Suite 108
Bakersfield, CA 93309

Taft Union High School Dist
701 - 7th Street
Taft, CA 93268

Elk Hills School Dist
P.O. Box 129
Tupman, CA 93276

Rosedale-Rio Bravo Water Dist
P.O. Box 20820
Bakersfield, CA 93390-0820

Buttonwillow Rec & Parks Dist
P.O. Box 434
Buttonwillow, CA 93206-9320

Buttonwillow County Water Dist
P.O. Box 874
Buttonwillow, CA 93206

Center on Race, Poverty
& the Environmental/
CA Rural Legal Assistance Foundation
1012 Jefferson Street
Delano, CA 93215

Pacific Gas & Electric Co
Land Projects
650 "O" Street, First Floor
Fresno, CA 93760-0001

Southern California Gas Co
Transportation Dept
9400 Oakdale Avenue
Chatsworth, CA 91313-6511

Tejon Indian Tribe
Kathy Morgan, Chairperson
1731 Hasti-acres Drive, Suite 108
Bakersfield, CA 93309

Twenty-Nine Palms Band of Mission Indians
Attn: Darrell Mike, Tribal Chairman
46-200 Harrison Place
Coachella, CA 92236

LIUNA
Attn: Danny Zaragoza
2201 "H" Street
Bakersfield, CA 93301

JB Energy Partners
Andrew Bremner
P.O. Box 82515
Bakersfield, CA 93308

QK Inc,
Chris Mynk
5080 California Ave. Suite 220
Bakersfield, CA 93309

Aera
Attn: Cindy Pollard
10000 Ming Avenue
Bakersfield, CA 93311

LINN Energy, LLC
5201 Truxtun Avenue, Suite 100
Bakersfield, CA 93309

Halliburton
Attn: Steve Pruett
34722 Seventh Standard Road
Bakersfield, CA 93314

Seneca Resources Corporation
2131 Mars Court
Bakersfield, CA 93308

Naftex Operating Company
P.O. Box 308
Edison, CA 93220

San Joaquin Refining
3129 Standard Street
Bakersfield, CA 93308

Ensign
7001 Charity Avenue
Bakersfield, CA 93308

Lozeau Drury LLP
1939 Harrison Street, Suite 150
Oakland, CA 94612

Livermore Lab Foundation
c/o UC Office of Institutional Advancement
1111 Franklin Street
Oakland, CA 94607

Chevron, USA
9525 Camino Media
Bakersfield, CA 93311

Exxon/Mobil Production Company
Attn: Troy Tranquada
12000 Calle Real
Goleta, CA 93117

Hathaway, LLC
Attn: Chad Hathaway
P.O. Box 81385
Bakersfield, CA 93380

Macpherson Oil Company
P.O. Box 5368
Bakersfield, CA 93388

Venoco, Inc.
Attn: Ian Livett
6267 Carpentaria Avenue, Suite 100
Carpentaria, CA 93013

Mt Poso CoGen Company, LLC
100 Wilshire Boulevard, Suite 800
Santa Maria, CA 90401

Tricor Refining, LLC
1134 Manor Street
Bakersfield, CA 93308

Key Energy Services, Inc.
5080 California Avenue
Bakersfield, CA 93309

Adams, Broadwell, Joseph & Cardozo
Attention: Janet M. Laurain
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080

WZI, Inc.
1717 - 28th Street
Bakersfield, CA 93301

Stanford University
Energy Resources Engineering
Center of Carbon Storage
367 Panama Street
Stanford, CA 94305

CIPA
Attn: Trent Rosenlibe
1200 Discovery Drive, Suite 100
Bakersfield, CA 93309

IOPA
Attn: Les Clark
4520 California Avenue, Suite 230
Bakersfield, CA 93309

WSPA
Attn: Suzanne Noble
1518 Mill Rock Way, Suite 103
Bakersfield, CA 93311

Kern Oil and Refining
7724 East Panama Lane
Bakersfield, CA 93307

E&B Natural Resources Management
1600 Norris Road
Bakersfield, CA 93309

GE Energy
13000 Jameson Road
Tehachapi, CA 93561

Hess Corporation
1675 Chester Avenue
Bakersfield, CA 93301

PCL Industrial Services
1500 Union Avenue
Bakersfield, CA 93307

PLCL Plus Int'l, Inc.
12418-B Rosedale Highway
Bakersfield, CA 93312

Vintage Production California
9600 Ming Avenue, Suite 300
Bakersfield, CA 93311

Sturgeon Services Int'l
3511 Gilmore Avenue
Bakersfield, CA 93308

Sturgeon Services Int'l
3511 Gilmore Avenue
Bakersfield, CA 93308

Kern Citizens for Energy
5001 California Avenue, Suite 211
Bakersfield, CA 93309

Weatherford Completions
Attn: Gregg Hurst
5060 California Avenue, Suite 1150
Bakersfield, CA 93309

Total Western
2811 Fruitvale Avenue
Bakersfield, CA 93308

Baker Hughes
3901 Fanucchi Way
Shafter, CA 93263

Schlumberger Oilfield Services
2157 Mohawk Street
Bakersfield, CA 93308

Nabors Completion & Production
3651 Pegasus Drive, Suite 101
Bakersfield, CA 93308

Golden Gate University School of Law
Environmental Law and Justice Clinic,
Attn: Lucas Williams, Susann Bradford
536 Mission Street
San Francisco, CA 94105

Center for Biological Diversity
Ann K. Brown
Open Government Coordinator
P.O. Box 11374
Portland, OR 97211-0974

California State University Bakersfield
Dr. Lynette Zelezny, Ph.D., M.B.A.
President
Mail Stop: 33BCD
9001 Stockdale Highway
Bakersfield, CA 93311

Kern Economic Development Corp
Richard Chapman, President & CEO
2700 M Street, Suite 200,
Bakersfield, CA 93301

Dolores Huerta Foundation
Dolores Huerta, President
P.O. Box 2087
Bakersfield, CA 93303

Dolores Huerta Foundation
Camila Chavez, Executive Director
P.O. Box 2087
Bakersfield, CA 93303

Kern Community College District
Dr. Sonya Christian, Chancellor
2100 Chester Avenue
Bakersfield, CA 93301

Kern Community College District
Bonita Steele, Ed. D
Director, Programs and Program Development
2100 Chester Avenue
Bakersfield, CA 93301

City of Bakersfield
Mayor Karen Goh
Office of the Mayor
1501 Truxtun Avenue
Bakersfield, CA 93301

Governor's Office of Business and Economic Development
Dee Dee Myers, Senior Advisor & Director
1325 J Street, 18th Floor
Sacramento, CA 95814

California Natural Resources Agency
Wade Crowfoot, Secretary for Natural Resources
715 P Street, 20th Floor
Sacramento, CA 95814

California Workforce Development Board
Tim Rainey, Executive Director
800 Capitol Mall, Suite 1022
Sacramento, CA 95814

California State Senate
Senator Melissa Hurtado, 14th District
State Capitol
Sacramento, CA 95814

Large Scale Solar Association
Shannon Eddy, Executive Director
2501 Portola Way
Sacramento, CA 95818

Kern County Farm Bureau
Patty Poire, Board President
1800 30th Street, Suite 390
Bakersfield, CA 93301

Kern County Farm Bureau
Romeo Agbalog, Executive Director
1800 30th Street, Suite 390
Bakersfield, CA 93301

Employers' Training Resource
Teresa Hitchcock, Assistant CAO
1600 East Belle Terrace
Bakersfield, CA 93307

Greater Bakersfield Chamber of Commerce
Nick Ortiz, President & CEO
1725 Eye Street
Bakersfield, CA 93301

International Brotherhood of Electrical Workers
Brian Holt, Business Manager/Financial Secretary
3921 Sillect Avenue
Bakersfield, CA 93308

Tejon Indian Tribe
Octavio Escobedo, Tribal Chair
P.O. Box 640
Arvin, CA 93203

Building Trades Council
Kern, Inyo, & Mono Counties, AFL-CIO
John Spaulding, Executive Secretary
200 West Jeffrey Street
Bakersfield, CA 93305-2434

Public Policy Institute of California
PPIC Water Policy Center
Ellen Hanak, Vice President, Senior Fellow, and Director
500 Washington Street, Suite 600
San Francisco, CA 94111

Lorelei H. Oviatt, AICP, Director
2700 "M" Street, Suite 100
Bakersfield, CA 93301-2323
Phone: (661) 862-8600
Fax: (661) 862-8601 **TTY Relay 1-800-735-2929**
Email: planning@kerncounty.com
Web Address: http://kernplanning.com/

PLANNING AND NATURAL RESOURCES DEPARTMENT

Planning
Community Development
Administrative Operations

DATE: March 4, 2022

TO: Surrounding Property Owners within 1,000 Feet of Project Boundary; and, Interested Parties

FROM: Kern County Planning and Natural Resources Department
2700 "M" Street, Suite 100
Bakersfield, CA 93301

SUBJECT: Notice of Preparation of an Environmental Impact Report – Carbon TerraVault 1 by California Resources Corporation (PP22405)

Dear Sir or Madam:

The Kern County Planning and Natural Resources Department has determined that preparation of an Environmental Impact Report (EIR) is necessary for the proposed project identified below. The purpose of this letter is to notify interested parties and surrounding property owners within 1,000 feet of the project boundaries of this determination. A copy of the Initial Study/Notice of Preparation (IS/NOP) prepared for this proposed project is available for viewing at the following Kern County website:

https://kernplanning.com/planning/notices-of-preparation/

The purpose of the IS/NOP is to describe the proposed project, specify the project location, and to identify the potential environmental impacts of the project so that Responsible Agencies and interested persons can provide a meaningful response related to potential environmental concerns that should be analyzed in the Environmental Impact Report.

You are invited to view the NOP and submit written comments regarding the scope and content of the environmental information in connection with the proposed project should you wish to do so. Due to the limits mandated by State law, your response must be received by **April 4, 2022 at 5:00 p.m**. Comments can be submitted to the Kern County Planning and Natural Resources Department at the address shown above or to hooverc@kerncounty.com. A Scoping meeting will be held on **Friday, March 18, 2022 at 1:30 p.m.**, at the address listed above.

Please be advised that any comments received after the dates listed above will still be included in the public record for this project and made available to decision makers when this project is scheduled for consideration at a public hearing. Please also be advised that you will receive an additional notice in the mail once a public hearing date is scheduled for this project. You will also be provided additional opportunities to submit comments at that time.

PROJECT TITLE: Carbon TerraVault 1 (CTV 1) by California Resources Corporation (PP22405); PLN21-01378: ZCC No. 5, Map No. 119; CUP No. 5, Map No. 119

PROJECT LOCATION: Central Valley portion of unincorporated Kern County, west side of Elk Hills Road and north side of Skyline Road, within the Elk Hills Oil Field, approximately 26 miles from the City of Bakersfield, approximately 8.5 miles from the City of Taft, and approximately 4 miles from the unincorporated community of Buttonwillow, also being located within sections 7, 8, 9, 10, 13, 15, 16, 17,

18, and 26 of Township 30 South, Range 23 East, Mount Diablo Base and Meridian (MDBM), County of Kern, State of California.

PROJECT DESCRIPTION: The proposed project is a Conditional Use Permit for a 5,745.44 acre carbon capture and sequestration field, associated Class VI geologic sequestration injection wells, and related improvements for storage of Carbon Dioxide (CO_2). The project, Carbon TerraVault 1 (CTV 1), is a wholly owned subsidiary of California Resources Corporation, the applicant for the project.

Implementation of the project as proposed includes the following requests:

a) Zone Change Case # 5, Map 119:From A-1 (Limited Agriculture) to A (Exclusive Agriculture) on approximately 4,465 acres; and

b) Issuance of Conditional Use Permit #5, Map 119 to allow for the construction and operation of a 5,745.44-acre carbon capture and sequestration field and accessory infrastructure with a CO_2 storage capacity of 48 million metric tons, within the A (Exclusive Agriculture) Zone District. Carbon Capture and Sequestration (CCS) has been determined to be a storage operation under the Kern County Zoning Ordinance, Section 19.08.085 and Section 19.06.020. Therefore, CCS in either existing formations or tanks is an allowed use with a Conditional Use Permit (CUP) in the following districts:

   - A District (Exclusive Agriculture)
   - M-2 District (Medium Industrial)
   - M-3 (Heavy Industrial)

Should you have any questions regarding this project, or the Initial Study/Notice of Preparation, please feel free to contact me at (661) 862-8629 or hooverc@kerncounty.com

Sincerely,

Cindi Hoover, Supervising Planner
Advanced Planning Division

Attachments: Figure 2 – Local Vicinity Map

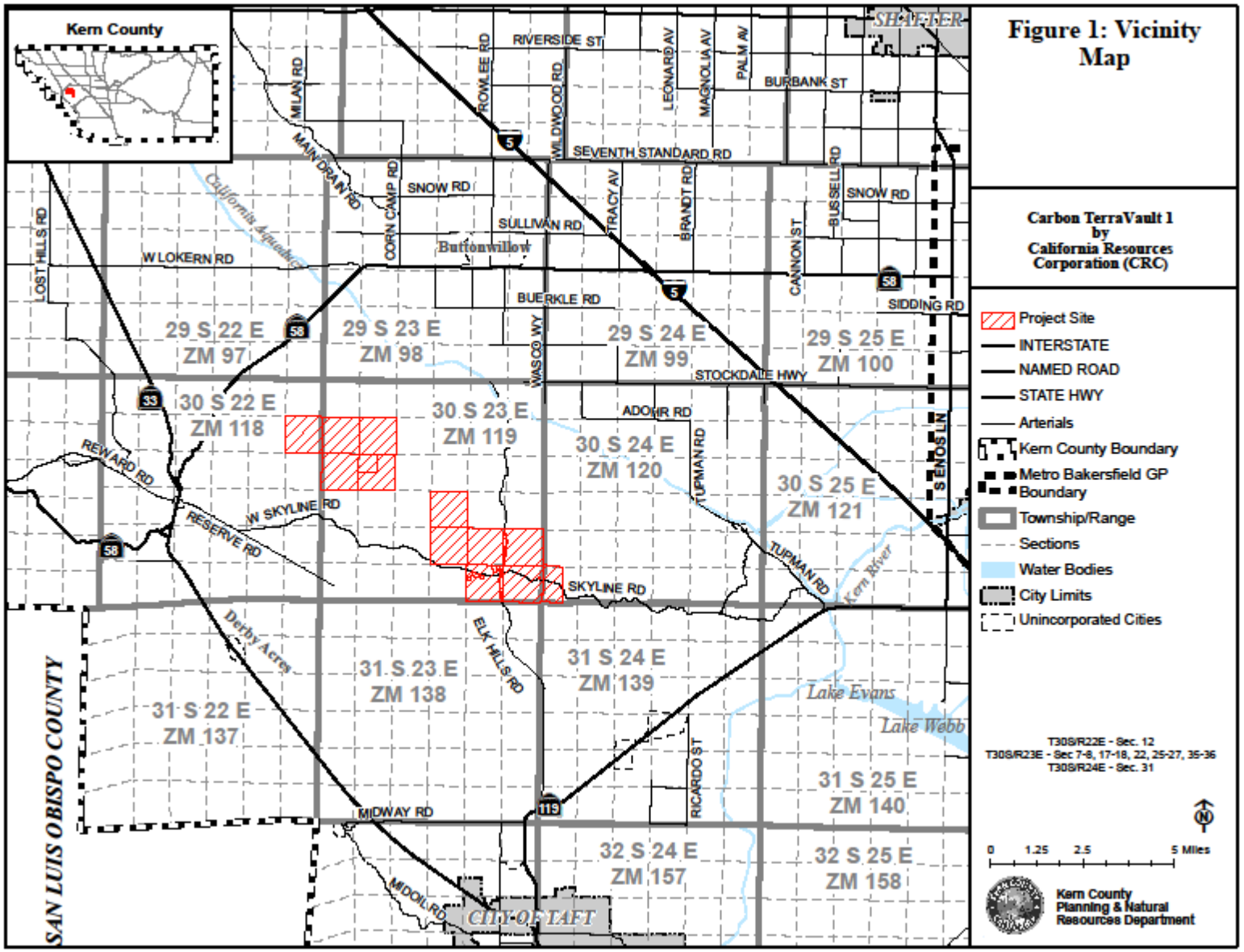

Figure 1: Regional Vicinity Map

Carbon TerraVault 1 Project

Carbon TerraVault1
ZCC 5, Map 119; CUP 5, Map 119
APN Labels

158 010 06 00 1
CENTER FOR NATURAL LANDS MANAGEMENT
27258 VIA INDUSTRIA # B
TEMECULA CA 92590-3751

158 090 16 00 4
ELK HILLS POWER LLC
PO BOX 27570
HOUSTON TX 77227-7570

158 010 23 00 0
BALDERAS REV TR
18053 ERWIN ST
ENCINO CA 91316-7116

158 080 09 00 1
CALIFORNIA RESOURCES ELK
272000 TOURNEY RD STE 200
SANTA CLARITA CA 91355-4910

157 010 02 00 2
CHEVRON USA INC
P O BOX 1392
BAKERSFIELD CA 93302-1392

158 010 07 00 4
GARRARD MELODY
PO BOX 4456
PALM SPRINGS CA 92263-4456

157 060 02 00 7
CALIFORNIA RESOURCES ELK HILLS LLC
27200 TOURNEY RD STE 200
SANTA CLARITA CA 91355-4910

158 040 07 00 3
CHEVRON USA INC
PO BOX 1392
BAKERSFIELD CA 93302-1392

158 010 05 00 8
MILLER MELVIN E & JACQULYN TRS
2872 STANBRIDGE AV
LONG BEACH CA 90815-1059

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # _____

Project Title: Carbon TerraVault 1 by California Resources Corporation (CRC)

Lead Agency: Kern County Planning and Natural Resources Department — Contact Person: Cindi Hoover

Mailing Address: 2700 "M" Street Suite 100 — Phone: (661) 862-8629

City: Bakersfield — Zip: 93301 — County: Kern

Project Location: County: Kern — City/Nearest Community: City of Taft, Community of Buttonwillow

Cross Streets: Skyline Road and Elk Hills Road — Zip Code: 93251

Lat. / Long.: 35° 19.51567' N, 119° 31.11937' W — Total Acres: 5,745.44

Assessor's Parcel No.: Multi — Section: Multi — Twp.: 30 S — Range: 23 E — Base: MDB&M

Within 2 Miles: State Hwy #: 58 W — Waterways: California Aqueduct

Airports: Elk Hills – Buttonwillow Airport — Railways: N/A — Schools: N/A

Document Type:

CEQA: ☒ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) _____ ☐ Other _____

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other _____

Local Action Type:

☐ General Plan Update ☐ General Plan Amendment ☐ General Plan Element ☐ Community Plan
☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan
☒ Rezone ☐ Prezone ☒ Use Permit ☐ Land Division (Subdivision, etc.)
☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☐ Other:

Development Type:

☐ Residential: Units _____ Acres _____
☐ Office: Sq.ft. _____ Acres _____ Employees _____
☐ Commercial: Sq.ft. _____ Acres _____ Employees _____
☐ Industrial: Sq.ft. _____ Acres _____ Employees _____
☐ Educational _____
☐ Recreational _____
☐ Water Facilities: Type _____ MGD _____
☐ Transportation: Type _____
☐ Mining: Mineral _____
☐ Power: Type _____ MW _____
☐ Waste Treatment: Type _____ MGD _____
☐ Hazardous Waste: Type _____
☒ Other: Carbon Capture and Sequestration

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☒ Agricultural Land ☒ Air Quality ☒ Archeological/Historical ☒ Biological Resources ☐ Coastal Zone ☒ Drainage/Absorption ☒ Economic/Jobs
☐ Fiscal ☒ Flood Plain/Flooding ☒ Forest Land/Fire Hazard ☒ Geologic/Seismic ☒ Minerals ☒ Noise ☒ Population/Housing Balance ☒ Public Services/Facilities
☒ Recreation/Parks ☒ Schools/Universities ☒ Septic Systems ☒ Sewer Capacity ☒ Soil Erosion/Compaction/Grading ☒ Solid Waste ☒ Toxic/Hazardous ☒ Traffic/Circulation
☒ Vegetation ☒ Water Quality ☒ Water Supply/Groundwater ☒ Wetland/Riparian ☒ Wildlife ☒ Growth Inducing ☒ Land Use ☒ Cumulative Effects
☒ Other GHG, Wildfire, Tribal Cultural Resources, Energy

Present Land Use/Zoning/General Plan Designation: Oil and Gas Exploration and Production/*Zoning:* A (Exclusive Agriculture); A-1 (Limited Agriculture)/*General Plan:* 8.3 (extensive Agriculture); 8.3/2.1 (Extensive Agriculture & Seismic Hazard); 8.4 (Mineral and Petroleum)

Project Description: The Carbon TerraVault 1 Project, as proposed by California Resources Corporation would develop an approximate 5,745 acre carbon capture and sequestration field, associated Class VI geologic sequestration injection wells, and related improvements for storage of Carbon Dioxide (CO_2). The proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project. Potential sources and locations of sources will be specifically identified and analyzed to the extent legally required by CEQA in the Draft EIR. The CO_2 would then be injected into identified geographically confined reservoirs for storage in perpetuity. This area has been identified as a location suitable for such storage and a potential to provide a contribution to the goals of California for carbon neutrality by 2045 by reducing industrial uses to no net contribution and potentially supporting direct removal of CO2 from the air. California executive order B-55-18 mandates that the state achieve carbon neutrality by 2045 and maintain net negative emissions thereafter. The project, as proposed, has the capacity for up to 40 million metric tons of estimated storage and capable of sequestrating over 1 million metric tons of CO_2 per year.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

S	Air Resources Board	X	Office of Emergency Services
	Boating & Waterways, Department of		Office of Historic Preservation
	California Highway Patrol		Office of Public School Construction
X	CalFire		Parks & Recreation
S	Caltrans District # 6		Pesticide Regulation, Department of
S	Caltrans Division of Aeronautics		Public Utilities Commission
	Caltrans Planning (Headquarters)	S	Regional WQCB # Central
	Central Valley Flood Protection Board	S	Resources Agency
	Coachella Valley Mountains Conservancy		S.F. Bay Conservation & Development Commission
	Coastal Commission		San Gabriel & Lower L.A. Rivers and Mtns Conservancy
	Colorado River Board		San Joaquin River Conservancy
S	Conservation, Department of		Santa Monica Mountains Conservancy
	Corrections, Department of		State Lands Commission
	Delta Protection Commission		SWRCB: Clean Water Grants
	Education, Department of	X	SWRCB: Water Quality
S	Energy Commission		SWRCB: Water Rights
S	Fish & Game Region # Fresno		Tahoe Regional Planning Agency
	Food & Agriculture, Department of	S	Toxic Substances Control, Department of
	General Services, Department of	S	Water Resources, Department of
	Health Services, Department of		
	Housing & Community Development		Other _____
	Integrated Waste Management Board		Other _____
X	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date March 4, 2022 Ending Date April 4, 2022

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone _____

Signature of Lead Agency Representative: /s/ **Date:** 03/04/2022

Cindi Hoover, Supervising Planner

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

NOTICE OF PREPARATION/INITIAL STUDY CHECKLIST

Carbon TerraVault 1 Project
by California Resources Corporation

Zone Classification Change No. 5, Map No. 118
Zone Classification Change No. 5, Map No. 119
Zone Classification Change No. 4, Map No. 120
Conditional Use Permit No. 13, Map No. 118
Conditional Use Permit No. 5, Map No. 119
Conditional Use Permit No. 3, Map No. 120

PLN21-01378
(PP22405)

LEAD AGENCY:

Kern County Planning and Natural Resources Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2370

Contact: Cindi Hoover
(661) 862-8629
hooverc@kerncounty.com

March 2022

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INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA), the Kern County Planning and Natural Resources Department (County) will initiate the preparation of an Environmental Impact Report (EIR) for the Carbon TerraVault 1 Carbon Capture and Sequestration Project in the unincorporated area of western Kern County, California.

Project Description

Project Location

The proposed Carbon TerraVault 1 Carbon Capture and Sequestration Project (proposed project) is a proposal by Carbon TerraVault 1, LLC (CRC) (project proponent) to construct and operate a carbon capture and sequestration (CCS) field on approximately 5,332 acres of privately owned land. The CCS field would include four to six injection wells and associated infrastructure, capable of storing approximately 48 million metric tons of Carbon Dioxide (CO_2) within identified geographically confined reservoirs.

The project site is located in the Central Valley portion of unincorporated Kern County, on the west side of Elk Hills Road and the north side of Skyline Road, within the administrative boundary of the Elk Hills Oil Field, approximately 26 miles from the City of Bakersfield (pop. 413,098) , approximately 8.5 miles from the City of Taft (pop 8945), and approximately 4 miles from the unincorporated community of Buttonwillow (pop. 1443), also being located within Sections 7,8,9,10,13,15,16,17,18,26 of Township 30 South, Range 23 East, Mount Diablo Base and Meridian (MDBM), County of Kern, State of California. Please see *Figure 1: Regional Vicinity Map.*

The project site is made up of ten (10) privately owned parcels totaling approximately 5,332 acres of land, predominately developed with oil and gas production and accessory facilities and infrastructure. Please see *Figure 2: Existing Parcel Map.* The total study area for this project includes the entirety of the confined reservoir proposed for CO_2 sequestration.

Primary access to the project site would be via existing access at the western intersection of Skyline Drive and Elk Hills Road. The access road connects to a network of existing dirt roads within the field, depending on the final locations of the injection wells and accessory facilities and infrastructure new internal access roads may be constructed. These new roads would most likely be compacted dirt roads as well. Please see *Figure 3: Aerial Photograph.*

Environmental Setting

The proposed project is located on approximately 5,332acres of privately-owned land located in the south-western extent of Kern County, California. Portions of the project site is located within the boundaries of Agricultural Preserve No. 3, however none of the parcels are currently subject to a Williamson Act Land Use Contract. The project is in the administrative boundary of the Elk Hills Oil Field and the United States Geological Survey (USGS) Elk Hills and West Elk Hills 7.5-minute topographical quadrangle. Development in the area surrounding the project site is predominantly oil and gas production and agricultural.

The project site is within the San Joaquin Valley Air Basin, under the regulatory authority of the San Joaquin Valley Air Pollution Control District. The Federal Emergency Management Agency (FEMA) delineates flood hazard areas on its Flood Insurance Rate Maps (FIRMs). According to the FIRMs for the project area, the project site is designated Flood Zone X; which indicates the site is outside of the 0.2% annual chance floodplain.

The project site is not designated by the California Department of Conservation (DOC) as Prime Farmland, Farmland of Statewide Importance, or Unique Farmland. The project site is designated *Urban Built-Up Land* and *Vacant or Disturbed Land*. Please see *Figure 4: Important Famland.* There is land designated as Non-Prime Farmland, which is subject to a Williamson Act land Use Contract, immediately adjacent to the west of the project site. Please see *Figure 5: Williamson Act Land*

The project site is not within a mineral recovery area, however seven parcels are within designated mineral and petroleum resource site designated by the Kern County General Plan. The project site is not located within the County's NR (Natural Resources) or PE (Petroleum Extraction) Zone Districts. *Table 1: Project Assessor Parcel Numbers, Existing Map Codes, Existing* Zoning, *and Acreage*, below identifies the individual parcels, their respective assessor parcel numbers (APN), acreages, and existing general plan and zoning designations. Please see *Figure 6: Existing General Plan Designations*, and *Figure 7: Existing Zoning Classifications*.

Table 1: Project Assessor Parcel Numbers, Existing Map Codes, Existing Zoning, and Acreage

APN	Existing Map Code Designation	Existing Zoning	Proposed Zoning	Section/Township / Range	Acres	Agricultural Preserve Inclusion
157-060-02	8.4	A	A	12/30 S/R 22 E	159.50*	Ag Preserve No. 3
158-040-07	8.3/2.1	A	A	7/ 30 S/R 23 E	642.85	Ag Preserve No. 3
158-040-06	8.4	A-1	A	8/30 S/R 23 E	641.20	
158-070-02	8.3	A-1	A	17/30 S/R 23 E	156.44	
158-070-03	8.4	A-1	A	17/ 30 S/R 23 E	154.38*	
158-070-01	8.4	A-1	A	18/ 30 S/R 23 E	319.06*	
158-080-06	8.4	A-1	A	22/ 30 S/R 23 E	160.89*	
158-090-03	8.3	A-1	A	25/ 30 S/R 23 E	340.82*	
158-090-02	8.4	A-1	A	26/ 30 S/R 23 E	637.78	
158-090-01	8.4	A-1	A	27/ 30 S/R 23 E	637.54	
158-090-19	8.4; 8.3/2.1	A	A	35/ 30 S/R 23 E	637.89	Ag. Preserve 3
158-090-04	8.4	A	A	36/ 30 S/R 23 E	683.74	Ag Preserve 3
159-280-07	8.4	A-1	A	31/ 30 S/R 24 E	160.15*	
Project Totals					5,332.34	

* = Represents a portion of total APN acreage.

General Plan Map Code:

8.3 = Extensive Agriculture (Min. 20 Acre Parcel Size)
8.4 = Mineral and Petroleum
2.1 = Seismic Hazard Overlay
2.4 = Steep Slope Overlay

Zone Designation:

A = Exclusive Agriculture
A-1 = Limited Agriculture

Surrounding Land Uses

Table 2, Existing Project Site and Surrounding Properties, Existing Land Use, General Plan Map Code Designations, and Zoning, identifies the existing land use, the existing general plan land use designation, and the existing zoning for each of the two parcels within the project site. Additionally, such conditions are described for adjacent lands to the north, east, south, and west of the project site.

Table 2: Existing Project Sites and Surrounding Properties, Existing Land Use, General Plan Map Code Designations, and Zoning

Location	Existing Land Use	Existing General Plan Map Code Designations	Existing Zoning
Project Site	**Oil and Gas Exploration and Production**	**8.3 (Extensive Agriculture; 8.3/ 2.1 (Extensive Agriculture Seismic Hazard Overlay) 8.4 (Mineral and Petroleum)**	**A (Exclusive Agriculture) A-1 (Limited Agriculture)**
North	Oil and Gas Exploration and Production; Oil and Gas Ancillary Services Undeveloped Private Lands; Elk Hills/Buttonwillow Airport Landing	8.3 (Extensive Agriculture); 8.3/2.1 (Extensive Agriculture and Seismic Hazard); 8.4 (Mineral and Petroleum); 1.1 (State or Federal Land)	A (Exclusive Agriculture); A-1 (Limited Agriculture); PL RS MH (Platted Lands, Residential Suburban Combining, Mobile home Combining); AH (Exclusive Agriculture, Airport Approach Height Combining)
South	Oil and Gas Exploration and Production	8.4 (Mineral and Petroleum)	A-1 (Limited Agriculture)
East	Oil and Gas Exploration and Production	8.3 (Extensive Agriculture); 8.4 (Mineral and Petroleum)	A (Exclusive Agriculture); A-1 (Limited Agriculture); A-1 H (Limited Agriculture, Airport Approach Height Combining)
West	Oil and Gas Exploration and Production	8.3 (Extensive Agriculture); 8.3/2.1 (Extensive Agriculture and Seismic Hazard); 8.4 (Mineral and Petroleum)	A (Exclusive Agriculture)

Existing land use in the vicinity of the project site generally includes oil and gas exploration and production and agricultural lands. The sensitive receptor closest to the project site is the rural residence approximately 1 mile to the south of the project site. Lost Hills Wonderful Park, a local park, is located approximately 14 miles southeast of the project site. The closest schools to the site are the McKittrick Elementary School and the Buttonwillow Elementary School, located approximately 4.5 miles southwest and north, respectively, of the project site. The Elk Hills Elementary is located approximately 6 miles east of the project site.

The proposed project would be served by the Kern County Sheriff's Department for law enforcement and public safety services, with the closest substation being the Taft Area Substation, located at 315 N. Lincoln Street. Fire protection and emergency medical services would be provided by the Kern County Fire Department, with the closest station being Fire Station #25, located at 100 Mirasol Avenue, and Kern County Emergency Medical Services for medical care and emergency services.

The nearest public airport to the project site is the Elk Hills - Buttonwillow Airport located adjacent to the northeast corner of the project. The portion of the project site is located within Zone C of the Elk Hills-Buttonwillow Airport Land Use Compatibility Plan (ALUCP).

Project Description

Project Overview

The proposed project is a Conditional Use Permit for a 5,332.34 acre carbon capture and sequestration field, associated Class VI geologic sequestration injection wells and related improvements for storage of Carbon Dioxide (CO_2). The project, Carbon TerraVault 1 (CTV 1), is a wholly owned subsidiary of California Resources Corporation, the applicant for the project. The project comprises the area shown in *Table 1: Project Assessor Parcel Numbers, Existing Map Codes, Existing* Zoning, *and Acreage, above.*

The proposed project site is located within the Elk Hills Oil Field which comprises an approximately 75- square mile (47,800 acre) complex, with surface and mineral rights privately held by CRC, in the San Joaquin Valley of unincorporated Kern County. The surrounding area is comprised of agricultural fields, both active and fallow, and other existing oilfields. They include the Midway – Sunset Oil Field, McKittrick Oilfield and Cymric Oil Field. Skyline Road is closed to public entry and is the southern boundary of the project. Skyline Road connects to Elk Hills Road, which connects the town of Taft, to the south, with Buttonwillow to the north. California Resource Corporation's gated and guarded entrance to the field is located at the western intersection of Skyline Drive and Elk Hills Road

The proposed project would take local industrial sources of CO_2 that are transported by a combination of truck, pipeline and/or rail to the dedicated Class VI injection wells for the project. The CO_2 would then be injected into identified geographically confined reservoirs for storage in perpetuity. This area has been identified as a location suitable for such storage and a potential to provide a contribution to the goals of California for carbon neutrality by 2045 by reducing industrial uses to no net contribution and potentially supporting direct removal of CO2 from the air. California executive order B-55-18 mandates that the state achieve carbon neutrality by 2045 and maintain net negative emissions thereafter. (https://livermorelabfoundation.org/2019/12/19/getting-to-neutral/). The project, as proposed, has the capacity for up to 48 million metric tons of estimated storage and capable of sequestrating in excess of 1.5 million metric tons of CO_2 per year.

Implementation of the project would require permits from the Federal Environmental Protection Agency (EPA) for up to six (6) Class VI injection wells in compliance with the UIC program Class VI geologic sequestration regulations. Location of the proposed Class VI injection wells will be within the proposed CUP boundary of 5,332.34 acres. All employee facilities needed to manage the project will be provided by the existing Elk Hills oil field facilities.

Implementation of the project as proposed includes the following requests:

- Zone Classification Change (ZCC No. 5, Map No. 118; ZCC No. 5, Map No. 119; ZCC No. 4, Map No. 120) from A-1 (limited Agriculture) Zone District to A (Exclusive Agriculture) Zone District on approximately 3,208 acres. See *Figure 8: Proposed Zoning Classification*

- Conditional Use Permit (CUP No. 13, Map No. 118; CUP No. 5, Map No. 119; CUP No. 3, Map No. 120) to allow for the construction and operation of a Carbon capture and sequestration field, within the A (Exclusive Agriculture) Zone District. Carbon Capture and Sequestration (CCS) has been determined to be a storage operation under the Kern County Zoning Ordinance, Section 19.08.085 and Section 19.06.020. Therefore, CCS in either existing formations or tanks is an allowed use with a Conditional Use Permit (CUP) in the following districts:

    - A District (Exclusive Agriculture)
    - M-2 District (Medium Industrial)
    - M-3 (Heavy Industrial)

Project Objectives

The project proponent had defined the following objectives for the project:

- Construct and operate a permanent underground storage facility for up to 48 million tons of Carbon Dioxide (CO_2) in an economically feasible manner.
- Contribute to California Resources Corporation (CRC) adopted goals of Full-Scope Net Zero emission for Scope 1, 2 and 3 emissions by 2045.
- Support California's Executive Order B-55-18 for Carbon neutrality by 2045 and net negative emissions thereafter.
- Site and design the project in an environmentally responsible manner consistent with current Kern County guidelines.
- To promote economic development and bring living-wage jobs to the region throughout the life of the proposed project.

Proposed Discretionary Actions/Required Approvals

The Kern County Planning and Natural Resources Department as the Lead Agency (per CEQA Guidelines Section 15052) for the proposed project has discretionary responsibility for the proposed project. To implement this project, the project proponent may need to obtain discretionary and ministerial permits/approvals including, but not limited to, the following:

Federal

- Environmental Protection Agency Underground Injection Control – Class VI Permit
- U.S. Fish and Wildlife Service (USFWS) Section 10 Incidental Take Permit and Habitat Conservation Plan (if required)
- United States Army Corps of Engineers Section 404 Permit (if required)

State

- California Department of Fish and Wildlife (CDFW)
    - Section 2081 Permit (State-listed endangered species) (if required)
- Central Valley Water Quality Control Board (RWQCB)
    - Waste Discharge Requirements
    - Regional Water Quality Certification (401 Permit) (if required)
    - National Pollution Discharge Elimination System (NPDES) Construction General Permit
    - General Construction Stormwater Permit (Preparation of a SWPPP) (if required)
- California Department of Transportation (Caltrans)
    - Right-of-Way Encroachment Permit (if required)
    - Permit for Transport of Oversized Loads (if required)

Local

- **Kern County**
    - Certification of Final Environmental Impact Report
    - Adoption of Mitigation Monitoring and Reporting Program
    - Adoption of 15091 Findings of Fact and 15093 Statement of Overriding Considerations
    - Approval of Zone Classification Change
    - Approval of Conditional Use Permits
    - Approval of Kern County Grading (if required)
    - Approval of Kern County Building Permits
    - Approval of Kern County Encroachment Permits (if required)
    - Approval of Fire Safety Plan
- **San Joaquin Valley Air Pollution Control District**
    - Approval of Fugitive Dust Control Plan
    - Authority to Construct (ATC)
    - Permit to Operate (PTO)

The preceding discretionary actions/approvals are potentially required and do not necessarily represent a comprehensive list of all possible discretionary permits/approvals required. Other additional permits or

approvals from responsible agencies may be required for the proposed project.

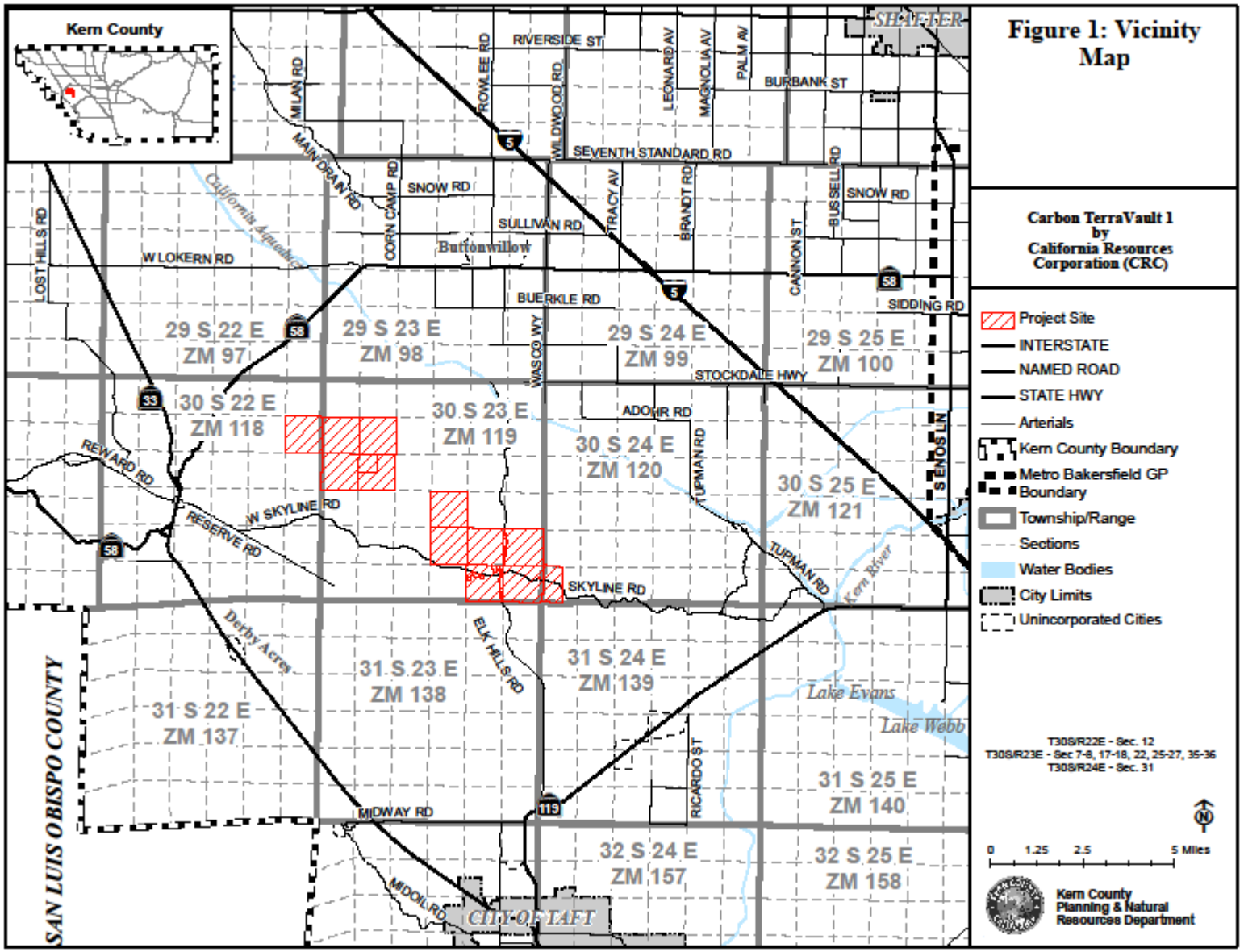


Figure 1: Regional Vicinity Map

Carbon TerraVault 1 Project

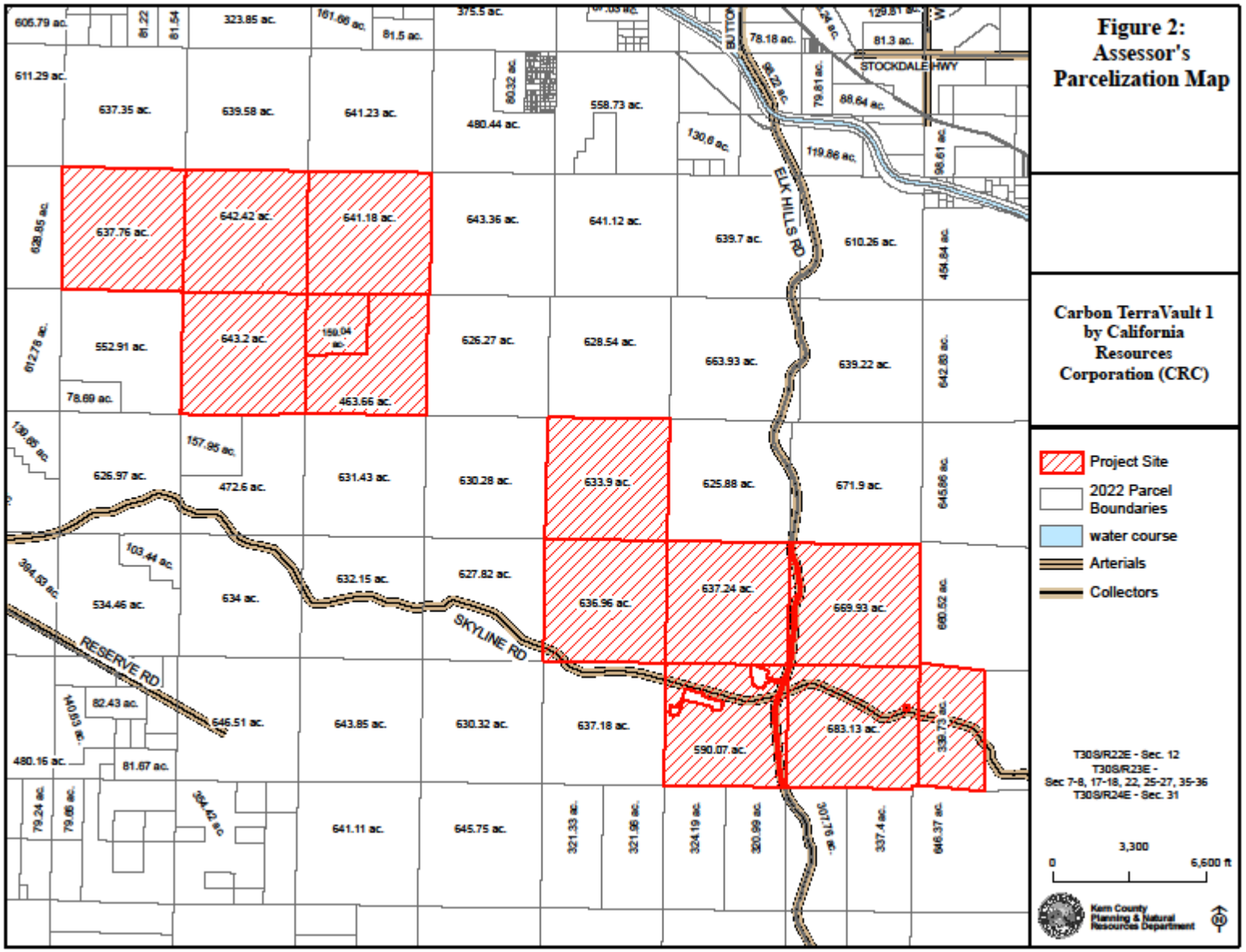
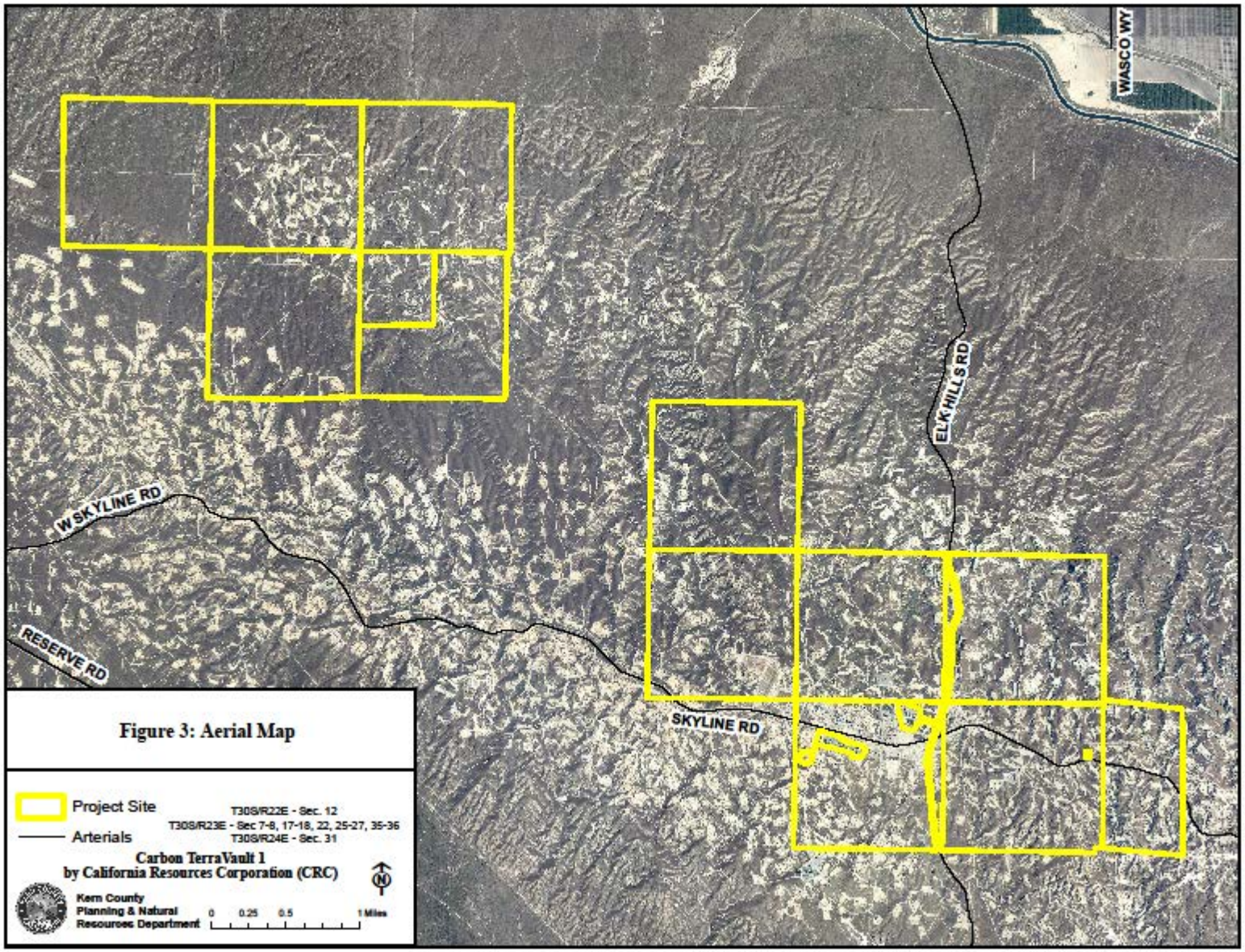


Figure 2: Existing Parcel Map


WASCO WY
ELK HILLS RD
W SKYLINE RD
RESERVE RD
SKYLINE RD
Figure 3: Aerial Map
Project Site
Arterials
T30S/R22E - Sec. 12
T30S/R23E - Sec 7-8, 17-18, 22, 25-27, 35-36
T30S/R24E - Sec. 31
Carbon TerraVault 1
by California Resources Corporation (CRC)
Kern County
Planning & Natural
Resources Department
0 0.25 0.5 1 Miles

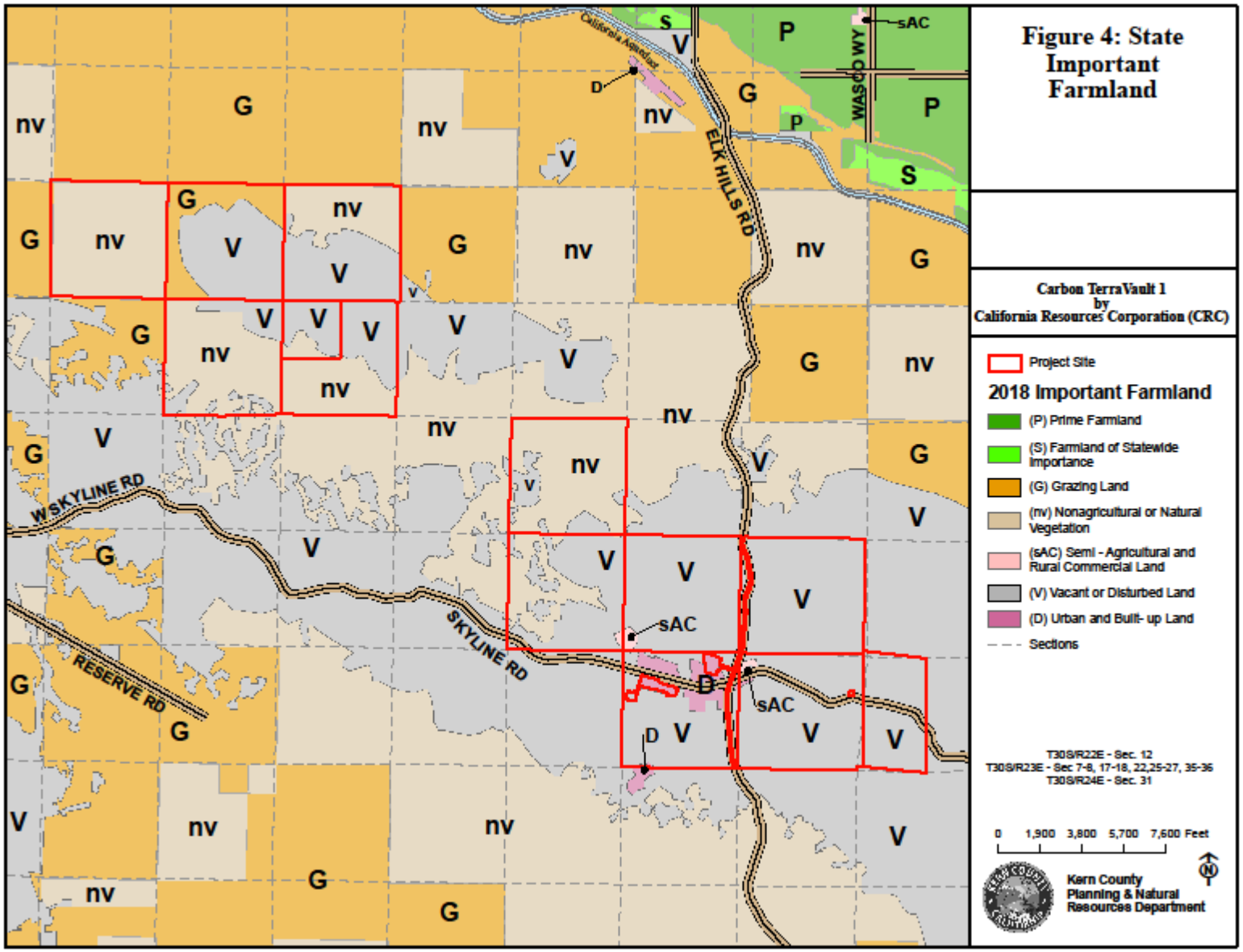


Figure 4: Important Farmland

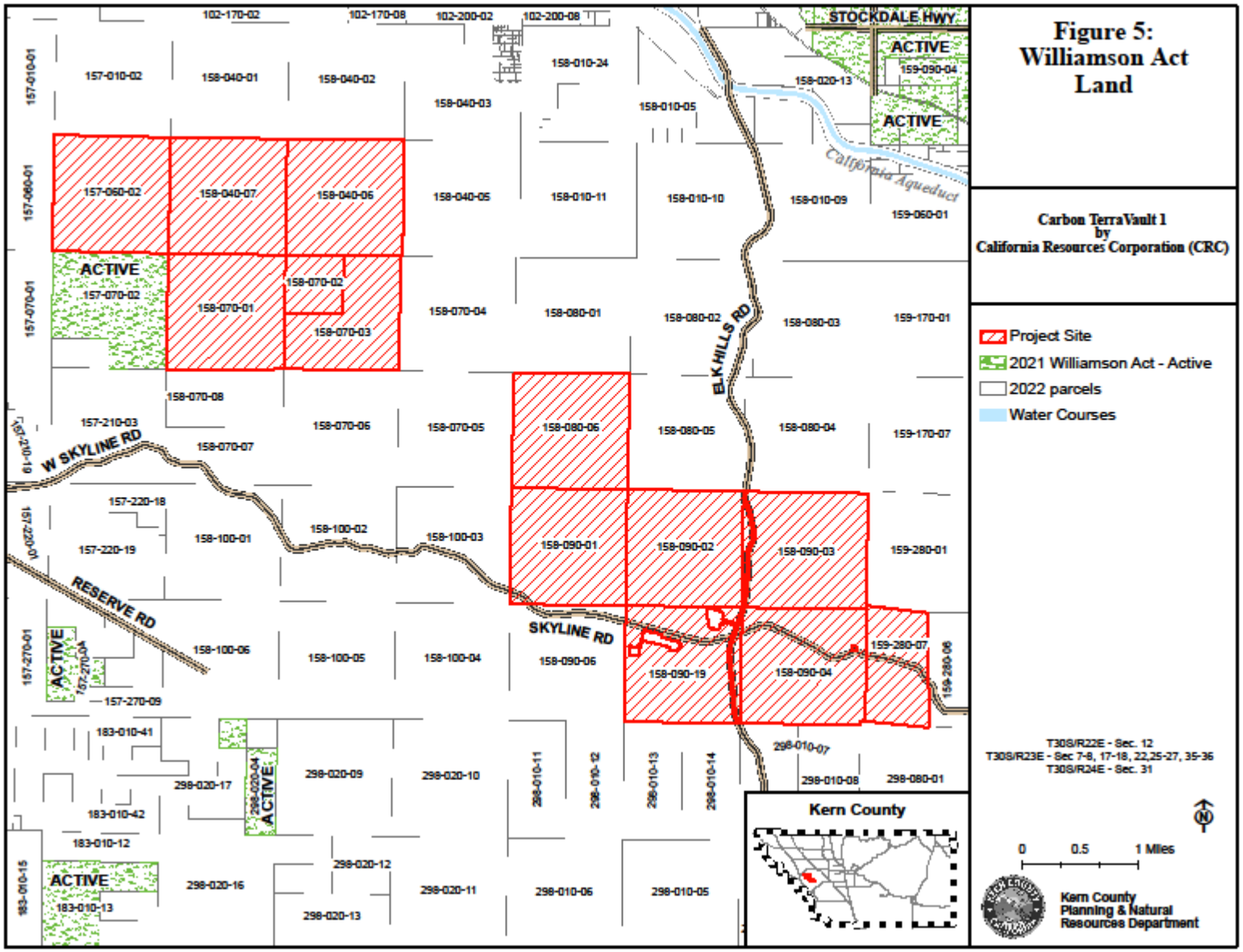


Figure 5: Williamson Act Land

Carbon TerraVault 1 Project

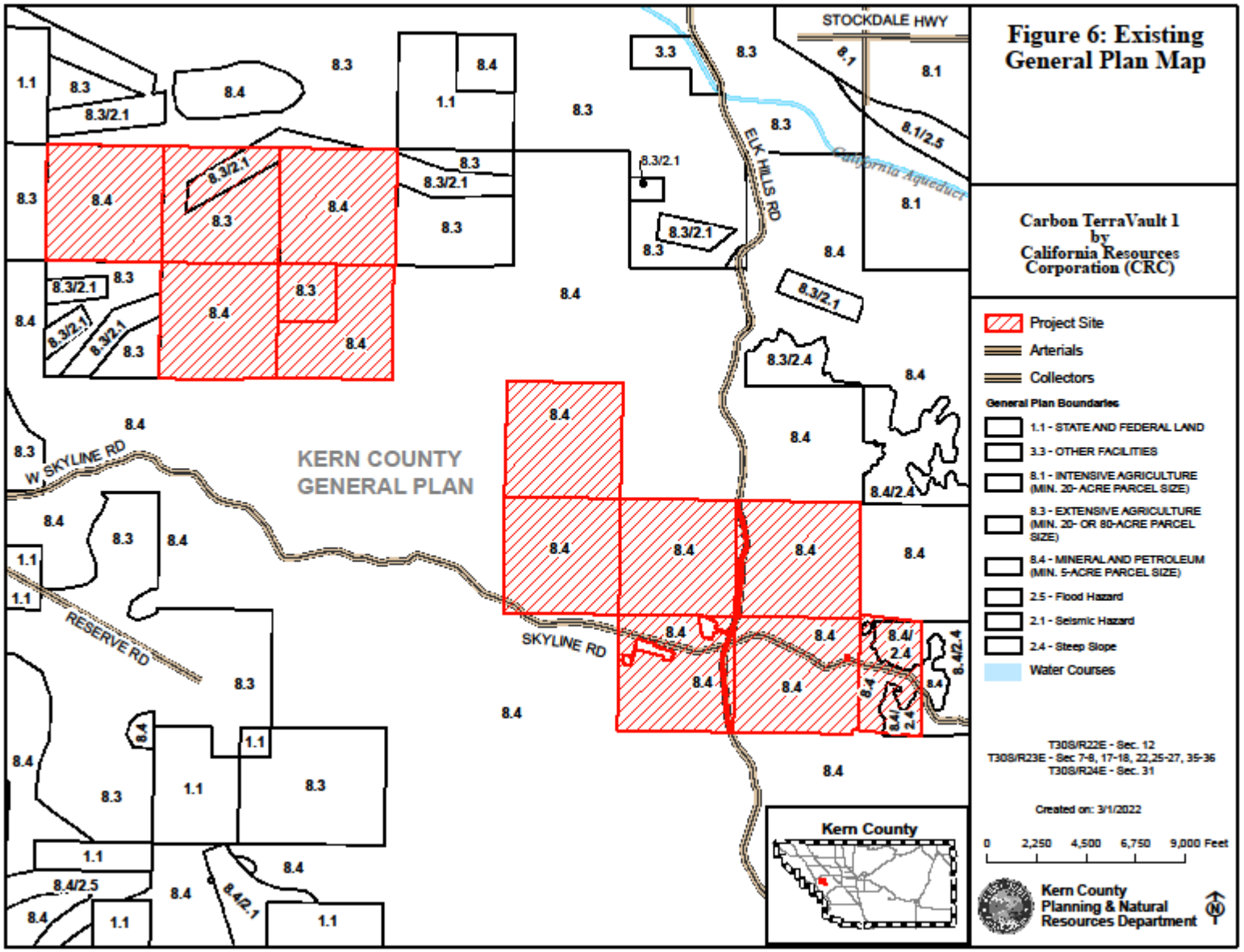


Figure 6: Existing General Plan Designation

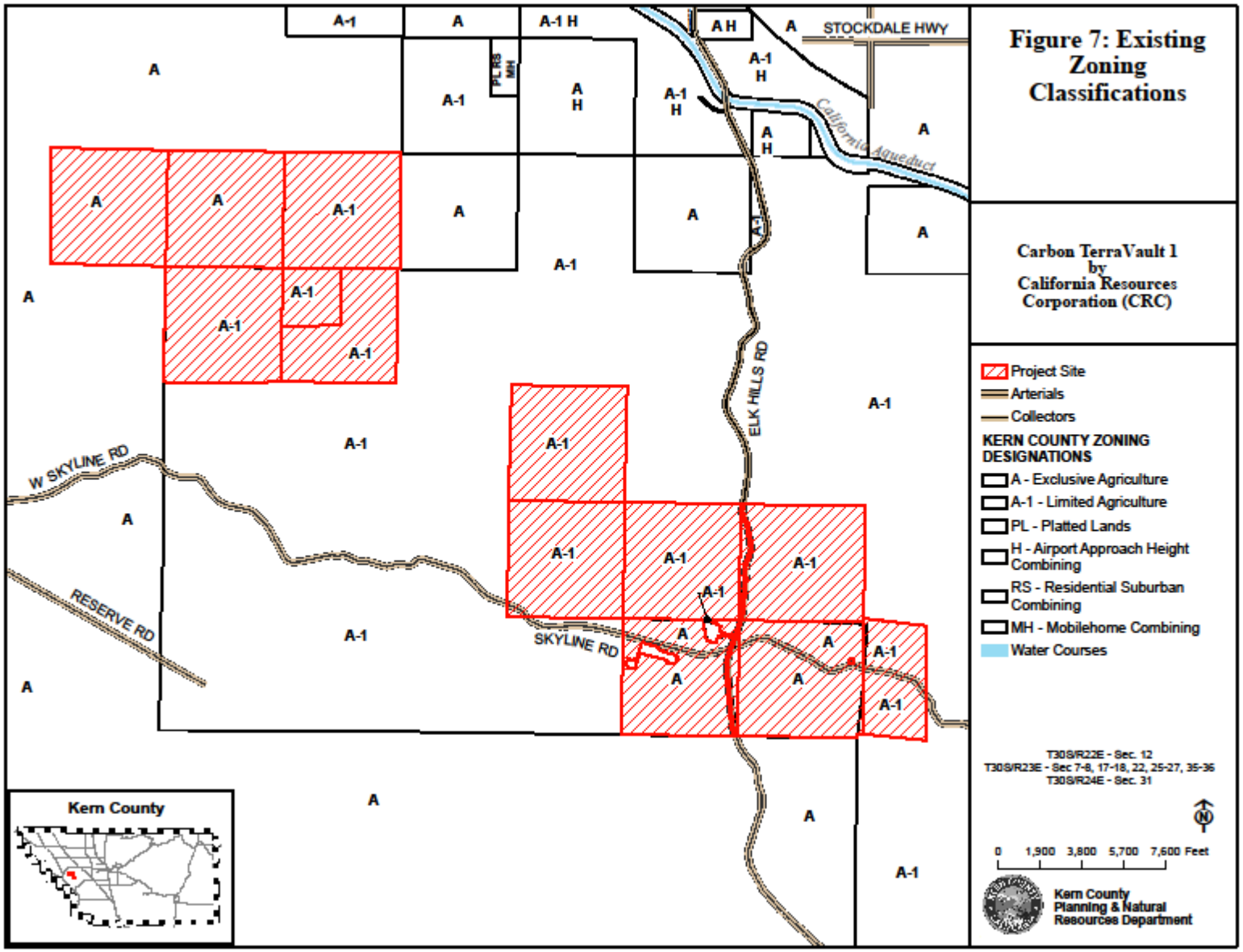


Figure 7: Existing Zoning Classifications

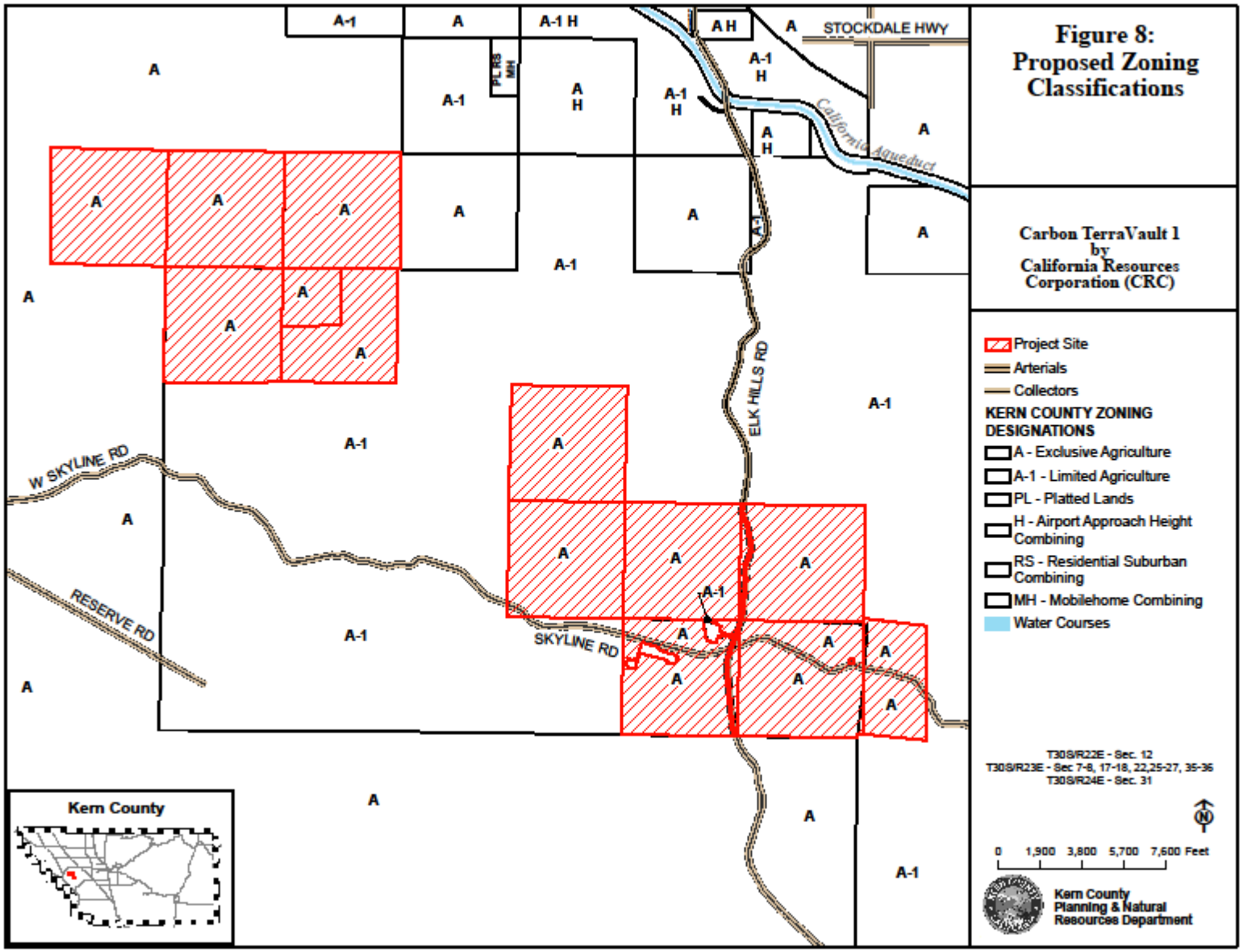


Figure 8: Proposed Zoning Classifications

KERN COUNTY
ENVIRONMENTAL CHECKLIST FORM

Environmental Factors Potentially Affected:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a Potentially Significant Impact" as indicated by the checklist on the following pages.

☒ Aesthetics	☒ Agriculture/Forestry	☒ Air Quality
☒ Biological Resources	☒ Cultural Resources	☒ Energy
☒ Geology / Soils	☒ Greenhouse Gas Emissions	☒ Hazards & Hazardous Materials
☒ Hydrology / Water Quality	☒ Land Use /Planning	☒ Mineral Resources
☒ Noise	☒ Population / Housing	☒ Public Services
☒ Recreation	☒ Transportation	☒ Tribal Cultural Resources
☒ Utilities / Service Systems	☒ Wildfire	☒ Mandatory Findings of Significance

DETERMINATION.

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (a) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (b) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENT IMPACT REPORT (EIR) is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature	March 4, 2022 Date
Cindi Hoover Printed Name	Supervising Planner Title

Evaluation of Environmental Impacts:

(1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a Lead Agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

(2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

(3) Once the Lead Agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an Environmental Impact Report (EIR) is required.

(4) Negative Declaration: "Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The Lead Agency must describe the mitigation measure and briefly explain how they reduce the effect to a less than significant level.

(5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or Negative Declaration, Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:

(a) Earlier Analysis Used. Identify and state where they are available for review.

(b) Impacts Adequately Addressed. Identify which effects from the above checklist where within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

(c) Mitigation Measures. For effects that are "Less Than Significant With Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

(6) Lead Agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

(7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

(8) The adopted guidelines state " This is only a suggested form, and lead agencies are free to use different formats; however, Lead Agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected. "Kern County has adopted this format and included all questions from Appendix G.

(9) The explanation of each issue should identify:

(a) The significance criteria or threshold, if any, used to evaluate each question; and

(b) The mitigation measure identified, if any, to reduce the impact to less than significance.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
I. AESTHETICS.				
Would the project:				
a) Have a substantial adverse effect on a scenic vista?	☒	☐	☐	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☒	☐
c) In nonurbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☒	☐	☐	☐
d) Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area?	☒	☐	☐	☐

RESPONSES:

a)–d) The proposed project is located within the Elk Hills Oil Field which is heavily developed with oil wells and associated infrastructure. The aesthetic features of the existing visual environment in the area are varied with agricultural and oil production/extraction equipment dominating the landscape. As such, there are no unique aesthetic features, identified scenic vistas, or designated scenic highways in the project vicinity. According to the California Department of Transportation's (Caltrans') California Scenic Highway Mapping System, the closest section of highway that would be eligible for State Scenic Highway designation are portions of State Routes 14 and 58 which are located many miles to the east of the project site within the desert region of the county. Portions of the project site may be visible from public roads or other publically accessible vantage points, however as stated previously the project site is currently dominated by oil and gas production facilities and associated infrastructure. The proposed project would introduce four to six CO_2 injection wells into the viewshed, however these would not be easily distinguishable in the viewshed from public roads or public vantage points. The proposed project would likely introduce new lighting features during construction and operations, similar to those currently existing within the project site, however the project would be required to conform to the Kern County Dark Skies Ordinance which would require the minimum lighting possible for safety, as well as shielding of light fixtures and a downward orientation to eliminate light spillover. Because oil and gas production activities and associated infrastructure, which are visually similar to the proposed project, currently dominate the existing

viewshed and no scenic vistas have been identified in the project area, impacts on aesthetic resources are anticipated to be less than significant. However, because the project will introduce a new source of light or glare, and because the project site is located in a non-urban area and may be visible from publicly accessible vantage points, potential impacts to aesthetic resources will be analyzed in the Environmental Impact Report.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
II. AGRICULTURE AND FOREST RESOURCES. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to nonagricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or Williamson Act contract?	☒	☐	☐	☐
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined in Public Resources Code section 4526) or timberland zoned Timberland Production (as defined by Government Code Section 51104 (g),	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to nonagricultural use or conversion of forest land to non-forest use?	☒	☐	☐	☐
f) Result in the cancellation of an open space contract made pursuant to the California Land Conservation Act of 1965 or Farmland Security Zone Contract for any parcel of 100 or more acres (Section 15206(b)(3) Public Resources Code?	☒	☐	☐	☐

RESPONSES:

a)-f) The proposed project currently has a zone classification of A (exclusive Agriculture) and A-1 (Limited Agriculture), however is not designated Prime or Unique Farmland or Farmland of Statewide Importance pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, nor is any portion of the project site subject to the California Land Conservation Act of 1965 (Williamson Act Land Use Contract) or Farmland Security Zone Contract. The project site is not designated Timberland or forest land and as no Timberland or Forestland is in the project vicinity would not conflict with existing zoning for, or cause rezoning of land designated as Timberland or forest land to non-forest use. However, land adjacent to the project site is subject to a Williamson Act Land Use Contract and is designated non-prime

farmland pursuant to the Farmland Mapping and Monitoring Program. Portions of the project site are located with Agricultural Preserve number 3. Due to the project site's zone classification of A (Exclusive Agriculture) and adjacent land that is subject to a Williamson Act Land Use Contract, impacts to agricultural resources will be analyzed in the Environmental Impact report.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
III. AIR QUALITY.				
The significance criteria established by the applicable Air pollution control district shall be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard? Specifically, would implementation of the project (in a specific location) exceed any of the following adopted thresholds:				
i. San Joaquin Valley Unified Air Pollution Control District:				
<u>Operational and Area Sources</u>				
Reactive Organic Gases (ROG) 10 tons per year.	☒	☐	☐	☐
Oxides of Nitrogen (NO_x) 10 tons per year.	☒	☐	☐	☐
Particulate Matter (PM_{10}) 15 tons per year.	☒	☐	☐	☐
<u>Stationary Sources as determined by District Rules</u>				
Severe Nonattainment 25 tons per year.	☒	☐	☐	☐
Extreme Nonattainment 10 tons per year.	☒	☐	☐	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
III. AIR QUALITY. (Continued)				
ii. Eastern Kern Air Pollution Control District.				
Operational and Area Sources				
Reactive Organic Gases (ROG) 25 tons per year.	☐	☐	☐	☒
Oxides of nitrogen (NO_x) 25 tons per year.	☐	☐	☐	☒
Particulate Matter (PM_{10}) 15 tons per year.	☐	☐	☐	☒
Stationary Sources - determined by District Rules				
25 tons per year.	☐	☐	☐	☒
c) Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.	☒	☐	☐	☐

RESPONSES:

a) The project would be located within the jurisdiction of the San Joaquin Valley Air Pollution Control District (SJVAPCD), in the San Joaquin Valley Air Basin (SJVAB). The SJVAB is classified by the State as a severe nonattainment area with respect to the 1-hour ozone standard as well as a nonattainment area for the State standards pertaining to particulate matter less than 10 microns (PM_{10}) and particulate matter less than 2 ½ microns ($PM_{2.5}$). In addition, the SJVAB is classified as an extreme nonattainment area for the Federal 8-hour ozone standard, a nonattainment area for the Federal $PM_{2.5}$ standard, and an attainment/maintenance area for the Federal carbon monoxide (CO) and PM_{10} standards.

Project construction activities would generate ozone precursor (i.e., oxides of nitrogen [NOX] and reactive organic compounds [ROC]) emissions as well as CO, $PM_{2.5}$, and PM_{10} emissions that could result in significant impacts on regional air quality. Emissions sources would include heavy equipment used for excavation and grading, cranes, drilling rigs and on-road motor vehicles for equipment and material deliveries as well as construction workers' vehicles. Long-term maintenance and operational activities are other emissions sources. Grading and activities on unpaved roads would contribute to fugitive PM_{10} and $PM_{2.5}$ emissions. This impact is potentially significant. Further analysis of air quality impacts is warranted to determine whether the project

would conflict with or obstruct implementation of the applicable plans for attainment and, if so, the reasonable and feasible mitigation measures that could be adopted to reduce such impacts. These issues will be evaluated in the EIR.

b) The project is located within the jurisdictional boundaries of SJVAPCD. The SJVAB is classified by the State as a severe nonattainment area with respect to the 1-hour ozone standard as well as a nonattainment area for the State standards pertaining to PM10 and PM2.5. In addition, the SJVAB is classified as an extreme nonattainment area for the Federal 8-hour ozone standard, a nonattainment area for the Federal PM2.5 standard, and an attainment/maintenance area for the Federal CO and PM10 standards.

SJVAPCD rules and regulations would apply to all project activities within the SJVAPCD. Construction and operational emissions will be analyzed in the EIR as well as long-term operational emissions. Some construction personnel may commute from outside the SJVAB. Cumulative contributions of emissions to the SJVAB are considered potentially significant and will be evaluated further in the EIR.

c)-d) The project site is located within the administrative boundary of the Elk Hills Oil Field. There are no schools or hospitals located with the vicinity of the project site, however, the project site is located approximately 8.5 miles north of the City of Taft and approximately 4 miles west of the unincorporated community of Buttonwillow, additionally there may be sparse, rural residences located within the project vicinity. The closest disadvantaged community to the project site is the unincorporated community of Buttonwillow (population 1,445). California Environmental Protection Agency's "CalEnviroScreen 4.0" ranks Buttonwillow and the City of Taft as communities in the state, heavily impacted from pollution and other health and socio-economic indicators.

Therefore, impacts on sensitive receptors are potentially significant and further analysis is warranted to determine whether the project would expose sensitive receptors to substantial pollutant concentrations or a substantial number of people to other emissions, and, if so, the reasonable and feasible mitigation measures that could be adopted to reduce such impacts. These issues will be evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
IV. BIOLOGICAL RESOURCES. Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
c) Have a substantial adverse effect on federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☒	☐	☐	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☒	☐	☐	☐

RESPONSES:

a)–f) The proposed Project site is located in the south-western portion of the San Joaquin Valley which hosts a variety of sensitive resources including several listed as threatened or endangered at the

state or federal level. Several conservation programs or mitigation requirements have been approved or proposed to comply with State and federal Endangered Species laws including the issuance of incidental take coverage through habitat conservation plans, federal Section 7 Consultations, Biological Opinions and mitigation measures that are a part of CEQA and NEPA environmental documents.

The proposed project would allow the construction of four to six Class VI injection wells, ancillary infrastructure and facilities, and the injection and storage of up to 48 million metric tons of CO_2 on approximately 5,332 acres.

Impacts could result from activities related to construction of injection and/or monitoring wells or from continued activities related to injection of CO_2 and maintenance of the injection wells and ancillary facilities. These impacts are considered potentially significant and will be discussed in the EIR. The EIR will assess impacts on known resources including protected wetlands, riparian areas and streams; impacts on resources that may occur in the future (e.g., foraging or nesting raptors); and impacts on landscape-level resources, such as wildlife corridors that could provide interconnectivity between existing higher value habitats. The EIR will also evaluate potential conflicts with regulatory policies or procedures for protection of biological resources.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact

V. CULTURAL RESOURCES.

Would the project:

a) Cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5?	☒	☐	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines § 15064.5?	☒	☐	☐	☐
c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☒	☐	☐	☐

RESPONSES:

a)–c) The potential for impacts on historical and prehistoric resources is considered potentially significant. Therefore, the EIR will more thoroughly address this issue. The EIR will set forth research criteria and report content needed to enable an evaluation of resource occurrence and possible significant impacts on sensitive historic and prehistoric cultural resources.

VI. ENERGY. Would the project:

a)	Result in potentially significant environmental impact due to wasteful, inefficient or unnecessary consumption of energy resources, during project construction or operation?	☒	☐	☐	☐
b)	Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☒	☐	☐	☐

RESPONSES:

a)-b) Construction of the proposed project would involve on-site energy demand and consumption related to use of oil in the form of gasoline and diesel fuel for construction worker vehicle trips, hauling and materials delivery truck trips, and operation of off-road construction equipment. In addition, diesel-fueled portable generators may be necessary to provide additional electricity demands for temporary on-site lighting, welding, and for supplying energy to areas of the sites where energy supply cannot be met via a hookup to the existing electricity grid. Ongoing injection activities would result in energy consumption for the duration of the project. Additionally, perpetual storage of CO_2 within confined reservoirs would most likely be passive and would not require the use of energy, however ongoing monitoring activities could result in energy consumption. Impacts related to the consumption of energy resources and the potential for the project to obstruct a state or local plan for renewable energy or energy efficiency will be analyzed in the Environmental Impact Report.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
VII . GEOLOGY AND SOILS. Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☒	☐
ii. Strong seismic ground shaking?	☒	☐	☐	☐
iii. Seismic-related ground failure, including liquefaction?	☒	☐	☐	☐
iv. Landslides?	☐	☐	☒	☐
b) Result in substantial soil erosion or the loss of topsoil?	☒	☐	☐	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, sub-sidence, liquefaction, or collapse?	☒	☐	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (19914), creating substantial risks to life or property?	☒	☐	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☒	☐
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.	☒	☐	☐	☐

RESPONSES:

a)–f) Due to the location of active faults in the general region, strong seismic ground shaking could occur at the project site, resulting in damage to above and below ground structures and other site improvements if not properly designed to withstand strong ground shaking. Adherence to applicable regulations would minimize the potential impacts associated with the proposed project.

A geotechnical investigation of the project site may be conducted to determine the physical characteristics of the underlying soils and geologic formations and to identify if any unstable conditions exist that could be exacerbated by proposed construction activities. The results of these investigations will be provided in the EIR.

The above listed project impacts will be further evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
VIII GREENHOUSE GAS EMISSIONS. Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b) Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☒	☐	☐	☐

RESPONSES:

a)–b) Greenhouse gas (GHG) emissions emitted by human activity are implicated in global climate change or global warming. The principal GHGs are CO_2, methane (CH_4), NO_X, ozone, water vapor, and fluorinated gases. The temporary construction activities associated with the proposed project, which would involve operation of heavy off-road equipment, on-road trucks (for deliveries and hauling), and construction worker commute trips, would generate GHGs through exhaust emissions. However, the proposed project is expected to capture traditional sources of CO_2 emissions that have historically been emitted into the environment. As such, the provision of carbon capture and sequestration in perpetuity by the proposed project would reduce GHG emissions and is anticipated to offset GHGs that would otherwise be emitted by traditional sources. The project's GHG emissions generated during construction of the project and the potential GHG offsets resulting from operation of the project, as well as any potential conflicts with any applicable plan, policy or regulation will be identified and quantified in the EIR. Additionally, the project's potential GHG impacts and the potential GHG offsets resulting from operation of the project will be examined in the EIR, with respect to the objectives of statewide programs to reduce GHGs associated with energy generation.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
IX. HAZARDS AND HAZARDOUS MATERIALS. Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☒	☐	☐	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☒	☐	☐	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 1/4 mile of an existing or proposed school?	☒	☐	☐	☐
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code § 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☒	☐	☐	☐
e) For a project located within the adopted Kern County Airport Land Use Compatibility Plan, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☒	☐	☐	☐
f) Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan?	☒	☐	☐	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☒	☐	☐	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
IX HAZARDS AND HAZARDOUS MATERIALS. (Continued)				
h) Would implementation of the project generate vectors (flies, mosquitoes, rodents, etc.) or have a component that includes agricultural waste? Specifically, would the project exceed the following qualitative threshold: The presence of domestic flies, mosquitoes, cockroaches, rodents, and/or any other vectors associated with the project is significant when the applicable enforcement agency determines that any of the vectors:				
i. Occur as immature stages and adults in numbers considerably in excess of those found in the surrounding environment; and	☐	☐	☒	☐
ii. Are associated with design, layout, and management of project operations; and	☐	☐	☒	☐
iii. Disseminate widely from the property; and	☐	☐	☒	☐
iv. Cause detrimental effects on the public health or well-being of the majority of the surrounding population.	☐	☐	☒	☐

RESPONSES:

a)-e) The proposed CO_2 capture and storage activities could create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials; create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. A small portion of the proposed project site is located within Zone C, as identified in the Elk Hills – Buttonwillow Airport Land Use Compatibility Plan (ALUCP). These impacts are considered potentially significant and will be further analyzed in the Environmental Impact Report.

The project is not anticipated to emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school, however the nearest schools are Buttonwillow Elementary and McKittrick Elementary, which are approximately 4.5 miles from the project site and Elk Hills Elementary, which is approximately 6.5 miles from the project site. Because the project proposes the transport of CO_2

by pipeline, truck, and/or rail, CO_2 could pass within one quarter mile of a school(s) during transport. Therefore, impacts are potentially significant and will be further analyzed in the Environmental Impact Report.

f) The project would generate construction trips, worker construction and maintenance trips, and CO_2 transport trips. The potential for roadway lane closures also exists, which could temporarily affect an emergency response or evacuation plan. This impact is considered potentially significant and will be addressed in the EIR.

g) According to the California Department of Forestry and Fire Protection (CalFire), Kern County Fire Hazards Severity Zone Maps for the Local Responsible Areas, the project site is classified as State Responsibility Area (SRA) Moderate (Calfire 2021). Moderate zones are typically wildland supporting areas of low fire frequency and relatively modest fire behavior. The proposed project would comply with all applicable wildland fire management plans and policies established by CalFire, and Kern County Fire Department. Accordingly, the project is not expected to expose people or structures to a significant risk of loss, injury, or death involving wildland fires. Nonetheless, potential impacts involving wildfires will be discussed in the EIR--please refer to the responses to the Checklist topic concerning Wildfire, later in this Initial Study.

h)i.-iv. Project construction and injection/storage activities are not expected to result in the generation of vectors (flies, mosquitoes, rodents, etc.) or have a component that includes agricultural waste. However, this issue will be addressed in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
X HYDROLOGY AND WATER QUALITY. Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☒	☐	☐	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☒	☐	☐	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or through the addition of impervious surfaces, in a manner which would:	☒	☐	☐	☐
i) result in a substantial erosion or siltation on – or off-site	☒	☐	☐	☐
ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on-or offsite;	☒	☐	☐	☐
iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☒	☐	☐	☐
iv) impede or redirect flood flows ?	☒	☐	☐	☐
d) In flood hazard, tsunami, seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☒	☐	☐	☐

RESPONSES:

a) The construction of injection wells and ancillary facilities could potentially fail to comply with water quality standards or waste discharge requirements. The potential to create substantial erosion and siltation or violate any water quality standards or waste discharge requirements is considered significant and will be discussed in the EIR.

b) The construction of injection wells and ancillary facilities could potentially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. This impact is considered potentially significant and will be addressed in the EIR.

c) The construction of injection wells and ancillary facilities could potentially result in alteration of drainage patterns and lead to substantial erosion and siltation. The potential to create substantial erosion and siltation is considered significant and will be discussed in the EIR.

The construction of injection wells and ancillary facilities and production facilities could potentially result in alteration of drainage patterns and lead to flooding. The potential to create flooding is considered significant and will be discussed in the EIR.

There are no stormwater drainage systems in the agricultural areas under consideration. It is not considered likely that future oil and gas exploration and production activities would create or contribute sufficient runoff water such that the capacity of existing stormwater drainage systems would be exceeded. Nonetheless, this impact is considered potentially significant and will be addressed in the EIR.

d) None of the injection well construction or storage activities occurs or would occur in locations where tsunamis, mudflows or seiche-related inundation would occur. This impact is considered no impact; however it will be discussed further in the EIR.

e) The proposed project is located with the San Joaquin Valley Groundwater Basin, in the Kern County sub-basin. The construction of injection wells and ancillary facilities could potentially deplete groundwater supplies or interfere substantially with groundwater recharge such that it would conflict with or obstruct implementation of a water quality control plan, the State Groundwater Management Act, or a Groundwater Sustainability Plan (GSP) as adopted by the West Kern Water District Groundwater Sustainability Agency (GSA). This impact is considered potentially significant and will be analyzed in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XI. LAND USE AND PLANNING. Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐

RESPONSES:

a) Construction of injection wells and CO_2 capture and storage activities are not expected to result in the division of established communities. There would be no impact.

b) The impacts of the proposed project and potential conflicts with County ordinances and policies, or regulation adopted for the purpose of avoiding or mitigating an environmental effect are not expected to be significant; however they will be addressed in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XII. MINERAL RESOURCES. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☒	☐	☐	☐
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☒	☐	☐	☐

RESPONSES:

a)–b) The proposed project is located within the administrative boundary of the Elk Hills Oilfield, however the project site is not a designated mineral resource zone. The project could potentially result in the loss of availability of a known mineral resource of value to the region and the residents of the state. Impacts to mineral resources will be addressed further in the Environmental Impact Report.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XIII. NOISE. Would the project result in:				
a) Generation of a substantial temporary or permanent increase in the ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies?	☒	☐	☐	☐
b) Generation of, excessive ground borne vibration or ground borne noise levels?	☒	☐	☐	☐
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☒	☐	☐	☐
d) For a project located within the Kern County Airport Land Use Compatibility Plan, would the project expose people residing or working in the project area to excessive noise levels?	☒	☐	☐	☐

RESPONSES:

a)–c) Construction activities, including injection well pad preparation, drilling, completion and testing of new injection wells, construction of necessary infrastructure, and general maintenance activities could result in temporary or periodic increases in noise and groundborne vibration. The Kern County General Plan Noise Element sets a 65-decibel limit on exterior noise levels from stationary sources (i.e., non- transportation sources) at sensitive receptors. The Noise Control Ordinance in the Kern County Code (Section 8.36.020 et seq.) prohibits a variety of nuisance noises. Construction-related noise is regulated by means of a limitation on the hours of construction activity for projects located within 1,000 feet of an occupied residential dwelling. In such cases, construction is prohibited between the hours of 9 p.m. and 6 a.m. on weekdays and 9 p.m. and 8 a.m. on weekends. The project proponent would adhere to the provisions of Kern County Ordinance Section 8.36.020. Nonetheless, the project could expose persons to or generate noise levels in excess of established standards. This impact is considered potentially significant and will be discussed further in the EIR.

d) A small portion of the project site is located within Zone C of the Elk Hills- Buttonwillow Airport Land Use Compatibility Plan. Depending on the final location of injection wells the project could potentially expose people residing or working in the project area to excessive noise levels. This impact is considered potentially significant and will be further addressed in the Environmental Impact Report

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XIV. POPULATION AND HOUSING. Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☒	☐	☐	☐
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

RESPONSES:

a)-b) Construction of the proposed project and ongoing storage, maintenance and monitoring activities could provide new employment opportunities consistent with adopted Kern County General Plan goals, plans, and policies. If temporary housing should be necessary, it is expected that accommodations would be available in the nearby communities. While the proposed project is not expected to induce substantial population growth in Kern County, displace a substantial number of existing homes or people, or necessitate the construction of replacement housing elsewhere, these issues will be evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XV. PUBLIC SERVICES. Would the project **:**				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or to other performance objectives for any of the public services:				
Fire Protection?	☒	☐	☐	☐
Police Protection?	☒	☐	☐	☐
Schools?	☒	☐	☐	☐
Parks?	☒	☐	☐	☐
Other Public Facilities?	☒	☐	☐	☐

RESPONSES:

a)i. - v. The demand for fire protection, police protection, schools, parks and other public facilities could be affected by the proposed project. Impacts on public services are considered potentially significant and will be addressed in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XVI. RECREATION.				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☒	☐	☐	☐
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

RESPONSES:

a)–b) The project would not include the construction or expansion of new recreational facilities. However, an increase in population that might result from an influx of workers and the associated increase in the use of parks or recreational facilities could require the expansion of recreational facilities. This impact is considered potentially significant and will be evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XVII. TRANSPORTATION AND TRAFFIC Would the project:				
a) Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☒	☐	☐	☐
b) Conflict or be inconsistent with CEQA Guidelines § 15064.3 (b)	☒	☐	☐	☐
c) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous inter-sections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
d) Result in inadequate emergency access?	☒	☐	☐	☐

RESPONSES:

a) There are no dedicated pedestrian or bicycle facilities in the immediate vicinity of the project site or along the surrounding roadways. Due to the rural nature of the project area, pedestrian and bicycle traffic is limited. The project is not located along an existing bus route and few bus stops exist on roadways that are likely to be used during construction and operation of the proposed project.

Further analysis in the EIR is required to determine whether construction traffic could disrupt normal traffic flows or otherwise conflict with the County's roadway performance policies and programs.

b) CEQA Guidelines section 15064.3, subdivision (b) was adopted in December 2018 by the California Natural Resources Agency. These revisions to the CEQA Guidelines criteria for determining the significance of transportation impacts are primarily focused on projects within transit priority areas and shift the focus from driver delay to reduction of vehicular greenhouse gas emissions through creation of multimodal networks, and creation of a mix of land uses that can facilitate fewer and shorter vehicle trips. Vehicle miles traveled (VMT) is a measure of the total number of miles driven for various purposes and is sometimes expressed as an average per trip or per person. Construction traffic would be temporary and would not permanently affect VMT characteristics in this part of Kern County or elsewhere. Long-term, operational traffic related to the CO_2 storage, maintenance, and monitoring activities would be limited. It is not known where the employees would live or how long their commuting trips would be but is assumed that they would commute from nearby communities. According to technical guidance issued by the Office of Planning and Research, projects generating less than 110 or fewer daily vehicle trips may be presumed to have a less than significant impact involving VMT. Further analysis of the operational VMT characteristics of the project is required to determine whether the project is considered a "low-VMT" project due to small daily traffic volumes alone, or whether more extensive analysis is warranted. An assessment of the project's VMT characteristics will be provided in the EIR, to ensure consistency with state and local guidance.

c) No new roadway design or features (i.e., sharp curves, dangerous intersections, or other hazardous features) that could result in transportation-related hazards or safety concerns are anticipated. The project injection wells and other infrastructure and facilities would be set back from roadways as required by the Kern County Zoning Ordinance. The types and numbers of vehicles utilized during injection well construction and for storage, maintenance, and monitoring activities would be similar to existing activities in the vicinity and therefore would not likely be incompatible. Given these considerations, significant impacts related to increased hazards are not anticipated to occur; however, additional analysis will be included in the EIR.

d) The project would generate construction trips and the potential for roadway lane closures exists during construction of ancillary infrastructure and during transport of CO_2 to the site, which could temporarily increase the daily traffic volumes on local roadways and at intersections. It is anticipated that emergency access would be maintained at all times, and appropriate detours would be provided, as necessary. Nonetheless, impacts related to emergency access are considered potentially significant and will be addressed in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XVIII. TRIBAL CULTURAL RESOURCES. Would the project:				
a) Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code § 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources defined in Public Resources Code section 5020.1 (k) or	☒	☐	☐	☐
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code section 5024.1, the lead agency shall consider the significance of the resource to a California Native America tribe.	☒	☐	☐	☐

RESPONSES:

a)i.-ii. The proposed project site is currently highly disturbed with oil and gas production and ancillary infrastructure, however because the injection well sites may not be on previously disturbed land there is a potential for tribal cultural resources to exist on-site and on surrounding lands. Therefore, the proposed project has the potential to impact tribal cultural resources during injection well pad constructions and drilling as well as during the construction of ancillary infrastructure. All tribes with possible cultural affiliation and interest within the project area will be notified pursuant to the requirements of Assembly Bill 52, and consultation with the potentially affected tribes will occur, as appropriate, between the County and the tribes. Further evaluation in the EIR is warranted to identify potential impacts to tribal cultural resources and to formulate avoidance or mitigation measures, if applicable.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XIX. UTILITIES AND SERVICE SYSTEMS. Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☒	☐	☐	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☒	☐	☐	☐
c) Result in a determination by the waste water treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐
d) Generate solid waste in excess of state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☒	☐	☐	☐
e) Comply with federal, State, and local management and reduction statutes and regulations related to solid waste	☒	☐	☐	☐

RESPONSES:

a) The proposed project would not require or result in the relocation or construction of new or expanded municipal wastewater facilities, and no connection to a public wastewater system is required or proposed. Impacts would be less than significant in this regard; however, further analysis in the EIR will be provided. The proposed project does not require expanded or new storm drainage facilities because the proposed project is not anticipated to generate a significant increase in the amount of impervious surfaces that would increase runoff during storm events. The proposed project is not anticipated to result in a significant increase in water demand/use; however, water will be needed for dust suppression and injection well drilling. Impacts associated with construction of the electrical lines and telecommunication lines will be evaluated in the EIR.

Impacts would be potentially significant and further analysis in the EIR is warranted.

b) Water consumption during construction would primarily be used for dust-suppression purposes. Water is anticipated to be obtained from existing on-site wells. A water supply assessment will be completed for the project to analyze potential water sources and potential impacts to water supplies.

This potentially significant impact will be addressed further in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XX. WILDFIRE. If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☒	☐	☐	☐
b) Due to slope, prevailing winds, or other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☒	☐	☐	☐
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☒	☐	☐	☐
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☒	☐	☐	☐

RESPONSES:

a)-d) According to the California Department of Forestry and Fire Protection (CalFire), Kern County Fire Hazards Severity Zone Maps, the project site is located within a Moderate Fire Hazard Severity Zone in a State Responsibility Area. Therefore, the potential for wildfire on the project site exists. The site is located in a rural area with limited population, primarily developed with oil and gas production facilities and agricultural land. The project site is not identified for any purpose in an adopted emergency evacuation plan to address wildfires or other types of emergencies. Further analysis of prevailing winds is required to determine if there are periodic high winds that could influence the spreading and velocity of wildfires. Adherence to applicable regulations would reduce wildfire ignitions and prevent the spread of wildfires. The proposed project involves the development of a carbon capture and sequestration facility. The proposed project would include the construction of injection wells, internal roads, power transmission lines, and ancillary infrastructure including CO_2 transport pipelines.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
XXI. MANDATORY FINDINGS OF SIGNIFICANCE.				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

RESPONSES:

a) The EIR's biological, cultural, and tribal cultural resources sections will discuss specific project impacts on plants and wildlife including avian species and impacts to cultural and tribal cultural resources. The document will also evaluate the project's contribution to cumulative biological, cultural and tribal cultural resources impacts and propose mitigation that will reduce the impacts to less than significant levels, where feasible.

b) The project has the potential to contribute to cumulatively significant air quality, biological resources, cultural resources, tribal cultural resources, greenhouse gas emissions, traffic, and wildfire impacts. Such impacts could occur during the construction phases and/or as a result of the fully built and operational project. The EIR will evaluate the project's contribution to cumulative impacts in these and other areas.

c) The Project could potentially result in environmental effects that have adverse impacts on human beings, either directly or indirectly. These impacts will be fully addressed in the EIR.

Lorelei H. Oviatt, AICP, Director
2700 "M" Street, Suite 100
Bakersfield, CA 93301-2323
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Email: planning@kerncounty.com
Web Address: http://kernplanning.com/

PLANNING AND NATURAL RESOURCES DEPARTMENT

Planning
Community Development
Administrative Operations

DATE: February 28, 2024

TO: See Attached Mailing List

FROM: Kern County Planning and Natural Resources Department
Attn: Jamal Ferguson
2700 "M" Street, Suite 100
Bakersfield, CA 93301
(661)862-5017; Fergusonj@kerncounty.com

SUBJECT: NOTICE OF PREPARATION (NOP) OF A DRAFT ENVIRONMENTAL IMPACT REPORT (EIR) FOR THE ELK HILLS BLUE HYDROGEN PROJECT BY LONE CYPRESS ENERGY SERVICES

The Kern County Planning and Natural Resources Department as Lead Agency (per CEQA Guidelines Section 15062) has determined that preparation of an Environmental Impact Report (per CEQA Guidelines 15161) is necessary for the proposed project identified below. The Planning and Natural Resources Department solicits the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use the EIR prepared by our agency when considering your permit or other approval of the project.

You are invited to view the Initial Study/NOP and submit written comments regarding the scope and content of the environmental information in connection with the proposed project should you wish to do so. Due to the limits mandated by State law, your response must be received by **Friday, March 29, 2024 at 5:00 p.m**. Comments can be submitted to the Kern County Planning and Natural Resources Department at the address shown above or to Fergusonj@kerncounty.com. A Scoping meeting will be held on **Wednesday, March 20, 2024 at 1:30 p.m**. at the address listed above.

PROJECT TITLE: Elk Hills Blue Hydrogen by Lone Cypress Energy Services (PP24403); GPA No. 4, Map 119; ZCC No. 6, Map 119; PD Plan No. 1, Map 119

DOCUMENT AVAILABILITY: The Notice of Preparation for the above referenced project are available for public review at the Planning and Natural Resources Department, which is located at 2700 "M" Street, Suite 100, Bakersfield, CA 93301, or it can be accessed on the Kern County Planning and Natural Resources Department website at: **https://kernplanning.com/environmental-doc/elk-hills-blue-hydrogen-project/**

PROJECT LOCATION: The proposed project is located in an unincorporated area of western Kern County, within the administrative boundary of Elk Hills Oil Field, approximately one quarter mile southwest of the intersection of Elk Hills Road and Skyline Road and, 8.5 miles north of the City of Taft. The project site is located in Section 35 of Township 30 South, Range 23 East in the Mount Diablo Base and Meridian (MDB&M).

PROJECT DESCRIPTION: The Elk Hills Blue Hydrogen Project would include the construction and operation of a hydrogen processing plant that will produce 65 Metric Tonnes (MT) per day of liquid hydrogen to be used as a low-carbon fuel alternative.

Implementation of the project as proposed includes the following requests:

a) General Plan Amendment No. 4, Map 119 to amend the Land Use Element of Kern County General Plan from a map code designation of Mineral Petroleum (8.4) to Heavy Industrial (7.3) on approximately 32 acres.

b) Zoning Classification Change No. 6, Map 119 to change the existing Zone Classification from Exclusive Agriculture (A) to Heavy Industrial, Precise Development Combining District (M-3 PD) on approximately 32 acres.

c) Precise Development Plan No. 1, Map 119 to allow for the development and operation of a hydrogen facility (A.40.020.E) on the approximate 32-acre project site in an M-3 PD zone district.

d) Parcel Map Waiver No. 4-23 proposing the division of a 1,286.52-acre parcel of record into three separate parcels consisting of a: (1) 43.89-acre parcel; (2) 40.00-acre gross parcel; and (3) 1,202.63-acre gross parcel. The 32-acre project site will be located on the 40.-acre gross parcel.

Signature:

Name: Jamal Ferguson, Planner I

I:\Planning\WORKGRPS\WP\LABELS\Elk Hills Blue Hydrogen NOP.docx
Elk Hills Blue Hydrogen NOP
cc 11/28/2023

PG&E
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Renewal Dev, T&D Intercon
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Dir Tech Serv
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Mojave, CA 93501

Carol Lawhon
Association Executive, IOM
Tehachapi Area Assoc of Realtors
803 Tucker Road
Tehachapi, CA 93561

City of Arvin
P.O. Box 548
Arvin, CA 93203

Bakersfield City Planning Dept
1715 Chester Avenue
Bakersfield, CA 93301

Bakersfield City Public Works Dept
1501 Truxtun Avenue
Bakersfield, CA 93301

California City Planning Dept
21000 Hacienda Blvd.
California City, CA 93515

Delano City Planning Dept
P.O. Box 3010
Delano, CA 93216

City of Maricopa
P.O. Box 548
Maricopa, CA 93252

City of McFarland
401 West Kern Avenue
McFarland, CA 93250

City of Ridgecrest
100 West California Avenue
Ridgecrest, CA 93555

City of Shafter
336 Pacific Avenue
Shafter, CA 93263

City of Taft
Planning & Building
209 East Kern Street
Taft, CA 93268

City of Tehachapi
Attn: John Schlosser
115 South Robinson Street
Tehachapi, CA 93561-1722

City of Wasco
764 E Street
Wasco, CA 93280

Inyo County Planning Dept
P.O. Drawer "L"
Independence, CA 93526

Kings County Planning Agency
1400 West Lacey Blvd, Bldg 6
Hanford, CA 93230

Los Angeles Co Reg Planning Dept
320 West Temple Street
Los Angeles, CA 90012

San Bernardino Co Planning Dept
385 North Arrowhead Avenue, 1st Floor
San Bernardino, CA 92415-0182

San Luis Obispo Co Planning Dept
Planning and Building
976 Osos Street
San Luis Obispo, CA 93408

Santa Barbara Co Resource Mgt Dept
123 East Anapamu Street
Santa Barbara, CA 93101

Tulare County Planning & Dev Dept
5961 South Mooney Boulevard
Visalia, CA 93291

Ventura County RMA Planning Div
800 South Victoria Avenue, L1740
Ventura, CA 93009-1740

U.S. Bureau of Land Management
Caliente/Bakersfield
35126 McMurtrey Avenue
Bakersfield, CA 93308

U. S. Fish & Wildlife Service
Division of Ecological Services
2800 Cottage Way #W-2605
Sacramento, CA 95825-1846

North West Kern Resource Cons Dist
5080 California Avenue, Suite 150
Bakersfield, CA 93309

Environmental Protection Agency
Region IX Office
75 Hawthorn Street
San Francisco, CA 94105

U.S. Dept of Agriculture/NRCS
5080 California Avenue, Ste 150
Bakersfield, CA 93309-0711

West Side Mosquito
Abatement Dist.
P.O. Box 205
Taft, CA 93268

So. San Joaquin Valley Arch Info Ctr
California State University of Bkfd
9001 Stockdale Highway
Bakersfield, CA 93311

Caltrans/Dist 6
Planning/Land Bank Bldg.
P.O. Box 12616
Fresno, CA 93778

State Dept of Conservation
Director's Office
801 "K" Street, MS 24-01
Sacramento, CA 95814-3528

State Dept of Conservation
Geologic Energy Management Division
11000 River Run Boulevard
Bakersfield, CA 93311

California State University
Bakersfield - Library
9001 Stockdale Highway
Bakersfield, CA 93309

California Fish & Wildlife
1234 East Shaw Avenue
Fresno, CA 93710

California Regional Water Quality
Control Board/Central Valley Region
1685 E Street
Fresno, CA 93706-2020

State Dept of Toxic Substance Control
Environmental Protection Agency
1515 Tollhouse Road
Clovis, CA 93612

Cal Environmental Protection Agency/
Dept of Toxic Substances Control, Reg 1
Attn: Dave Kereazis, Permit Div - CEQA
8800 Cal Center Drive, 2nd Floor
Sacramento, CA 95826

Kern County Public Works Department/
Building & Development/Floodplain

Kern County Public Works Department/
Building & Development/Survey

Kern County
Env Health Services Department

Kern County Fire Dept (Put in FIRE BOX)
Regina Arriaga
Roxanne Routh
Jim Killam

Kern County Library/Beale
Local History Room

Kern County Library/Beale
Andie Sullivan

Kern County Sheriff's Dept
Administration

Kern County Public Works Department/
Building & Development/Development
Review

Kern County Public Works Department/Operations &
Maintenance/Regulatory Monitoring &
Reporting

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526 Mannel Avenue
Shafter, CA 93263

Taft Union High School Dist
701 - 7th Street
Taft, CA 93268

Buttonwillow Union School Dist
42600 Highway 58
Buttonwillow, CA 93206

Elk Hills School Dist
P.O. Box 129
Tupman, CA 93276

West Side Rec & Parks Dist
500 Cascade Place, Building C
Taft, CA 93268

Buttonwillow Rec & Parks Dist
P.O. Box 434
Buttonwillow, CA 93206-9320

Kern High School Dist
5801 Sundale Avenue
Bakersfield, CA 93309

Kern County Superintendent of Schools
Attention School District Facility Services
1300 - 17th Street
Bakersfield, CA 93301

Local Agency Formation Comm/LAFCO
5300 Lennox Avenue, Suite 303
Bakersfield, CA 93309

Kern County Water Agency
3200 Rio Mirada Drive
Bakersfield, CA 93308

San Joaquin Valley
Air Pollution Control District
1990 East Gettysburg Avenue
Fresno, CA 93726

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601 Gateway Boulevard, Suite 1000
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CA Rural Legal Assistance Foundation
1012 Jefferson Street
Delano, CA 93215

Pacific Gas & Electric Co
Land Projects
650 "O" Street, First Floor
Fresno, CA 93760-0001

Southern California Gas Co
Transportation Dept
P.O. Box 513249
Los Angeles, CA 90051

Kern Valley Indian Council
Attn: Robert Robinson, Chairperson
P.O. Box 401
Weldon, CA 93283

LIUNA
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Charlotte, NC 28273

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Weldon, CA 93283

Los Angeles Audubon
926 Citrus Avenue
Los Angeles, CA 90036-4929

Defenders of Wildlife
P.O. Box 401
Folsom, CA 95763

Sierra Club/Kern Kaweah Chapter
P.O. Box 3357
Bakersfield, CA 93385

Verizon California, Inc.
Attention Engineering Department
520 South China Lake Boulevard
Ridgecrest, CA 93555

Kern Valley Indian Council
Historic Preservation Office
P.O. Box 401
Weldon, CA 93283

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Oakland, CA 94612

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Center on Race, Poverty
& the Environment
5901 Christie Avenue, Suit 208
Emeryville, CA 94608

Verizon California, Inc.

Native American Heritage Council
of Kern County
Attn: Gene Albitre
18169 Highway 155
Woody, CA 93287

Southern California Gas Co
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Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # _____

Project Title: Elk Hills Blue Hydrogen by Lone Cypress Energy Services

Lead Agency: Kern County Planning and Natural Resources Department — Contact Person: Jamal Ferguson

Mailing Address: 2700 "M" Street Suite 100 — Phone: (661) 862-5017

City: Bakersfield — Zip: 93301 — County: Kern

Project Location: County: Kern — City/Nearest Community: City of Taft

Cross Streets: Elk Hills Road and Skyline Road — Zip Code: 93313

Lat. / Long.: 35° 16' 32.8" North; 119° 28' 10.2" West — Total Acres: 32

Assessor's Parcel No.: 158-090-19 — Section: 35 — Twp.: 30 S — Range: 23 E — Base: MDB&M

Within 2 Miles: State Hwy #: N/A — Waterways: N/A

Airports: N/A — Railways: N/A — Schools: N/A

Document Type:

CEQA: ☒ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) _____ ☐ Other _____

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other _____

Local Action Type:

☐ General Plan Update
☒ General Plan Amendment
☐ General Plan Element
☐ Community Plan
☐ Specific Plan
☐ Master Plan
☐ Planned Unit Development
☒ Site Plan
☒ Rezone
☐ Prezone
☐ Use Permit
☐ Land Division (Subdivision, etc.)
☐ Annexation
☐ Redevelopment
☐ Coastal Permit
☐ Other: _____

Development Type:

☐ Residential: Units _____ Acres _____
☐ Office: Sq.ft. _____ Acres _____ Employees _____
☐ Commercial: Sq.ft. _____ Acres _____ Employees _____
☐ Industrial: Sq.ft. _____ Acres _____ Employees _____
☐ Educational _____
☐ Recreational _____
☐ Water Facilities: Type _____ MGD _____
☐ Transportation: Type _____
☐ Mining: Mineral _____
☐ Power: Type _____ MW _____
☐ Waste Treatment: Type _____ MGD _____
☐ Hazardous Waste: Type _____
☒ Other: Hydrogen 65 Metric Tonnes per day

Project Issues Discussed in Document:

☒ Aesthetic/Visual
☒ Agricultural Land
☒ Air Quality
☒ Archeological/Historical
☒ Biological Resources
☐ Coastal Zone
☒ Drainage/Absorption
☒ Economic/Jobs
☐ Fiscal
☒ Flood Plain/Flooding
☒ Forest Land/Fire Hazard
☒ Geologic/Seismic
☒ Minerals
☒ Noise
☒ Population/Housing Balance
☒ Public Services/Facilities
☒ Recreation/Parks
☐ Schools/Universities
☒ Septic Systems
☒ Sewer Capacity
☒ Soil Erosion/Compaction/Grading
☒ Solid Waste
☒ Toxic/Hazardous
☒ Traffic/Circulation
☒ Vegetation
☒ Water Quality
☒ Water Supply/Groundwater
☒ Wetland/Riparian
☒ Wildlife
☒ Growth Inducing
☒ Land Use
☒ Cumulative Effects
☒ Other GHG, Wildfire, Tribal Cultural Resources, Energy

Present Land Use/Zoning/General Plan Designation:

Agricultural Land/*Zoning:* A (Exclusive Agriculture)/*General Plan:* 8.4 (Mineral Petroleum)

Project Description: The Elk Hills Blue Hydrogen Project would include the construction and operation of a hydrogen processing plant that will produce 65 Metric Tonnes (MT) per day of liquid hydrogen to be used as a low-carbon fuel alternative.

Implementation of the project as proposed includes the following requests:

a) General Plan Amendment No. 4, Map 119 to amend the Land Use Element of Kern County General Plan from a map code designation of Mineral Petroleum (8.4) to Heavy Industrial (7.3) on approximately 32 acres.

b) Zoning Classification Change No. 6, Map 119 to change the existing Zone Classification from Exclusive Agriculture (A) to Heavy Industrial, Precise Development Combining District (M-3 PD) on approximately 32 acres.

c) Precise Development Plan No. 1, Map 119 to allow for the development and operation of a hydrogen facility (A.40.020.E) on the approximate 32-acre project site in an M-3 PD zone district.

d) Parcel Map Waiver No. 4-23 proposing the division of a 1,286.52-acre parcel of record into three separate parcels consisting of a: (1) 43.89-acre parcel; (2) 40.00-acre gross parcel; and (3) 1,202.63-acre gross parcel. The 32-acre project site will be located on the 40.-acre gross parcel.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

S Air Resources Board	____ Office of Emergency Services
____ Boating & Waterways, Department of	____ Office of Historic Preservation
S California Highway Patrol	____ Office of Public School Construction
____ CalFire	____ Parks & Recreation
S Caltrans District # 6	____ Pesticide Regulation, Department of
____ Caltrans Division of Aeronautics	S Public Utilities Commission
____ Caltrans Planning (Headquarters)	S Regional WQCB # Central Valley
____ Central Valley Flood Protection Board	____ Resources Agency
____ Coachella Valley Mountains Conservancy	____ S.F. Bay Conservation & Development Commission
____ Coastal Commission	____ San Gabriel & Lower L.A. Rivers and Mtns Conservancy
____ Colorado River Board	____ San Joaquin River Conservancy
S Conservation, Department of	____ Santa Monica Mountains Conservancy
____ Corrections, Department of	S State Lands Commission
____ Delta Protection Commission	____ SWRCB: Clean Water Grants
____ Education, Department of	____ SWRCB: Water Quality
X Energy Commission	____ SWRCB: Water Rights
S Fish & Game Region # Fresno	____ Tahoe Regional Planning Agency
____ Food & Agriculture, Department of	____ Toxic Substances Control, Department of
____ General Services, Department of	S Water Resources, Department of
____ Health Services, Department of	
____ Housing & Community Development	____ Other _____
X Integrated Waste Management Board	____ Other _____
X Native American Heritage Commission	

Local Public Review Period (to be filled in by lead agency)

Starting Date February 28, 2024 Ending Date March 29, 2024

Lead Agency (Complete if applicable):

Consulting Firm: _____ Applicant: _____
Address: _____ Address: _____
City/State/Zip: _____ City/State/Zip: _____
Contact: _____ Phone _____
Phone: _____

Signature of Lead Agency Representative: _____/s/_____ **Date:** 02/28/2024

Jamal Ferguson, Planner I

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

NOTICE OF PREPARATION/INITIAL STUDY CHECKLIST

Elk Hills Blue Hydrogen Project
by Lone Cypress Energy Services, LLC

General Plan Amendment No. 4, Map 119
Zone Classification Change No. 6, Map 119
Precise Development Plan No. 1, Map 119
Parcel Map Waiver No. 4-23

PLN23-00800
(PP24403)

LEAD AGENCY:

Kern County Planning and Natural Resources Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2370

Contact: Jamal Ferguson, Planner I
(661) 862-5017
Fergusonj@kerncounty.com

February 2024

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INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA), the Kern County Planning and Natural Resources Department (County) will initiate the preparation of an Environmental Impact Report (EIR) for the Elk Hills Blue Hydrogen Project in the unincorporated area of western Kern County, California.

1. Project Description

1.1. Project Location

The Elk Hills Blue Hydrogen (proposed project) is a proposal by Lone Cypress Energy Services (project proponent) for the construction and operation of a hydrogen production facility. The proposed project will include the construction of a hydrogen production facility on an approximate 32 acres of a 40 acre parcel, with an associated 190 square feet Security Room. The proposed project located is on an approximately 32-acre portion of an approximate 590 acre privately owned parcel (current Assessor's Parcel Number 158-090-19) at the southwestern end of the San Joaquin Valley in unincorporated Kern County, California as shown in **Figure 1**, *Regional Vicinity Map.* The project site is within the administrative boundary of Elk Hills Oil Field, one quarter mile southwest of the intersection of Elk Hills Road and Skyline Road, shown in **Figure 2**, *Local Vicinity Map.*

The project site is approximately 26 miles west of the City of Bakersfield, 8.5 miles north of the City of Taft, and 8.5 miles Southwest of the unincorporated community of Buttonwillow. The project site is situated approximately 9 miles southeast of Interstate 5 (I-5) and approximately 6.8 miles east of Highway 33 (HWY-33). Regional Access is approximately 16 miles off I-5 to Stockdale Highway exit. Local access to the project site is available from Highway 119 to Elk Hills Road and then approximately 7 miles north to Skyline Road.

The project site is located on the *West Elk Hills, California* United States Geological Survey (USGS) 7.5-minute Topographic Quadrangle Map, Township 30 South, Range 23 East, Section 35 (Latitude 35° 16' 32.8" North; Longitude 119° 28' 10.2" West).

1.2. Environmental Setting

The project site is situated in the southwestern end of the San Joaquin Valley, in unincorporated Kern County. Kern County is California's third largest county in land area and encompasses approximately 8,161 square miles. The County's geography includes, among others, mountainous areas, agricultural lands, and deserts. Bakersfield is the largest city in Kern County and has a current estimated population of 408,865 residents (California Department of Finance [CDF] 2022). The County's current estimated population is 909,813 residents (CDF 2022).

The project site ranges in elevation from roughly 1,000 to 1,300 feet above mean sea level (AMSL), with elevation sloping gradually upward from north to south. While this area may be generally characterized as "open flats," outside of leveled fields and orchards, it is better described as an uneven plain consisting of extensive alluvial fans, debris flows and over-bank deposits. Vegetation on the valley floor is predominated by modern cultigens and other non-native species, such as Russian thistle (tumbleweed) and grasses, but also includes cheatgrass and doveweed.

Land uses within the region and the area of the site consist of oil fields. Land uses surrounding the site include the following:

North–Oil fields, with Elk Hills Power LLC being directly north of the project site.

South–Oil Fields.

West–Oil Fields.

East–Oil Fields.

The immediate project area has no nearby residences. The nearest residence is approximately 6 miles to the southeast in the community Dustin Acres. **Table 1,** *Project Site and Surrounding Land Uses,* **Figure 3***, Existing General Plan Map, and* **Figure 5***, Existing Zone Classifications.* presents the existing land uses, Kern County General Plan designations, and Zoning classification for the project site and surrounding area. The nearest existing schools are in the City of Taft, approximately 8 miles south and in the Town of McKittrick approximately 8 miles northwest.

Table 1. Project Site and Surrounding Land Uses

	Existing Land Use	Existing Map Code Designation	Existing Zone Classification
Project Site	Oil fields/ Elk Hills Power Substation	8.4 (Mineral Petroleum)	A (Exclusive Agriculture)
North	Oil fields	8.4 (Mineral Petroleum)	A (Exclusive Agriculture) and A-1 (Limited Agriculture)
East	Oil fields	8.4 (Mineral Petroleum)	A (Exclusive Agriculture)
South	Oil fields	8.4 (Mineral Petroleum)	A (Exclusive Agriculture)
West	Oil fields	8.4 (Mineral Petroleum)	A (Exclusive Agriculture) and A-1 (Limited Agriculture)

1.3. Project Description

The Elk Hills Blue Hydrogen Project would include the construction and operation of a hydrogen processing plant that will produce 65 Metric Tonnes (MT) per day of liquid hydrogen using proven technology. The hydrogen will be manufactured by feeding approximately 13 million standard cubic feet per day (MMSCFD) of natural gas and 0.32 acre-feet per day (2,440 barrels per day (bpd)) of water into a Steam Methane Reformer (SMR). In an SMR, water and natural gas react with the help of a catalyzer to produce hydrogen and CO2. A total of 721 MT per day of CO2 will be generated as a byproduct of hydrogen production. From that total, a minimum of 95%, or 686 MT per day, will be captured, compressed to supercritical state, and piped to Carbon TerraVault's EPA Class VI sequestration well. The remaining 5% or 36 MT per day will be released into the atmosphere due to the inherent efficiency of the technology available.

After the hydrogen is produced and separated from the CO2, it will be compressed and liquified to be loaded into cryogenic tanker trucks for distribution throughout California.

The Elk Hills Blue Hydrogen Project will sequester over 200,000 MT of carbon dioxide annually, keeping harmful emissions from impacting the local community all while creating a low-carbon alternative fuel option.

Implementation of the project as proposed includes the following requests:

- General Plan Amendment No. 4, Map 119 to amend the Land Use Element of Kern County General Plan from a map code designation of Mineral Petroleum (8.4) to Heavy Industrial (7.3) on approximately 32 acres.
- Zoning Classification Change No. 6, Map 119 to change the existing Zone Classification from Exclusive Agriculture (A) to Heavy Industrial, Precise Development Combining District (M-3 PD) on approximately 32 acres.
- Precise Development Plan No. 1, Map 119 to allow for the development and operation of a hydrogen facility (A.40.020.E) on the approximate 32-acre project site in an M-3 PD zone district.
- Parcel Map Waiver No. 4-23 proposing the division of a 1,286.52-acre parcel of record into three separate parcels consisting of a: (1) 43.89-acre gross parcel; (2) 40.00-acre gross parcel; and (3) 1,202.63-acre gross parcel, of which the proposed 32-acre project site will be located on the 40.00-acre gross parcel.

The proposed project site is within the administrative boundaries of the Kern County General Plan. **Table 2**, *Project Assessor's Parcel Number, Existing and Proposed Land Uses, and Acreages* identifies the proposed project parcels, existing land uses, and the proposed land uses for the proposed project.

Table 2: Project Assessor's Parcel Number, Existing and Proposed Land Uses, and Acreages

Count	APN	Zone Map	General Plan	Existing Map Code Designation	Proposed Map Code Designation	Existing Zoning	Proposed Zoning	Acres
1.	158-090-19	119	Kern County	8.4	7.3	A	M-3 PD	32
Kern County General Plan (KCGP) Map Code Designation: *8.4 (Resource – Mineral Petroleum); 7.3 (Heavy Industrial)* *Kern County Zoning District:* *A (Exclusive Agriculture); M-3 PD (Heavy Industrial, Precise Development Combining)*								

1.4. Project Facilities, Construction Activities, and Operations

Project Facilities

The overall proposed development is a 32-acre facility dedicated to hydrogen manufacturing, liquefaction, hydrogen storage, hydrogen loading, and CO2 removal and compression for sequestration.

The proposed facility has a footprint of approximately 32-acres, including a 190 square feet Security Room to identify and check-in any person(s) entering the plant. This room includes a small office and a bathroom. **Table 3**, *Project Summary* provides a project summary of the proposed project.

Table 3: Project Summary

Acreage	Proposed End Use	Percentage Building Coverage	Maximum Building Height	Handicapped Parking Spaces	Standard Parking Spaces	Automobile Parking Spaces
32 acres	Hydrogen processing plant with approximately 190 square foot building. Used for security of plant.	0.01%	+/-18 feet	1	4	5 Parking Spaces Total

Source:

Substation

The proposed substation will be located at the northeast portion of the site and will include circuit breakers, disconnect switches, metering protection equipment, and main step-up transformers. The substation will occupy an area that will be approximately 140 feet by 230 feet in size. The substation will be enclosed by a 6-foot-high chain link fence topped with barbed wire, and gravel will cover the ground surface in accordance with Pacific Gas & Electric (PG&E) Substation requirements. Lighting will be installed in the substation for security and for use at times when nighttime emergency repair work is required.

Vehicular Access and Circulation

Primary access to the project site will be via existing access off Elk Hills Road to be upgraded for the proposed project. Such improvements will meet applicable California Department of Transportation (Caltrans) and Kern County Public Works Department development standards. A secondary access point will be at the southwest corner of the plant which connects to an existing field road.

Construction Activities

Schedule and Workforce

The plant construction will last approximately 18 months. Grading of the proposed project will start in September 2024. and last 60 to 90 days. Construction will be completed in a single phase, beginning in September 2024, and concluding in March 2025. It is anticipated that the proposed project will be operational in 2025. Should commencement of construction be delayed, the commencement date of September 2024 represents a conservative estimate for the purpose of this document.

Construction will primarily occur during daylight hours, Monday through Friday, as required to meet the construction schedule. Additional hours/days may be necessary to facilitate the schedule. Any construction work performed outside of the normal work schedule be coordinated with the appropriate agencies and will conform to the Kern County Noise Ordinance (Chapter 8.36).

The on-site construction workforce will consist of up to 125 individuals; however, the average daily workforce will vary depending upon the stage in construction. The average daily workforce will include construction, supervisory, support, and construction management personnel on-site during construction. It is anticipated that the construction workforce will commute to the project site each day from local communities and report to the designated construction staging yards prior to the beginning of each workday. Parking for construction personnel will be provided on-site. Portable toilets will be used and will be maintained by a private off-site company during the construction period.

Construction Activities and Equipment

Construction activities will consist of civil, structural, mechanical, and electrical construction with heavy equipment will be utilized during construction from the beginning of civil through startup.

Construction Water Use and Wastewater

During construction of the proposed project, water will be required for common construction-related purposes, including but not limited to dust suppression, soil compaction, grading, and general site cleanup. Dust-control water may be used for ingress and egress of on-site construction vehicle equipment traffic and for the construction of the warehouse infrastructure. A sanitary water supply will not be required during construction because restroom facilities will be provided by portable units to be serviced by licensed providers.

Operations

The proposed facility will operate 24 hours a day, 365 days a year and typically consist of both day and night shifts. The facility will employ 1 to 5 employees per shift. Approximately 10 operational employees will work remotely.

Vehicular access and circulation operations for the proposed project will generate approximately 16 to 20 daily truck trips.

Ingress to the plant will be off Elk Hills Road and requiring check-in at the Security Room. Employee parking will be located immediately after the entrance, directly to the east of the Security Room. After loading, the cryogenic tanker trucks will egress through the same access point.

1.5. Applicant Submitted Project Objectives

State CEQA Guidelines Section 15124(b) requires that a project description include a clearly written statement of objectives. The statement of objectives should include the underlying purpose of the project and may discuss the project benefits. The following are the applicant objectives for the proposed project:

- Construct and operate a low-carbon hydrogen plant.
- Provide the California Market with clean transportation fuel.
- Support California's Carbon neutrality goals by 2045.
- Site and design the project in an environmentally responsible manner consistent with current Kern County guidelines.
- Promote economic development and bring living-wage jobs to the region throughout the life of the proposed project.

1.6. Proposed Discretionary Actions/Required Approvals

The Kern County Planning and Natural Resources Department as the CEQA Lead Agency (per CEQA Guidelines Section 15052) has discretionary responsibility for the Elk Hills Blue Hydrogen owned by Lone Cypress Energy Services, LLC. To implement this project, the project proponent may need to obtain the following discretionary and ministerial permits/approvals, but not be limited to:

- **Federal**
    - U.S. Fish and Wildlife Service (USFWS) Section 10 Incidental Take Permit and Habitat Conservation Plan (if required).
    - United States Army Corps of Engineers Section 404 Permit (if required)
- **State**
    - California Department of Fish and Wildlife (CDFW)
        - Section 2081 Permit (State-listed endangered species) (if required)
    - Central Valley Regional Water Quality Control Board (RWQCB)
        - Regional Water Quality Certification (401 Permit) (if required)
        - Waste Discharge Requirements
        - National Pollution Discharge Elimination System (NPDES) Construction General Permit
        - General Construction Stormwater Permit (Preparation of a SWPPP)
    - California Department of Transportation (Caltrans)
        - Right-of-Way Encroachment Permit (if required)
        - Permit for Transport of Oversized Loads (if required)
- **Local**
    - Kern County
        - Certification of Final Environmental Impact Report
        - Adoption of 15091 Findings of Fact and 15093 Statement of Overriding Considerations
        - Adoption of Mitigation Monitoring and Reporting Program
        - Approval of Amendment to the Land Use Element of the Kern County General
        - Approval of Change in Zone Classification
        - Approval of Precise Development Plan
        - Approval and recordation of Parcel Map

- Approval of Kern County Grading and Building Permits
- Approval of Kern County Encroachment Permits
- Approval of Fire Safety Plan

- San Joaquin Valley Air Pollution Control District
  - Authority to Construct (ATC)
  - Construction Fugitive Dust Control Plan
  - Permit to Operate (PTO)
  - Indirect Source Rule and Voluntary Emission Reduction Agreement
  - Other permits as required

The preceding discretionary actions/approvals are potentially required and do not necessarily represent a comprehensive list of all possible discretionary permits/approvals required. Other additional permits or approvals from responsible agencies may be required for the proposed project.

Figure 1 – Regional Vicinity

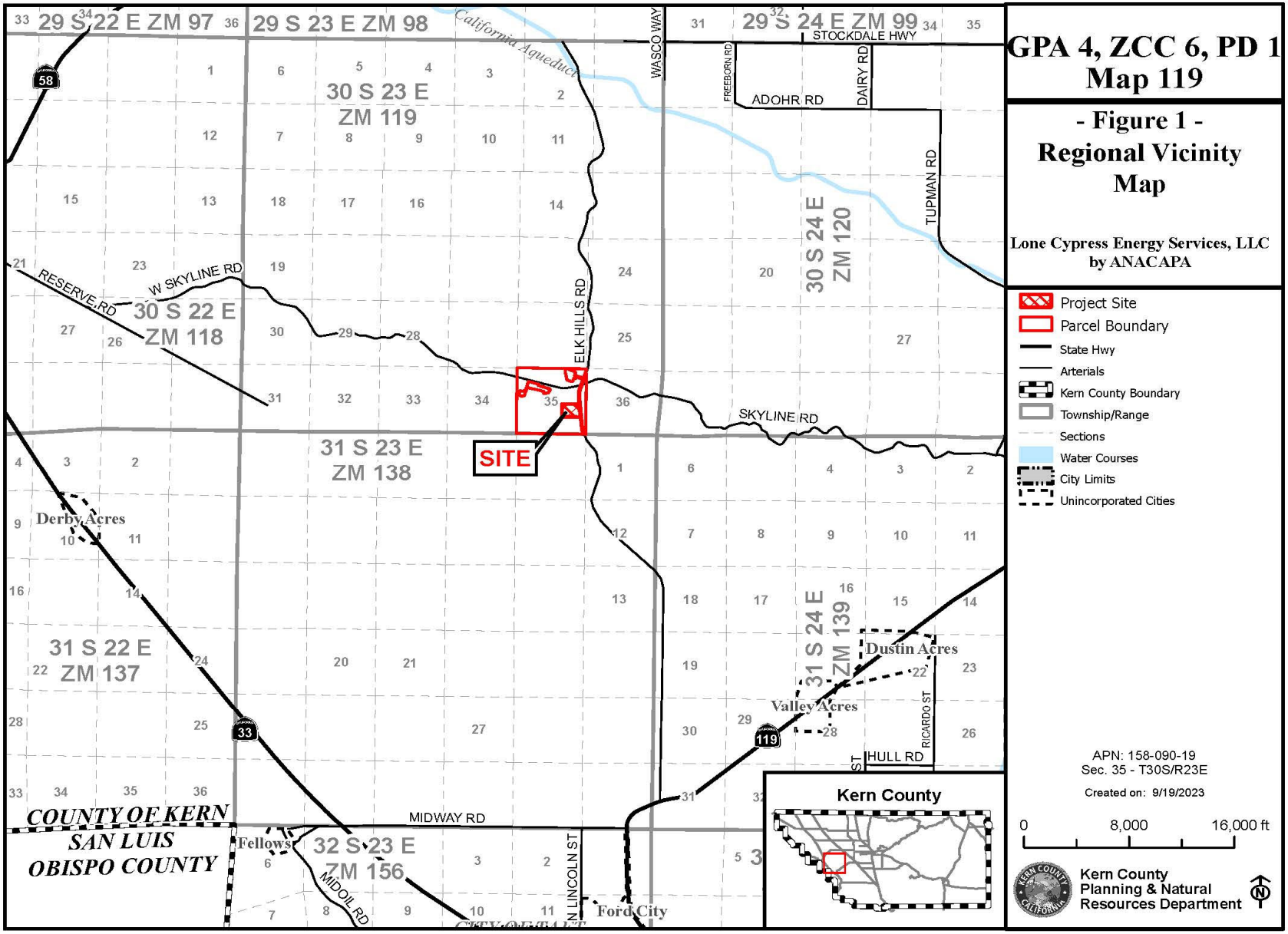


Figure 2 – Project Vicinity

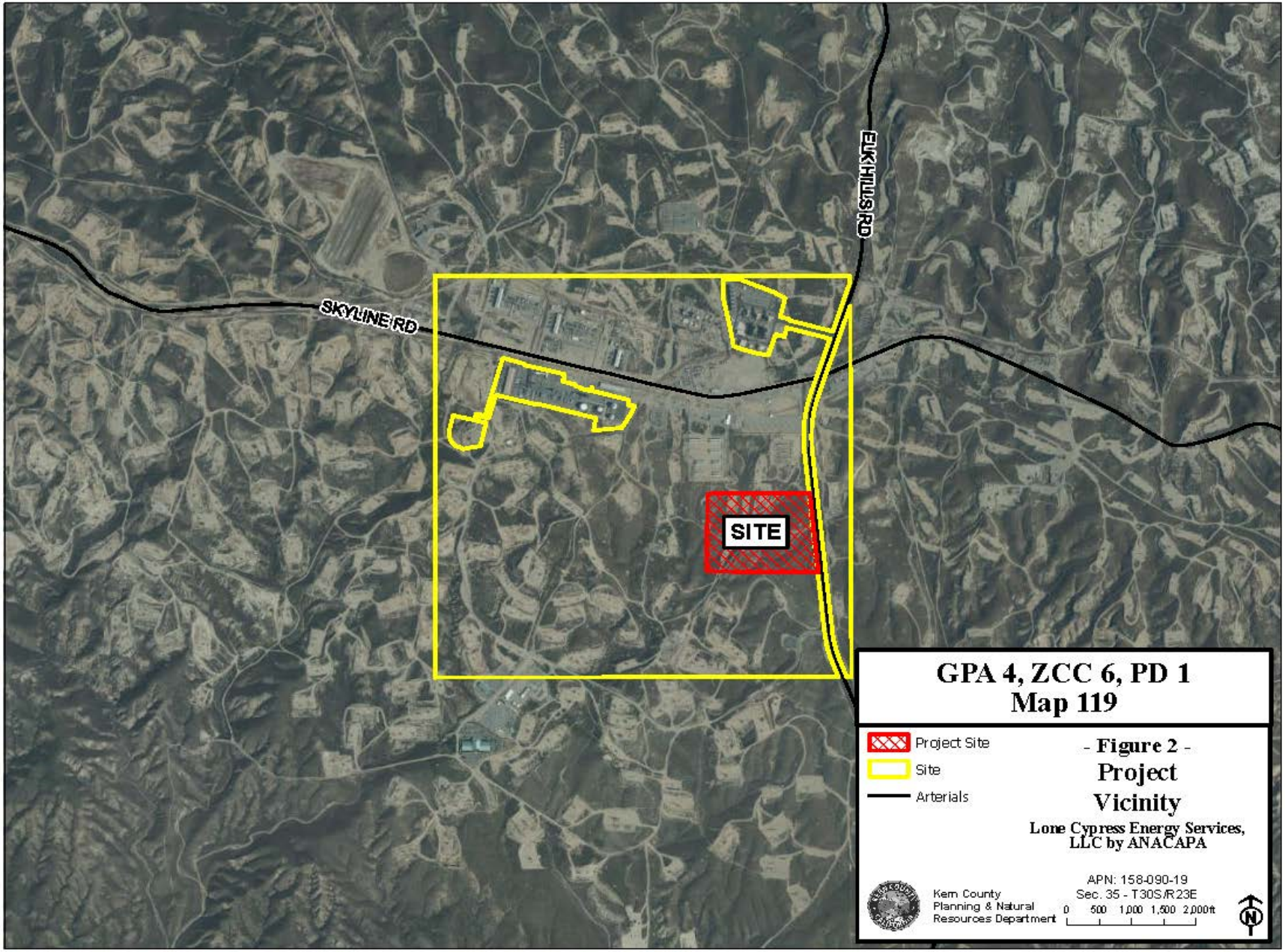


Figure 3 – Existing General Plan Map

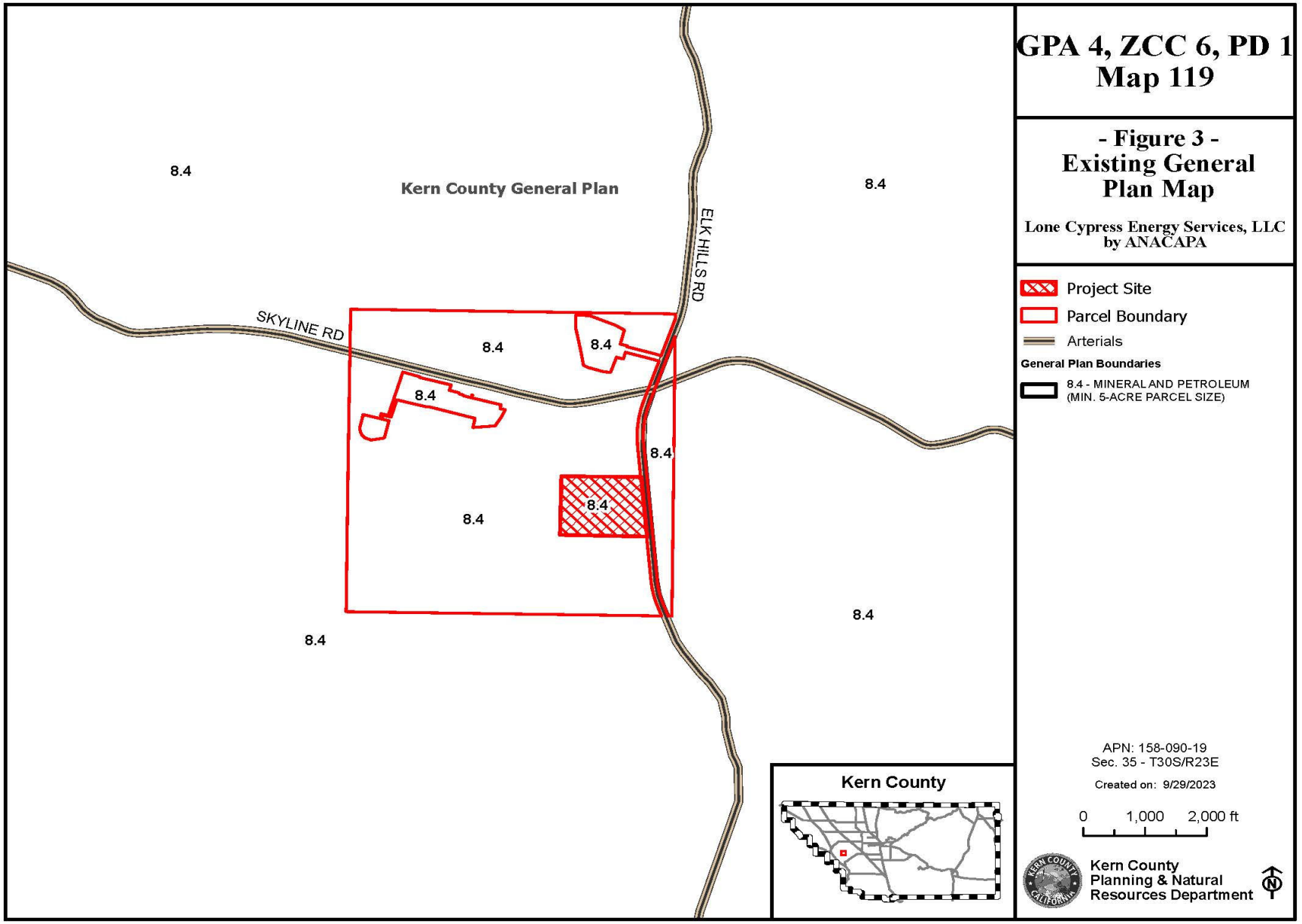


Figure 4 – Proposed General Plan Map

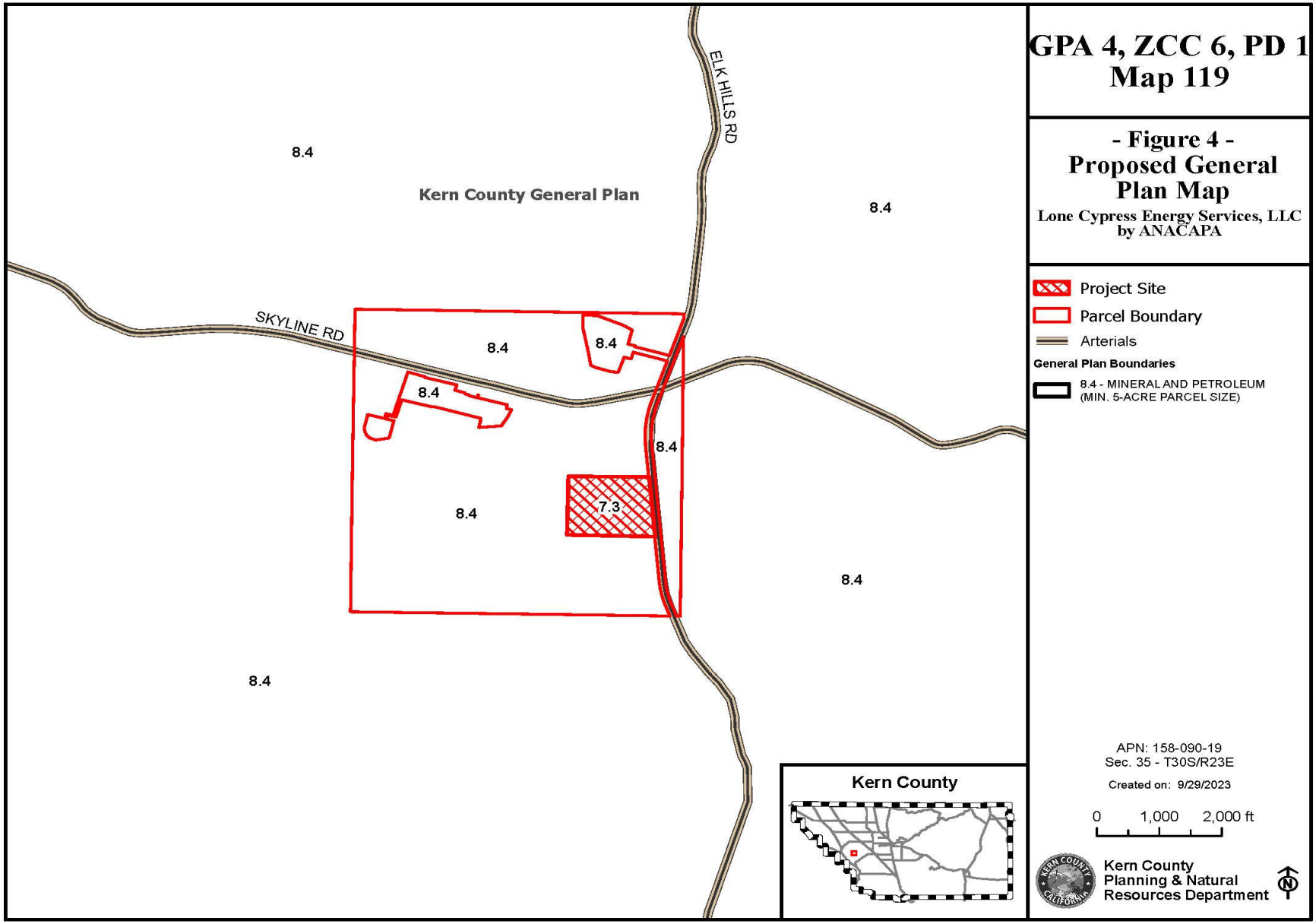


Figure 5 – Existing Zoning Classifications

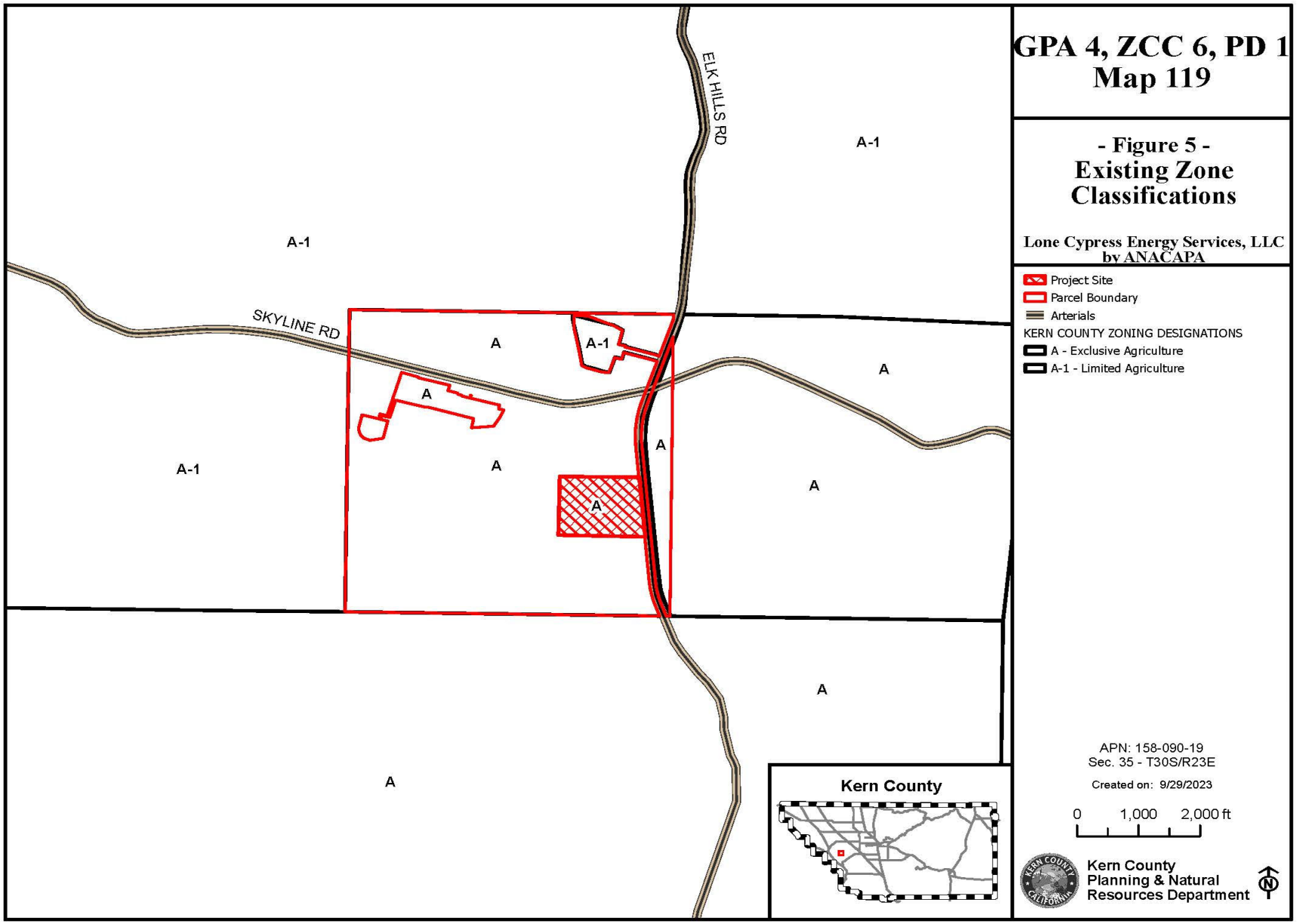


Figure 6 – Proposed General Plan Map

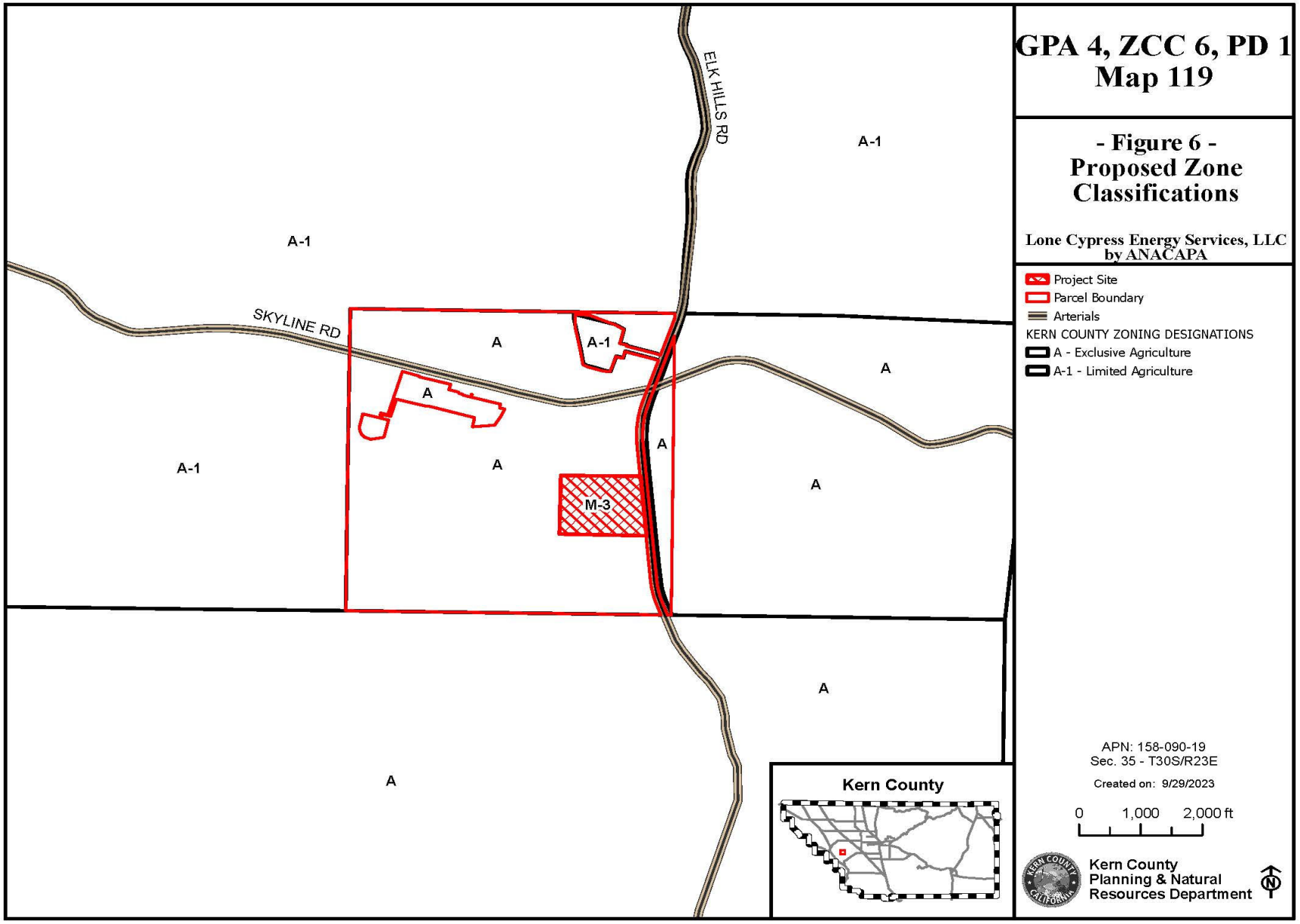


Figure 7a – Proposed PD Plan – Overall Site Plan

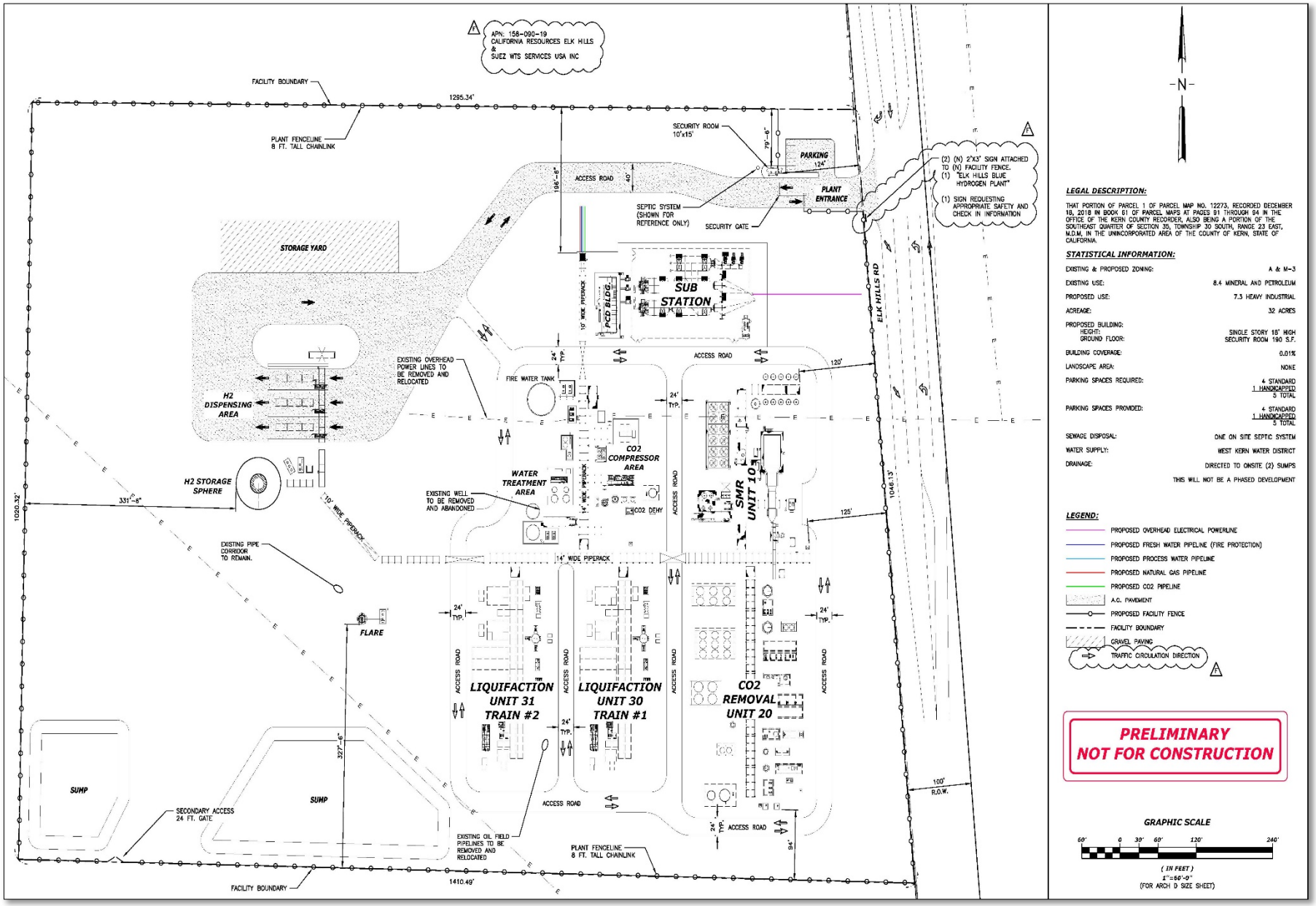


Figure 7b - Proposed PD Plan – Enlarged Northwest Site Plan

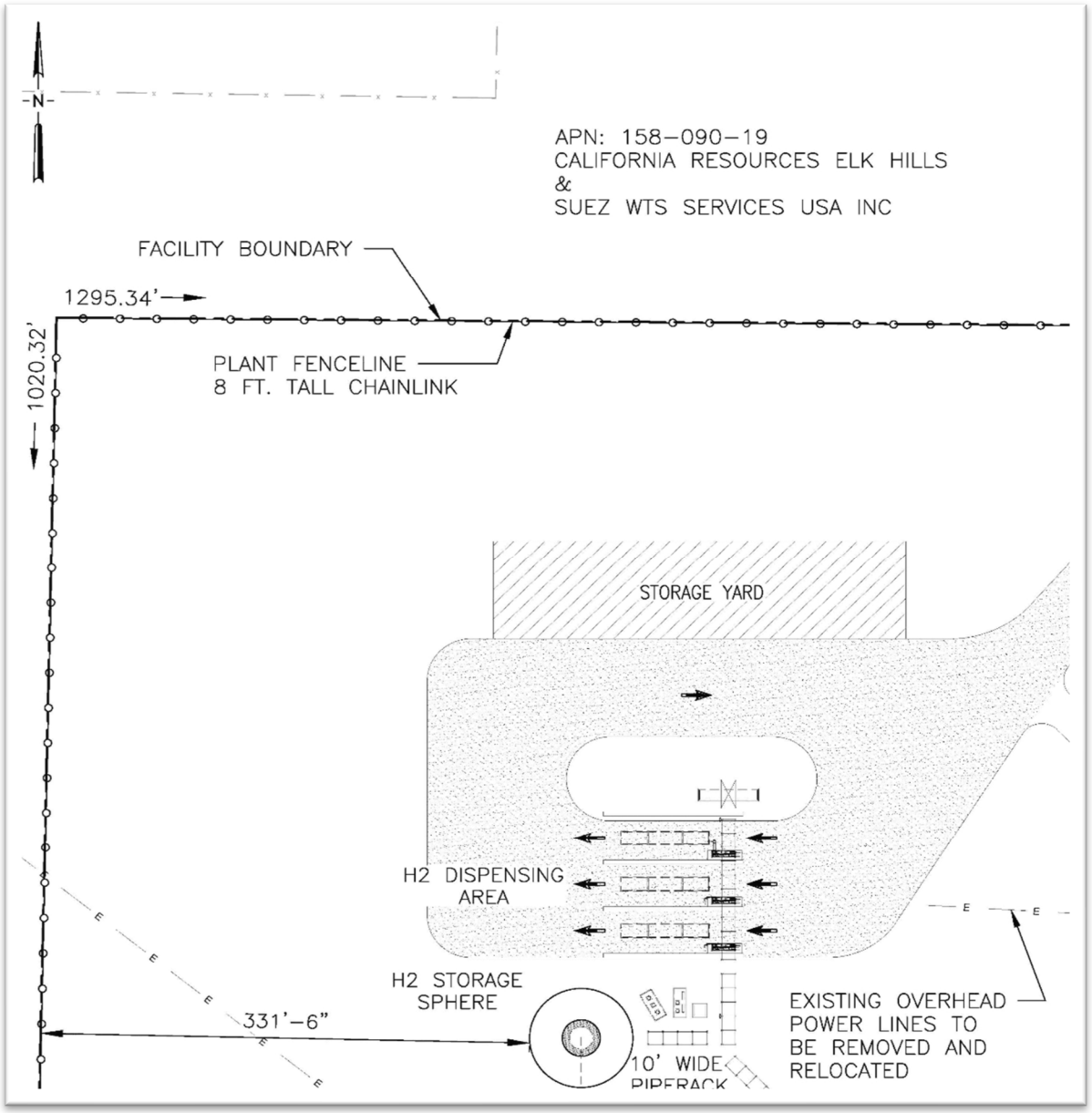


Figure 7c - Proposed PD Plan – Enlarged Northeast Site Plan

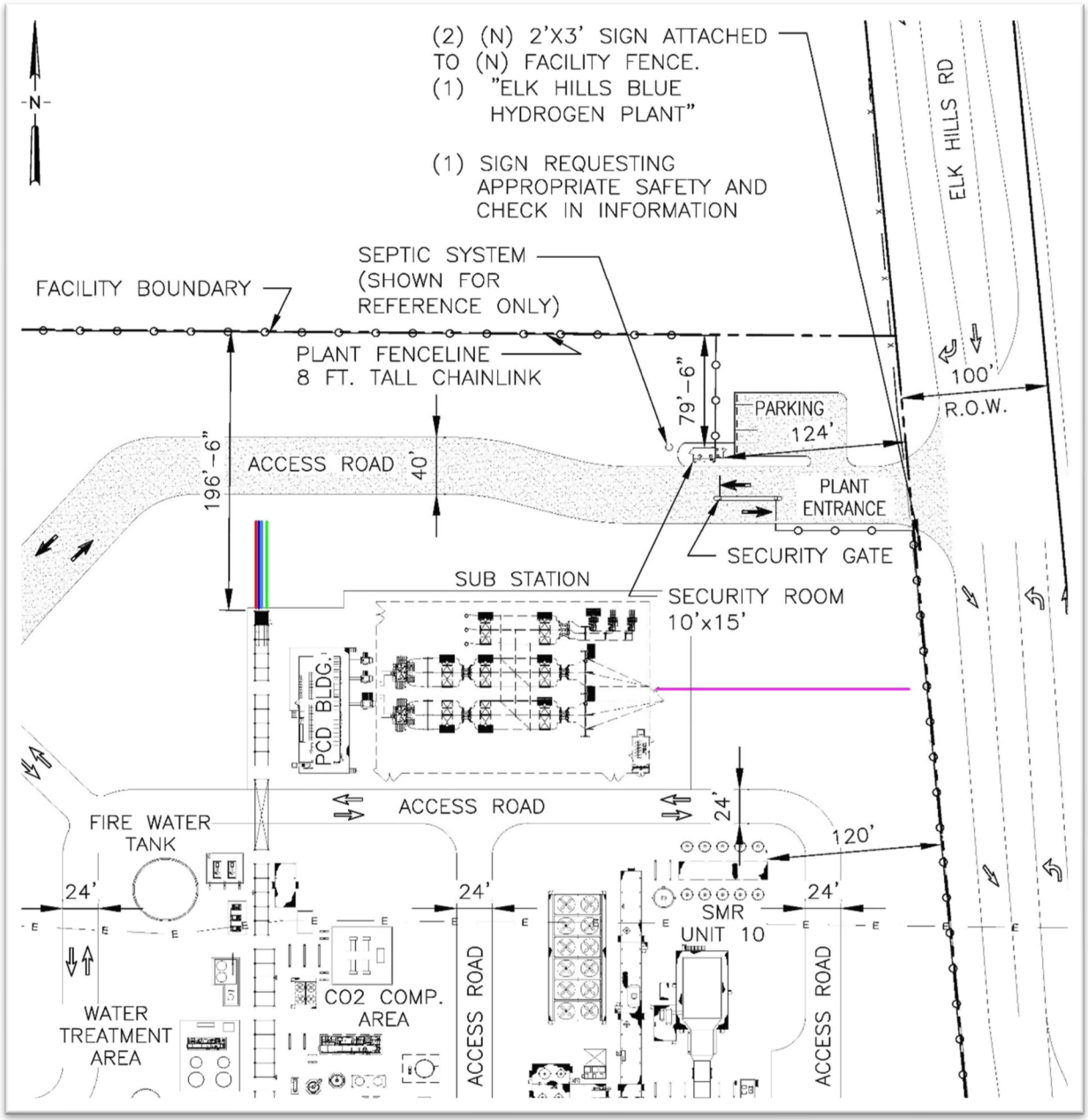


Figure 7d - Proposed PD Plan – Enlarged Southeast Site Plan

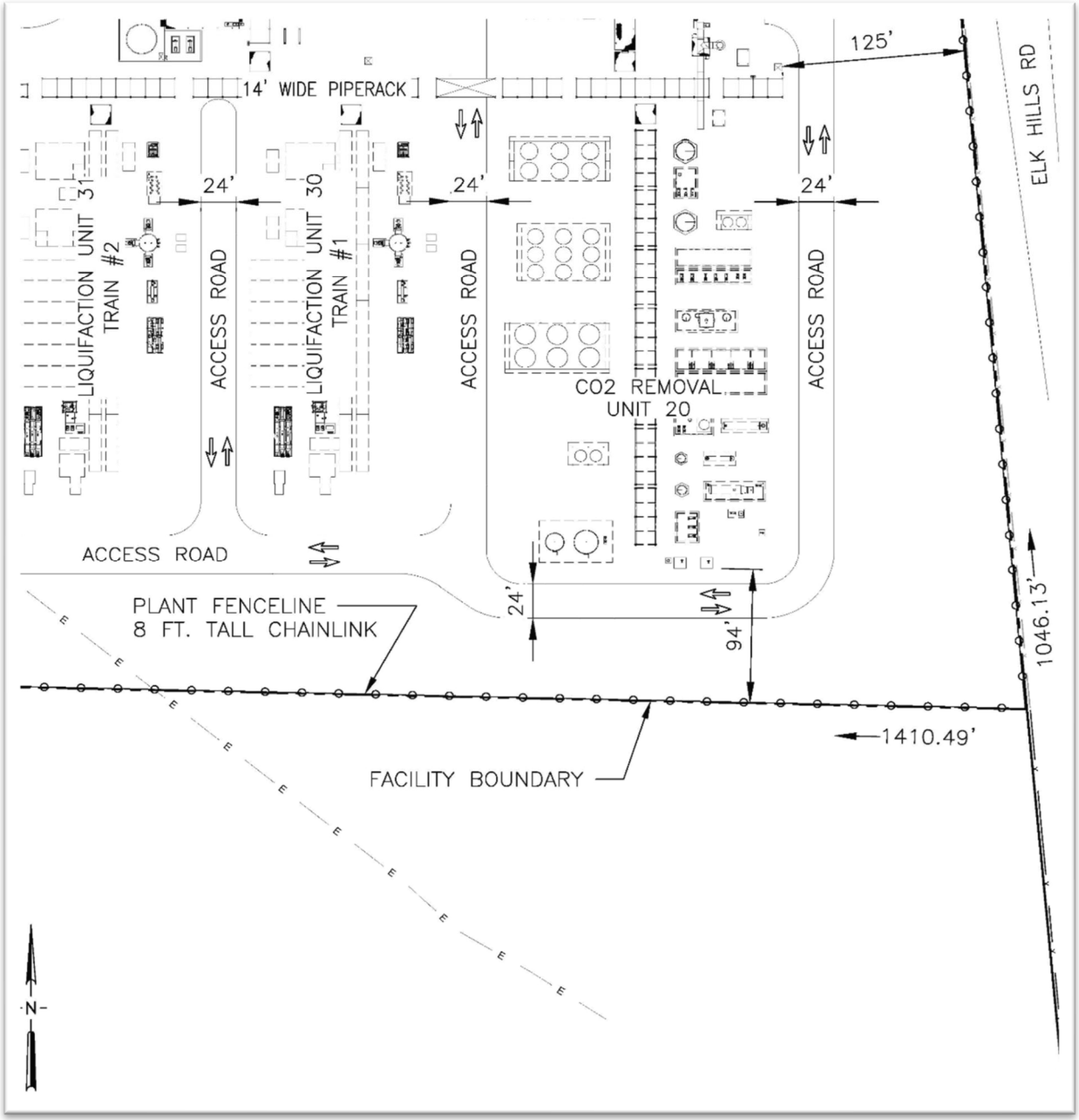
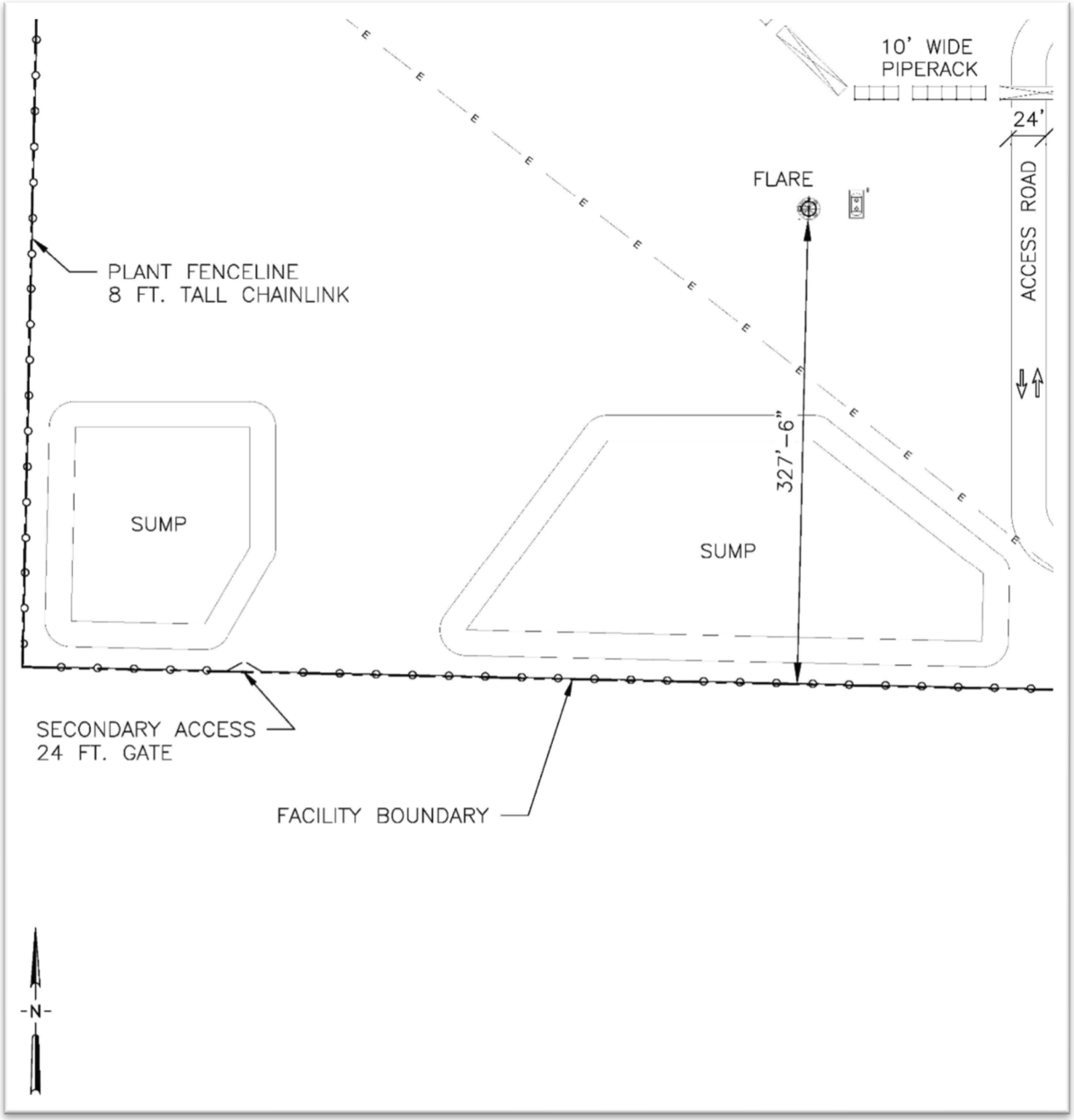


Figure 7e - Proposed PD Plan – Enlarged Southwest Site Plan



2. Kern County Environmental Checklist Form

2.1. Environmental Factors Potentially Affected

In accordance with CEQA Guidelines, the County intends to prepare an Environmental Impact Report (EIR) to evaluate potential environmental effects of the project and to propose mitigation measures to reduce any significant effects identified.

The environmental factors checked below will be potentially affected by this project, involving at least one impact that is a "potentially significant impact" as indicated by the Kern County Environmental Checklist. As such, the analysis contained within the EIR will focus on these issue areas.

☒ Aesthetics	☒ Agricultural and Forestry Resources	☒ Air Quality
☒ Biological Resources	☒ Cultural Resources	☒ Energy
☒ Geology and Soils	☒ Greenhouse Gas Emissions	☒ Hazards and Hazardous Materials
☒ Hydrology and Water Quality	☒ Land Use and Planning	☒ Mineral Resources
☒ Noise	☐ Population and Housing	☒ Public Services
☐ Recreation	☒ Transportation and Traffic	☒ Tribal Cultural Resources
☒ Utilities/Service Systems	☒ Wildfire	☒ Mandatory Findings of Significance

Other Environmental Issues

The County conducted a preliminary review of the proposed Project and has determined it is not likely to result in significant environmental effects to the following resources. Therefore, further analysis is not warranted in the EIR.

Population / Housing: The proposed Project will not induce substantial unplanned population growth through the construction of new homes, roads, or other infrastructure nor displace any housing units or people.

Although the proposed project would provide new employment consistent with the adopted Kern County General Plan goals, plan, and policies, long-term employment opportunities would be minimal. The proposed project would require approximately 10 operational employees working remotely per day. Full-time onsite employees will vary from 1 to 5 employees per shift with 3 shifts per 24 hours.

The on-site construction workforce will consist of up to 125 individuals; however, the average daily workforce will vary depending upon the stage in construction. The entire construction process is anticipated to take 18 months. Therefore, the majority of project-generated jobs would be from the local and regional area and would occur on a temporary and short-term basis. If temporary housing should be necessary, it is expected that accommodations (i.e., extended stay hotels, apartments, RV parks, homes for rent or sale) would be available in the nearby communities of Taft City, or Bakersfield. Therefore, the project is not anticipated to directly or indirectly induce the development of any new housing or businesses within the local communities.

The proposed project is located in the administrative boundary of Elk Hills Oil Field which consists of oil fields which has no existing housing.

Recreation: The Kern County General Plan does not identify any existing or proposed recreational facilities near the project area.

The proposed project itself does not include new recreational facilities and is not anticipated to increase demands on existing facilities. The number of workers needed during the construction phase will consist of up to 125 individuals; however, the average daily workforce will vary depending upon the stage in construction. These workers are not likely to visit local parks or recreation facilities during the workday and the workers that are relocating temporarily during construction would create little or no impact on local recreational resources after work hours.

Operation of the proposed project would require from 1 to 5 full-time onsite employees for maintenance and monitoring activities, but they would likely be drawn from the local labor force and would commute from their existing permanent residence to the project site. However, even if the maintenance/monitoring employees were hired from out of the area and relocated to western Kern County, the addition of any such families to the project area would not result in a substantial increase in the number of users at local parks or recreational facilities. As a result, there would not be a detectable increase in the use of existing neighborhood or regional parks or other recreational facilities, and therefore, no deterioration of any such facilities would occur or require the construction of new facilities as a result of project implementation.

2.2. Determination

(To be completed by the Lead Agency)

Based on this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (a) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (b) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENT IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature:	Date: 02/28/2024
Printed Name: Jamal Ferguson	Title: Planner I

2022 SCOPING PLAN FOR ACHIEVING CARBON NEUTRALITY

NOVEMBER 16, 2022

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Abbreviations

°F	Fahrenheit
°C	Celsius
AB	Assembly Bill
AQMD	Air Quality Management District
AR5	IPCC Fifth Assessment Report
BECCS	bioenergy with carbon capture and storage
CAISO	California Independent System Operator
CalEPA	California Environmental Protection Agency
CalGEM	California Geologic Energy Management Division
CalSTA	California State Transportation Agency
CAP	climate action plan
CARB	California Air Resources Board
CCR	California Code of Regulations
CCS	carbon capture and sequestration
CCUS	carbon capture, utilization, and storage
CDFA	California Department of Food and Agriculture
CDPH	California Department of Public Health
CDR	carbon dioxide removal
CE	common era
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CES	CalEnviroScreen
CH_4	methane
CMAQ	Community Multiscale Air Quality
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
COPD	chronic obstructive pulmonary disease

CORE	Clean Off-Road Equipment
CPUC	California Public Utilities Commission
CVM	Climate Vulnerability Metric
DAC	direct air capture
DPR	Department of Pesticide Regulation
Draft EA	Draft Environmental Analysis for this Scoping Plan
EA	Environmental Analysis
ED	emergency department
EIA	U.S. Energy Information Administration
EJ	environmental justice
EJ Advisory Committee	Environmental Justice Advisory Committee
EO	executive order
EV	electric vehicle
F-gas	fluorinated gas
FCEV	fuel cell electric vehicle
GCF	Governors' Climate and Forests Task Force
GDP	gross domestic product
GHG	greenhouse gas
GSP	gross state product
GW	gigawatt
GWh	gigawatt-hour
GWP	global warming potential
HDV	heavy-duty vehicle
HD ZEV	heavy-duty zero-emission vehicle
HFC	hydrofluorocarbon
IBank	Infrastructure and Economic Development Bank
ICE	internal combustion engine
IPCC	Intergovernmental Panel on Climate Change

IPT	incidence-per-ton
IWG	Interagency Working Group
LCFS	low-carbon fuel standard
LDV	light-duty vehicle
MDV	medium-duty vehicle
MMT	million metric tons
$MMTCO_2e$	million metric tons of carbon dioxide equivalent
MOU	memorandum of understanding
MRR	Mandatory Reporting of GHG Emissions
$MTCO_2e$	metric tons of carbon dioxide equivalent
MW	megawatt
N_2O	nitrous oxide
NEMS	National Energy Systems Model
NF_3	nitrogen trifluoride
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NRDC	National Resources Defense Council
NWL	Natural and Working Lands
OEHHA	Office of Environmental Health Hazard Assessment
OGV	Ocean-Going Vessel
OPR	Governor's Office of Planning and Research
OTC	once-through cooled
PFC	perfluorocarbon
PHMSA	Pipelines and Hazardous Materials Safety Administration
PM	particulate matter
$PM_{2.5}$	fine particulate matter
PPP	public-private partnership
RFS	renewable fuel standard

ROG	reactive organic gases
RPS	Renewables Portfolio Standard
SB	Senate Bill
SC-CH_4	social cost of methane
SC-CO_2	social cost of carbon
SC-GHG	social cost of greenhouse gases
SC-N_2O	social cost of nitrous oxide
SF_6	sulfur hexafluoride
SGIP	Self-Generation Incentive Program
SLCP	short-lived climate pollutant
TSD	Technical Support Document
UC	University of California
UCLA	University of California, Los Angeles
UNFCCC	United Nations Framework Convention on Climate Change
U.S. EPA	United States Environmental Protection Agency
VMT	vehicle miles traveled
WUI	wildland-urban interface
ZEV	zero-emission vehicle

Executive Summary

This Scoping Plan lays out the sector-by-sector roadmap for California, the world's fifth[1] largest economy, to achieve carbon neutrality by 2045 or earlier, outlining a technologically feasible, cost-effective, and equity-focused path to achieve the state's climate target. This is a challenging but necessary goal to minimize the impacts of climate change. There have been three previous Scoping Plans. Previous plans have focused on specific greenhouse gas (GHG) reduction targets for our industrial, energy, and transportation sectors—first to meet 1990 levels by 2020, then to meet the more aggressive target of 40 percent below 1990 levels by 2030. This plan, addressing recent legislation and direction from Governor Newsom, extends and expands upon these earlier plans with a target of reducing anthropogenic emissions to 85 percent below 1990 levels by 2045. This plan also takes the unprecedented step of adding carbon neutrality as a science-based guide and touchstone for California's climate work. The plan outlines how carbon neutrality can be achieved by taking bold steps to reduce GHGs to meet the anthropogenic emissions target and by expanding actions to capture and store carbon through the state's natural and working lands and using a variety of mechanical approaches.

What this means for California is an ambitious and aggressive approach to decarbonize every sector of the economy, setting us on course for a more equitable and sustainable future in the face of humanity's greatest existential threat, and ensuring that those who benefit from this transformation include communities hardest hit by climate impacts and the ongoing pollution from the use of fossil fuels. The combustion of fossil fuels has polluted our air—particularly in low-income communities and communities of color—for far too long and is the root cause of climate change. This Scoping Plan helps us chart the path to a future where race and class are no longer predictors of disproportionate burdens from harmful air pollution and climate impacts.

The major element of this unprecedented transformation is the aggressive reduction of fossil fuels wherever they are currently used in California, building on and accelerating carbon reduction programs that have been in place for a decade and a half. That means rapidly moving to zero-emission transportation; electrifying the cars, buses, trains, and trucks that now constitute California's single largest source of planet-warming pollution. It also means phasing out the use of fossil gas used for heating our homes and buildings. It means clamping down on chemicals and refrigerants that are thousands of times more powerful at trapping heat than carbon dioxide (CO_2). It means providing our communities

[1] In October 2022, California was poised to become the world's fourth largest economy.

with sustainable options for walking, biking, and public transit to reduce reliance on cars and their associated expenses. It means continuing to build out the solar arrays, wind turbine capacity, and other resources that provide clean, renewable energy to displace fossil-fuel fired electrical generation. It also means scaling up new options such as renewable hydrogen for hard-to-electrify end uses and biomethane where needed. Successfully achieving the outcomes called for in this Scoping Plan would reduce demand for liquid petroleum by 94 percent and total fossil fuel by 86 percent in 2045 relative to 2022.[2] Despite these world-leading efforts, some amount of residual emissions will remain from hard-to-abate industries such as cement, internal combustion vehicles still on the road, and other sources of GHGs, including high global warming chemicals used as refrigerants.

The plan addresses these remaining emissions by re-envisioning our natural and working lands—forests, shrublands/chaparral, croplands, wetlands, and other lands—to ensure they play as robust a role as possible in incorporating and storing more carbon in the trees, plants, soil, and wetlands that cover 90 percent of the state's 105 million acres while also thriving as a healthy ecosystem. Modeling indicates that natural and working lands will not, on their own, provide enough sequestration and storage to address the residual emissions. For that reason, it is necessary to research, develop, and deploy additional methods of capturing CO_2 that include pulling it from the smokestacks of facilities, or drawing it out of the atmosphere itself and then safely and permanently utilizing and storing it, as called for in recent legislation. Carbon removal also will be necessary to achieve net negative emissions to address historical GHGs already in the atmosphere.

This is a plan that aims to shatter the carbon status quo and take action to achieve a vision of California with a cleaner, more sustainable environment and thriving economy for our children. This ambitious plan will serve as a model for other partners around the world as they consider how to make their transition. As we have so often in the past, California can continue to serve as a leader in innovation that has produced not only the fifth largest economy on the planet, but ultimately one of the most energy-efficient economies, with a track record of demonstrating the ability to decouple economic growth from carbon pollution. This plan also builds upon current and previous environmental justice efforts to integrate environmental justice directly into the plan, to ensure that all communities can reap the benefits of this transformational plan. Specifically, this plan:

[2] See *https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx* for energy demand reductions.

- Identifies a path to keep California on track to meet its SB 32 GHG reduction target of at least 40 percent below 1990 emissions by 2030.
- Identifies a technologically feasible, cost-effective path to achieve carbon neutrality by 2045 and a reduction in anthropogenic emissions by 85 percent below 1990 levels.
- Focuses on strategies for reducing California's dependency on petroleum to provide consumers with clean energy options that address climate change, improve air quality, and support economic growth and clean sector jobs.
- Integrates equity and protecting California's most impacted communities as driving principles throughout the document.
- Incorporates the contribution of natural and working lands (NWL) to the state's GHG emissions, as well as their role in achieving carbon neutrality.
- Relies on the most up-to-date science, including the need to deploy all viable tools to address the existential threat that climate change presents, including carbon capture and sequestration, as well as direct air capture.
- Evaluates the substantial health and economic benefits of taking action.
- Identifies key implementation actions to ensure success.

The path forward is informed by robust science. The recent Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) summarizes the latest scientific consensus on climate change. It finds that atmospheric concentrations of CO_2 have increased by 50 percent since the industrial revolution and continue to increase at a rate of two parts per million each year.[3] By the 2030s, and no later than 2040, the world will exceed 1.5°C warming unless there is drastic action. While every tenth of a degree matters—every incremental increase in warming brings additional negative impacts—climate-related risks to human health, livelihoods, and biodiversity are projected to increase further under 2°C warming, compared to 1.5°C.[4] For example, at 1.5°C of global warming, we would experience increasing heat waves, longer warm seasons, and shorter cold seasons, but at 2°C of global warming, heat extremes would more often reach critical tolerance thresholds for human health and agriculture.[5] We are already seeing unprecedented climate change impacts, such as continued sea level rise, that are

[3] IPCC. 2021. *Climate Change 2021: The Physical Science Basis.* Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press. https://www.ipcc.ch/report/ar6/wg1/.

[4] IPCC. 2018. *Global Warming of 1.5°C.* World Meteorological Organization. Geneva, Switzerland. 32 pp. https://www.ipcc.ch/sr15/.

[5] IPCC. 2021. Climate change widespread, rapid, and intensifying – IPCC. August. *https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/.*

"irreversible" for centuries to millennia, and we are dangerously close to hitting 1.5ºC in the near term.[6] To avoid climate catastrophe and remain below 1.5°C with limited or no overshoot of that threshold, global net anthropogenic CO_2 emissions need to reach net zero by 2050.

It has been 16 years since the Global Warming Solutions Act of 2006 was passed and signed into law. In 2017, the second update to the Assembly Bill (AB) 32 Climate Change Scoping Plan[7] (2017 Scoping Plan) laid out a cost-effective and technologically feasible path to achieve the 2030 GHG reduction target. At the time, many characterized the plan and the AB 32 target as unachievable, citing that it would lead to massive business and job loss, and excessive costs. Those predictions proved to be incorrect as California achieved its AB 32 target years ahead of schedule, all the while growing our economy, with the state distinguishing itself as a hub for green technology investment. This Scoping Plan draws on a decade and a half of proven successes and additional new approaches to provide a balanced and aggressive course of effective actions to achieve carbon neutrality in 2045, if not before, in addition to the 2030 goal.

California's economy is projected to grow vigorously in the coming years and decades. In 2045, under a Reference Scenario, the gross state product would be $5.1 trillion, nearly $2 trillion more than in 2021, and allow growth that would add hundreds of thousands of jobs. Under the Scoping Plan scenario, impacts to economic and job growth would be negligible in both 2035 and 2045, while delivering $199 billion of benefits in the form of reduced hospitalizations, asthma cases, and lost work and school days due to the cleaner air supported by this plan. This should come as no surprise given the tremendous growth of California's economy since the Great Recession of 2007–2009, even as the state has taken drastic measures to lower emissions. As noted, the savings associated with ambitious climate action are extensive, both in terms of avoided climate impacts and health costs. As described in Chapter 1, the health costs of climate and air pollution in the U.S. are well over $800 billion today and will continue to grow in the coming years[8] without robust action. Similarly, the costs of delayed or insufficient climate action could cost the

[6] United Nations. 2021. IPCC report: 'Code red' for human driven global heating, warns UN chief. August 9. *https://news.un.org/en/story/2021/08/1097362*.
[7] CARB. 2017. *California's 2017 Climate Change Scoping Plan.* *https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf.*
[8] Alwis, D. D., and V. S. Limaye. No date. *The Costs of Inaction: The Economic Burden of Fossil Fuels and Climate Change on Health in the United States.* NRDC, The Medical Society Consortium on Climate and Health, and WHPCA. https://www.nrdc.org/sites/default/files/costs-inaction-burden-health-report.pdf.

U.S. upwards of $14.5 trillion over the next 50 years.[9] We can either take action now or pay the cost of inaction, both now and later.

We cannot take on this unprecedented challenge alone. Collaboration with the federal government, other U.S. states, and other jurisdictions around the world will continue to be fundamental for California to succeed in achieving its climate targets, especially as the pace of our efforts increases in the coming years. We believe this collaboration and coordination also creates a race to the top, encouraging and enabling other jurisdictions to achieve climate and air quality goals as well, and often providing lessons for national action.

One example of fruitful collaboration is California's longstanding vehicle emissions standards programs, which have repeatedly been freely adopted by other states, consistent with the federal Clean Air Act. California's programs frequently pioneer more rigorous standards or new technologies—such as the now-standard catalytic converter and the rules that led directly to the nation-leading numbers of zero-emission vehicles on our roads today. From initial standards for cars and trucks decades ago to the world-leading Advanced Clean Trucks program currently helping to electrify heavy-duty vehicles, this partnership continues to offer regulatory options and spread innovative technologies. A major example of future work is the Advanced Clean Cars II program, which lays out California's legally binding path to achieving 100 percent zero emission vehicle (ZEV) sales in 2035.[10] The California Air Resources Board (CARB) continues to work closely with many other states that also see zero-emission vehicles as critical to their climate and public health goals and expects many states to choose to adopt this regulation as well. This partnership with other states also creates market certainty for automakers, which in turn helps to ensure that California consumers have access to a variety of ZEVs at multiple price points.

The Scoping Plan Process

Four scenarios were extensively modeled to develop this Scoping Plan, with the objective of informing the most viable path to remain on track to achieve our 2030 GHG reduction target: a reduction in anthropogenic emissions by 85% below 1990 levels and carbon neutrality by 2045. All four have their merits and are informed by stakeholder input. The scenario ultimately chosen as the basis of this Scoping Plan is the alternative that most

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[9] Deloitte. 2022. *The Turning Point: A New Economic Climate in the United States.* https://www2.deloitte.com/content/dam/Deloitte/us/Documents/about-deloitte/us-the-turning-point-a-new-economic-climate-in-the-united-states-january-2022.pdf?id=us:2el:3dp:wsjspon:awa:WSJSBJ:2021:WSJFY22.

[10] Executive Department. State of California. Executive Order N-79-20. *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf*.

closely aligns with existing statute and Executive Orders. It was selected because it best achieves the balance of cost-effectiveness, health benefits, and technological feasibility.

For the first time, this Scoping Plan includes modeling and quantification of GHG emissions and carbon sequestration in natural and working lands (NWL). To date, the focus has been only on reducing the emissions of GHGs from our transportation, energy, and industrial sectors. The state's 2020 and 2030 GHG reductions targets only include these sources, as they are the primary drivers of climate change and disproportionate harmful air pollution in our vulnerable communities. This Scoping Plan, through the lens of carbon neutrality, expands the scope to more meaningfully consider how our NWL contribute to our long-term climate goals. For the first time, new and cutting-edge modeling tools allow us to estimate the quantitative ability of our forests and other landscapes to remove and store carbon under different scenarios. These cutting-edge tools were developed through a stakeholder process and in coordination with other agencies for the purpose of this update and will continue to be refined over time and made available to others seeking to do similar work.

As recent data and Scoping Plan modeling shows, our NWL also can act as a source of emissions, principally in the form of wildfires. California's forests are experiencing a deadly combination of drought and heat combined with a century of misguided fire suppression management. Scoping Plan modeling shows that, at this time and until our forests reach a balance through appropriate treatments, California's NWL will act as a net source of emissions, not a sink. As such, the Scoping Plan includes policy direction and actions intended to quickly move the sector toward being a net sink and a more natural state, where wildfires will continue to be an important part of the healthy forest cycle but not at the intensity and frequency observed in recent years.

Development of this Scoping Plan also includes careful consideration of, and coordination with, other state agencies, consistent with Governor Gavin Newsom's whole-of-government approach to tackling climate change. State agency plans and regulations, including the SB 100 Joint Agency Report,[11] State Implementation Plan, Climate Action Plan for Transportation Infrastructure,[12] AB 74 Studies on Vehicle Emissions and Fuel

[11] California Public Utilities Commission (CPUC), California Energy Commission (CEC), and CARB. 2021. *SB 100 Joint Agency Report.* https://www.energy.ca.gov/sb100.
[12] California State Transportation Agency (CalSTA). 2021. Climate Action Plan for Transportation Infrastructure. https://calsta.ca.gov/subject-areas/climate-action-plan.

Demand and Supply,[13,14,15] Short-Lived Climate Pollutant Strategy (SLCP Strategy),[16] CARB's Achieving Carbon Neutrality Report,[17] Climate Smart Lands Strategy,[18] Natural Working Land Implementation Plan,[19] and the California Climate Insurance Report: *Protecting Communities, Preserving Nature, and Building Resiliency,*[20] among others, provided critical inputs and data points for this plan. This Scoping Plan is the product of work by multiple agencies across the Administration, including dozens of public workshops and years of rigorous analysis and economic modeling by California's leading institutions. This cooperation on planning lays the foundation for even closer coordination among and between state agencies to put the plan into effect.

The plan is also the product of tireless efforts of, and recommendations from, the AB 32 Environmental Justice Advisory Committee (EJ Advisory Committee). The EJ Advisory Committee, created by statute, plays a critical role to inform the development of each Scoping Plan and helps to ensure environmental justice is integrated throughout the plan. CARB reconvened the EJ Advisory Committee in early 2021 to advise on the development of this Scoping Plan. In their advisory role, the EJ Advisory Committee has worked together to provide inputs to CARB to inform the development of scenarios and the associated modeling. And in April 2022, the EJ Advisory Committee provided draft preliminary recommendations in advance of the Draft 2022 Scoping Plan to help ensure the draft plan meaningfully addresses environmental justice. The CARB Board and EJ Advisory Committee held a joint board hearing on September 1, 2022, where the EJ Advisory Committee presented their final recommendations on the Scoping Plan. Over five dozen of the recommendations are reflected in the Scoping Plan. Going forward, as this plan is ultimately acted on by the Board, ongoing input from the EJ Advisory

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[13] California Environmental Protection Agency (CalEPA). 2021. Carbon Neutrality Studies. https://calepa.ca.gov/climate/carbon-neutrality-studies/.

[14] Brown, A. L., et. al. 2021. *Driving California's Transportation Emissions to Zero.* University of California Institute of Transportation Studies. https://escholarship.org/uc/item/3np3p2t0.

[15] Deschenes, O. 2021. *Enhancing equity while eliminating emissions in California's supply of transportation fuels.* University of California Santa Barbara. https://zenodo.org/record/4707966#.YKPiaKhKi73.

[16] CARB. Short-Lived Climate Pollutants. https://ww2.arb.ca.gov/our-work/programs/slcp.

[17] Energy and Environmental Economics, Inc. 2020. *Achieving Carbon Neutrality in California: PATHWAYS Scenarios Developed for the California Air Resources Board*. October. *https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf*.

[18] California Natural Resources Agency (CNRA). 2021. Draft Climate Smart Lands Strategy. *https://resources.ca.gov/Initiatives/Expanding-Nature-Based-Solutions*.

[19] CARB. 2019. *Draft California 2030 Natural and Working Lands Climate Change Implementation Plan. https://ww2.arb.ca.gov/resources/documents/nwl-implementation-draft*.

[20] California Department of Insurance. 2021. *Protecting Communities, Preserving Nature, and Building Resiliency. climate-insurance-report.pdf (ca.gov)*.

Committee will be essential to address environmental justice and achieve the ambitious vision outlined in the plan throughout its implementation in the coming years.

Importantly, per legislative direction, the Scoping Plan development includes modeling and analyses of emissions, economics, air quality, health, jobs, and public health. This work is important to inform the discussion around trade-offs and how to balance the various legislative direction in identifying a path to achieve the state's climate goals. The technical work serves as a backdrop to what this means to Californian's daily lives—to how they will work, play, and live as we act to eliminate fossil fuel combustion and achieve the many public health and environmental benefits that will result from that action.

Ensuring Equity and Affordability

The state has a long history of public health and environmental protection. However racist and discriminatory practices such as redlining have resulted in low-income communities and communities of color being disproportionately exposed to health hazards and pollution burdens.[21] These communities are often located adjacent to major roadways and large stationary sources that not only emit GHGs, but also harmful localized air pollution. The plan delivers on the promise to transform the way we move, live, and work by nearly eliminating our dependence on fossil fuels. It includes effective actions to move with all possible speed to clean energy, zero-emission cars and trucks, energy-efficient homes, sustainable agriculture, and resilient NWL. And it prioritizes working with the communities most impacted to ensure that these strategies address their needs.

An important part of our equity consideration is ensuring the transition to a zero-emission economy is affordable and accessible, and that it uplifts disadvantaged, low-income communities and communities of color. Some aspects of the transition will have associated costs (e.g., escalating efforts to retrofit existing homes and businesses to support electric appliances and vehicles and increased costs of insurance). The state must ensure that these costs do not disproportionately burden consumers. In addition, the state has an important role to play in providing financial incentives, especially to low-income consumers, to allow for uptake of clean technologies. The Department of Community Services and Development's Low Income Weatherization Program is a prime example of this approach, enabling low-income Californians to be part of the zero-emission transition, all while lowering energy bills. The program provides low-income households with solar photovoltaic systems and energy efficiency upgrades at no cost to residents, helping cushion the impact of climate change on vulnerable communities.

[21] CalEPA. 2021. Pollution and Prejudice: Redlining and Environmental Injustice in California. August 16. *https://storymaps.arcgis.com/stories/f167b251809c43778a2f9f040f43d2f5*.

With this Scoping Plan, the state also adds another tool to help identify and close climate change impact gaps that will emerge over time. As California invests in climate mitigation and adaptation, it is essential to understand the relative impact of climate change across the state's diverse communities. We know not all communities are equally resilient in the face of climate impacts due to persisting health and opportunity gaps. We also know that a global metric such as the Social Cost of Carbon cannot adequately capture the incremental additional impact faced by overly burdened communities. The Climate Vulnerability Metric (CVM) is specifically focused on quantifying the community-level impacts of a warming climate on human welfare.

Energy and Technology Transitions

To support the transformation needed, we must build the clean energy production and distribution infrastructure for a carbon-neutral future. The solution will have to include transitioning existing energy production and transmission infrastructure to produce zero-carbon electricity and hydrogen, and utilizing biogas resulting from wildfire management or landfill and dairy operations, among other substitutes. In almost all sectors, electrification will play an important role. That means that the grid will need to grow at unprecedented rates and ensure reliability, affordability, and resiliency through the next two decades and beyond. It also means we need to keep all options on the table, as it will take time to fully grow the electricity grid to be the backbone for a decarbonized economy. We also know that electrification is not possible in all situations. As such, this plan systematically evaluates and identifies feasible clean energy and technology options that will bring both near-term air quality benefits and deliver on longer-term climate goals.

This transition will not happen overnight. It will take time and planning to ensure a smooth transition of existing energy infrastructure and deployment of new clean technology. And while this Scoping Plan has the longest planning horizon of any Scoping Plan to date, this 25-year horizon is still relatively short in terms of transforming California's economy. We must avoid making choices that will lead to stranded assets and incorporate new technologies that emerge over time. Importantly, given the pace at which we must transition away from fossil fuels, we absolutely must identify and address market and implementation barriers to be successful. The scale of transition includes adding four times the solar and wind capacity by 2045 and about 1,700 times the amount of current hydrogen supply.

As we transition our energy systems, we must also rapidly deploy the clean technologies that rely on a decarbonized grid. As called for in Executive Order N-79-20, all new passenger vehicles sold in California will be zero-emission by 2035, and all other fleets will have transitioned to zero-emission as fully possible by 2045. This means the percentage of fossil fuel combustion vehicles will continue to rapidly decrease, becoming a fading vision of the past. Successful implementation of this Executive Order (EO) and other zero-emission priorities will have to be attractive to consumers. As an example,

electric and hydrogen transportation refueling must be readily accessible, and active transportation and clean transit options must be cheaper and more convenient than driving.

Cost-Effective Solutions Available Today

Ultimately, to achieve our climate goals, urgent efforts are needed to slash GHG emissions. Fortunately, cost-effective solutions are available to do so in many cases. In short, this plan relies on existing technologies—it does not require major technological breakthroughs that are highly uncertain.

For example, targeted action to reduce methane emissions can be achieved at low or negative cost, and with significant near-term climate and public health benefits. In many cases, renewable energy and energy storage are cheaper than polluting alternatives, and are already firmly part of our business-as-usual approach; modeling related to the most recent integrated resource planning process at the California Public Utilities Commission (CPUC) has shown that scenarios associated with the best emissions outcomes had the lowest average rates. As another example, research from Energy Innovation shows that the U.S. can achieve 100 percent zero-carbon power by 2035 without increasing customer costs.[22]

The same is either already true, or soon to be true, for zero-emission vehicles as well. Myriad studies show cost parity for light-duty and heavy-duty ZEVs being achieved by mid-decade or shortly thereafter. A carbon neutrality study conducted by the University of California (UC) Institute of Transportation Studies and funded by the California Environmental Protection Agency (CalEPA) shows that achieving carbon neutrality in the transportation sector will *save* Californians $167 billion through 2045.[23] Similar research from the Goldman School of Public Policy at UC Berkeley finds that achieving 100 percent light-duty ZEV sales nationwide would save consumers $2.7 trillion through 2050; equivalent to $1,000 per household, per year, for 30 years.[24]

Many of these outcomes are a direct result of California's vision and policy development to advance clean energy and climate solutions, including through the Renewables Portfolio Standard, Advanced Clean Cars II regulations, SLCP Reduction Strategy, and

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[22] Phadke, A. et al. 2020. "Illustrative Pathways to 100 Percent Zero Carbon Power by 2035 Without Increasing Customer Costs, Energy Innovation." September. *https://energyinnovation.org/wp-content/uploads/2020/09/Pathways-to-100-Zero-Carbon-Power-by-2035-Without-Increasing-Customer-Costs.pdf*.

[23] Brown, A. L., et al. 2021. *Driving California's Transportation Emissions.* *http://dx.doi.org/10.7922/G2MC8X9X*. Retrieved from https://escholarship.org/uc/item/3np3p2t0.

[24] Goldman School of Public Policy. 2021. *2035: The Report: Transportation.* UC Berkeley. April. *https://www.2035report.com/transportation/*.

others. While the world collectively has not yet fully deployed clean energy and climate solutions at the scale needed to adequately address climate change, California has made tremendous progress—even since the last Scoping Plan update in 2017. Continued ambition, leadership, and climate policy development from California will help the state achieve the scale of emissions reductions needed from technologies and strategies that are already cost-effective or close to it today, and will move additional technologies and strategies to that point in the near future. Achieving those outcomes and reducing costs for the entire array of climate solutions needed to achieve carbon neutrality and then maintain net-negative emissions will prove the true measure of California's success. This will enable California to not just meet our own climate targets, but to ultimately develop the replicable solutions that can scale globally to address global warming.

Continue with a Portfolio Approach

Over the past decade and a half, the state has undertaken a successful three-pronged approach to reducing GHGs: incentives, regulations, and carbon pricing. The 2017 Scoping Plan leveraged existing programs such as the Renewables Portfolio Standard, Advanced Clean Cars, Low Carbon Fuel Standard, Short-lived Climate Pollutant Strategy, mobile source measures to achieve federal air quality targets, and a Cap-and-Trade Program, among others, to lay out a technologically feasible and cost-effective path to achieve the 2030 GHG reduction target. When looking toward the 2045 climate goals and the deeper GHG reductions needed across the AB 32 GHG Inventory sectors, all of the existing programs must be evaluated and, as necessary, strengthened to support the rapid production and deployment of clean technology and energy, as well as the increased pace and scale of actions on our natural and working lands.

The challenge before us requires us to keep all tools on the table. Given the climate mitigation co-benefits, critical actions to deliver near-term air quality benefits, such as those included in the State Implementation Plan to achieve the federal air quality standards, are incorporated into this Scoping Plan, as are new legislative mandates to decarbonize the electricity and cement sectors. And, if additional gaps are identified, new programs and policies must be developed and implemented to ensure all sectors are on track to reduce emissions. Opportunities to leverage these programs to address ongoing air quality disparities must also be considered, along with targeted environmental justice policies such as the AB 617 Community Air Protection Program and the investments made possible through the California Climate Investments Program.

Conclusion

California has never undertaken such a comprehensive, far-reaching, and transformative approach to fighting climate change as that called for in this plan. Once implemented, it will place every aspect of how we live, work, play, and travel in California on a more sustainable footing, with a focus on directly benefitting those communities already most burdened by pollution. This comprehensive approach reflects how climate change is

already changing life in California. We have all experienced the impacts of devastating wildfires, extreme heat, and drought. Despite much progress, California still has some of the worst air pollution in the nation, especially in the San Joaquin Valley and the Los Angeles Basin, which is driven by the continued use of fossil fuel-powered trucks and cars.

This Scoping Plan provides a solution; a way forward and a vision of a California where we can and will address those impacts. This plan is fundamentally based on hope. It is a hope grounded in experience and science that we can fundamentally improve the California we leave to future generations. The plan is built on the legacy of effective actions and on the conviction that we can effectively marshal the combined capabilities of California—from state, regional, tribal, and local governments to industry to our research institutions, and most importantly, to the nearly 40 million Californians who will benefit from the actions laid out in the plan. It addresses the challenge of our generation by laying out a pathway and guideposts for action across three decades. But the Scoping Plan is only that: a plan. The hard work—and hopeful work—is putting its recommendations into action. And there is no time to waste.

Post-adoption of the Scoping Plan

As with previous Scoping Plans, CARB Board approval is the beginning of the next phase of climate action. Specifically, approval of this plan catalyzes a number of efforts, including the development of new regulations as well as amendments to strengthen regulations and programs already in place, not just at CARB but across state agencies. The unprecedented rate of transition will also require the identification and removal of market and implementation barriers to the production and deployment of clean technology and energy. All of these actions and more will be needed if we are to achieve our climate goals.

Chapter 1: Introduction

"The debate is over around climate change. Just come to the state of California. Observe it with your own eyes."

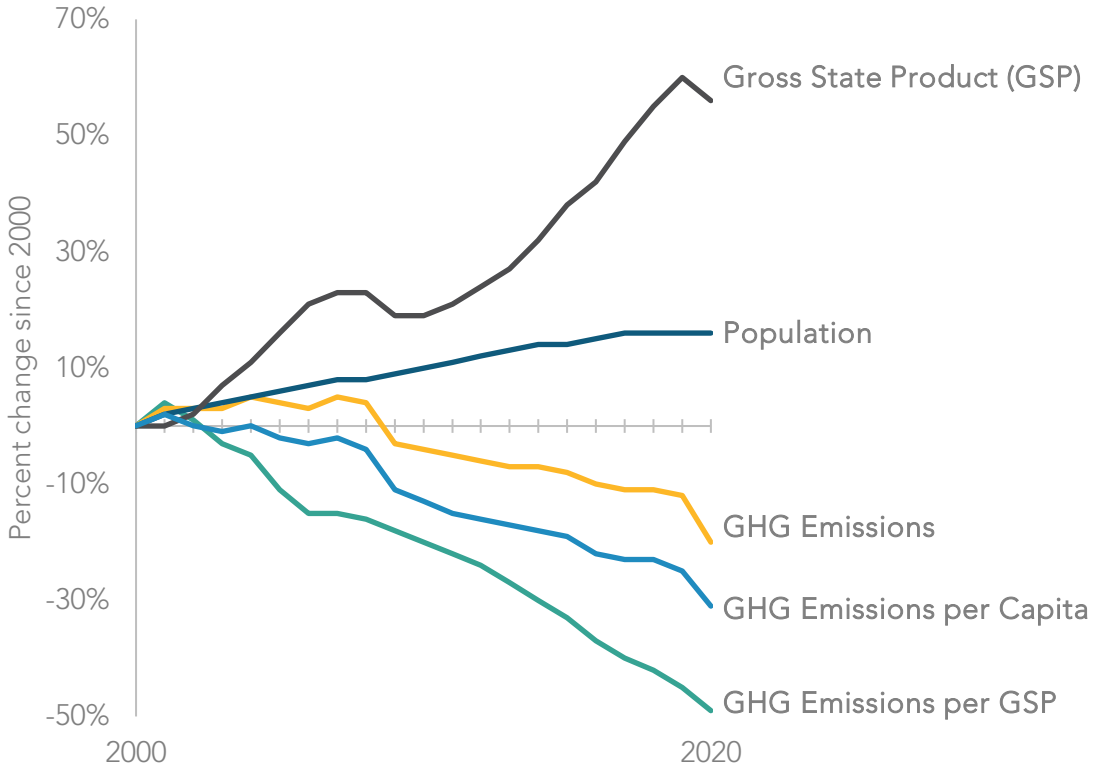
- California Governor Gavin Newsom in September 2020 after surveying the devastation caused by catastrophic wildfires

The impacts of climate change are no longer a distant threat on the horizon—they are right here, right now, with a growing intensity that is adversely affecting our communities and our environment, here in California and across the globe. The science that, decades ago, predicted the impacts we are currently experiencing is even stronger today and unambiguously tells us what we must do to limit irreversible damage: we must act with renewed commitment and focus to do more and do it sooner. That science is indisputable. Unless we increase ambition, we will be faced with more fire, more drought, more temperature extremes, and deadly, choking air pollution. The future of our state—our communities, economy, and ecosystems—is inextricably tied to the way we respond in this decade and the partnerships we forge along the way.

The impacts of climate change fall most heavily on frontline communities that bear the brunt of extreme heat, drought, wildfires, and other effects. Low-income communities and communities of color are also disproportionately impacted by fossil fuel combustion-related air pollution and related health problems. The continued phaseout of fossil fuel combustion will advance both climate and air quality goals and will deliver the greatest health benefits to the most impacted communities.

As it has responded to this climate crisis, California has established itself as a global leader in science-based, public health-focused climate change mitigation and air quality control. The California Legislature has worked with both Republican and Democratic governors to advance action on public health and environmental protections—and California has made progress on addressing climate change during periods of both Republican and Democratic federal administrations. Since the passage of Assembly Bill 32 (AB 32) (Núñez and Pavley, Chapter 488, Statutes of 2006), California has developed bold, creative, and durable policy solutions to protect our environment and public health, all while growing our economy. In fact, California met the target established in AB 32—a return of greenhouse gas (GHG) emissions to 1990 levels by 2020—years ahead of schedule, even as the state established itself as the one of the largest economies in the world. As Figure 1-1 below shows, California's emissions and economic growth have continued to decouple, and California is now the fifth largest economy in the world.

Figure 1-1: California total and per capita GHG emissions[25]



Recognizing both California's early successes in achieving GHG emissions reductions while growing the economy, as well as the worsening impacts of climate change, our governors and legislators have continued to enact ambitious goals. California's unwavering commitment to address climate change is based on indisputable science and data. This commitment is also informed by our collective efforts to address environmental justice and advance racial equity, such that race will no longer be a predictor for disproportionate environmental burdens faced by low-income communities and communities of color. As the Office of Environmental Health Hazard Assessment's

[25] Due to the global pandemic, 2020 is an outlier year and should not be considered indicative of a trend; emissions are likely to increase as economies recover from the impacts of the pandemic.

(OEHHA's) recent analysis of race/ethnicity and air pollution vulnerability and CalEnviroScreen 4.0 scores demonstrate, much work remains to be done.[26]

Many of California's environmental policies have served as models for similar policies in other U.S. states, and at national and international levels. Moving forward, California will continue its pursuit of collaborations and advocacy for action to address climate change at all levels of government. While California is responsible for just one percent of global GHG emissions, and we must do our part, we also play an important role in exporting both political will and technical solutions to address the climate crisis globally.

Today, we have a chance to re-envision California's future and set the state on a path to be carbon neutral no later than 2045 while advancing equity, addressing environmental justice, and continuing to grow our economy. This Scoping Plan provides a roadmap outlining key policies we can implement to achieve our climate goals while improving the health and welfare of Californians and addressing disparities in health outcomes to create a more equitable future. It will enable us to turn the corner in our efforts to protect and preserve our critical natural and public resources, all while providing unparalleled opportunities for clean, pollution-free economic growth.

Severity of Climate Change Impacts

With the increasing severity and frequency of drought, wildfire, extreme heat, and other impacts, Californians just have to look out their windows to know that climate change is real and rapidly getting worse. The impacts we thought we would see in the decades to come are happening now. We must act decisively to both reduce our GHG emissions and build resilience to these impacts for ourselves, future generations, and our iconic landscapes.

Wildfires

Of the twenty largest wildfires ever recorded in California, nine occurred in 2020 and 2021. The worst wildfire season in California's recorded history was in 2018, with over 24,226 structures damaged or destroyed and over 100 lives lost. The largest wildfire season ever recorded in state history was in 2020, where more than 4.3 million acres burned, albeit at different intensity and with varying ecological impacts, and over 112 million metric tons of

[26] OEHHA and CalEPA. 2021. Analysis of Race/Ethnicity and CalEnviroScreen 4.0 Scores. *https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40raceanalysisf2021.pdf*.

carbon dioxide (CO_2) emitted into the atmosphere.[27] The economic damage of these fires was estimated to be over $10 billion in property damage and over $2 billion in fire suppression costs.[28] The Camp Fire, which destroyed much of Paradise, California, was the world's costliest natural disaster in 2018, with overall damages of $16.5 billion.[29] It was also the deadliest fire in California history, with 85 civilian fatalities. Wildfires have always been part of California's natural ecology and will continue to be. However, changes to the state's climate and precipitation expands the footprint of wildfire threat, severity, and intensity, with one quarter of California—more than 25 million acres—now classified as being under very high or extreme fire threat.[30]

The impacts of wildfire smoke have been linked to respiratory infections, cardiac arrests, low birth weight, mental health conditions, and exacerbated asthma and chronic obstructive pulmonary disease.[31] In 2020, with all of California covered by wildfire smoke for over 45 days—and 36 counties for at least 90 days—maximum fine particulate ($PM_{2.5}$) levels persisted in the "hazardous" range of the Air Quality Index for weeks in several areas of the state.[32,33]

Catastrophic wildfire damages extend beyond human health and the economy. The Castle Fire in 2020 and the KNP Complex and Windy Fires in 2021 led to the loss of an unprecedented number of giant sequoias: an estimated 13 to 19 percent of the giant

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[27] CARB. 2020. Public Comment Draft Greenhouse Gas Emissions of Contemporary Wildfire, Prescribed Fire, and Forest Management Activities. https://ww3.arb.ca.gov/cc/inventory/pubs/ca_ghg_wildfire_forestmanagement.pdf.

[28] News18. 2021. San Francisco Bay Area Receives its First Wildfire Warning of 2021, After California Concludes its Driest Year. https://www.news18.com/news/buzz/san-francisco-bay-area-receives-its-first-wildfire-warning-of-2021-after-california-concludes-its-driest-year-3722897.html.

[29] Munich RE. 2019. Extreme Storms, Wildfires and Droughts Cause Heavy Nat Cat Losses In 2018. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2019/2019-01-08-extreme-storms-wildfires-and-droughts-cause-heavy-nat-cat-losses-in-2018.html#-1808457171.

[30] CARB. No date. Wildfires. https://ww2.arb.ca.gov/our-work/programs/wildfires/about.

[31] Reid, C. E., M. Brauer, F. H. Johnston, M. Jerrett, J. R. Balmes, and C. T. Elliott. 2016. "Critical Review of Health Impacts of Wildfire Smoke Exposure." *Environmental Health Perspectives* http://dx.doi.org/10.1289/ehp.1409277.

[32] Vargo J. A. 2020 (updated in 2021 using the NOAA Hazard Mapping System). "Time Series of Potential US Wildland Fire Smoke Exposures." *Frontiers in Public Health* https://doi.org/10.3389/fpubh.2020.00126.

[33] CalFire. 2020 *Fire Siege Report.* https://www.fire.ca.gov/media/hsviuuv3/cal-fire-2020-fire-siege.pdf.

sequoia population in the Sierra Nevada. An iconic species, giant sequoias are the largest trees on earth, with exceptional longevity outside of climate extremes.[34,35]

It is clear that we must take drastic measures to prepare for future wildfires, which is why California invested $2.7 billion in wildfire resilience from fiscal years 2020 to 2023. The exponential increase in funding launched more than 552 wildfire resilience projects in less than a year, and CAL FIRE met its 2025 goal of treating 100,000 acres a full three years ahead of schedule. Since Fiscal Year 2019–20, treatment work has significantly increased, and CAL FIRE has averaged 100,000 acres treated each fiscal year.

Although we are making progress, we have a lot more work to do in order to achieve our goal of treating one million acres annually by 2025. The Governor's Wildfire and Forest Resilience Strategy details 99 actions needed to address the key drivers of catastrophic wildfires, ramp up the pace and scale of forest management, and make threatened communities more resilient to catastrophic fires. It is also important to note that natural wildfire cycles are a part of a sustainable forest ecosystem and will continue to play a role in a healthy forests' future. We should not expect wildfires to cease, but we must manage our lands to address catastrophic wildfires that result from buildup of carbon stocks due to our interventions to suppress wildfires and from climate change resulting from fossil fuel combustion.

Drought

Drought is a recurring feature of the California climate that has been intensified by increasingly warmer average temperatures. Anthropogenic climate trends have exacerbated drought conditions; human-caused climate change accounts for 19 percent of drought severity and 42 percent of the soil moisture deficit in this region since 2000. The governor declared a drought state of emergency in October 2021, and as of September 2022, 94 percent of California was in severe drought, and 99.8 percent[36] of the state was in at least moderate drought. The first three months of 2022 were the driest January, February, and March on record in California.[37] The harsh drought conditions affecting California are part of a larger megadrought—a drought lasting more than two

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[34] Shive, K., C. Brigham, T. Caprio, and P. Hardwick. 2021. 2021 Fire Season Impacts to Giant Sequoias. The Nature Conservancy and National Park Service. *https://www.nps.gov/articles/000/2021-fire-season-impacts-to-giant-sequoias.htm*.

[35] Shive, K. L., A. Wuenschel, L. J. Hardlund, S. Morris, M. D. Meyer, and S. M. Hood. 2022. "Ancient Trees and Modern Wildfires: Declining Resilience to Wildfire in the Highly Fire-adapted Giant Sequoia." *Forest Ecology and Management* 511, 120110. *https://doi.org/10.1016/j.foreco.2022.120110*.

[36] Drought.gov. California. National Oceanic and Atmospheric Administration (NOAA) and the National Integrated Drought Information System. *https://www.drought.gov/states/california*.

[37] Drought.ca.gov. September 26, 2022. California Drought Update. *https://drought.ca.gov/media/2022/09/Weekly-CA-Drought-Update-09262022-FINAL.pdf*.

decades—that has been ongoing in the Southwestern region of North America since 2000. The past 22 years have been the region's driest period since at least 800 CE.[38]

While large urban water districts with diversified sources of water supply have maintained water deliveries to customers through the drought, hundreds of individual well owners and some small water systems have suffered disruption. The state is providing funding for water system consolidation and modernization projects in small communities, emergency repairs and replacements for dry wells, and bottled and hauled water deliveries. A 2021 law requires small suppliers to create drought contingency plans. During the drought of the last three years the state has delivered emergency drinking water assistance to nearly 10,000 households and 150 water systems.

California agriculture is responsible for more than half of all U.S. domestic fruit and vegetable production, and in 2021 drought resulted in the fallowing of nearly 400,000 acres of fields.[39] Direct crop revenue losses were approximately $962 million, and total economic impacts were more than $1.7 billion, with over 14,000 full- and part-time job losses.[40] During the 2011–2017 drought, California's agricultural industry suffered at least $5 billion in losses.[41] The 2022–23 budget includes $100 million to support agricultural water conservation practices, provide on-farm technical assistance, and provide direct relief to small farm operators.

Though native California species are adapted to drought, human engineering has altered most streams and wetlands in the state, making drought increasingly stressful to fish and wildlife. The state has conducted hundreds of fish and amphibian rescues in this drought to move creatures from diminished habitat, upgraded hatcheries, and boosted hatchery production, and has hauled millions of young hatchery salmon to San Francisco Bay to avoid adverse river conditions. State biologists monitor dozens of streams statewide and have negotiated voluntary agreements with landowners and water users to improve stream flows and temperatures.

California has started to implement major policies to build resilience to combat drought—such as the Sustainable Groundwater Management Act of 2014, the governor's Water Resilience Portfolio (2020), the governor's Water and Supply Strategy (August 2022), and

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[38] Williams, A. P., B. I. Cook, and J. E. Smerdon. 2022. "Rapid Intensification of The Emerging Southwestern North American Megadrought in 2020–2021." *Nature Climate Change* https://doi.org/10.1038/s41558-022-01290-z.

[39] Medellín-Azuara, J. 2022. *Economic Impacts of the 2021 Drought on California Agriculture.* University of California Merced. https://wsm.ucmerced.edu/wp-content/uploads/2022/02/2021-Drought-Impact-Assessment_20210224.pdf.

[40] Medellín-Azuara. *Economic Impacts of the 2021 Drought*.

[41] National Resources Defense Council (NRDC). 2019. Climate Change and Health in California. Issue Brief. https://www.nrdc.org/sites/default/files/climate-change-health-impacts-california-ib.pdf.

new standards for indoor, outdoor, and industrial water use. However, it is crucial that we take further actions to minimize the impacts of drought in the years to come.

Extreme Heat

California's hottest summer on record was 2021.[42] Death Valley recorded the world's highest reliably measured temperature (130°F) in July 2021, breaking its own record (129°F) from summer 2020.[43] Meanwhile, Fresno also broke one of its own records, with 64 days over 100°F in 2021.[44] This is part of a trend: the daily maximum average temperature, an indicator of extreme temperature shifts, is expected to rise 4.4°F–5.8°F by 2050 and 5.6°F–8.8°F by 2100.[45] Heat waves that result in public health impacts are also projected to worsen throughout the state. By 2050, these heat-related health events are projected to last two weeks longer in the Central Valley and occur four to ten times more often in the Northern Sierra region.[46]

Heat ranks among the deadliest of all climate hazards in California, and heat waves in cities are projected to cause two to three times more heat-related deaths by mid-century.[47] Climate vulnerable communities[48] will experience the worst of these effects, as heat risk is associated and correlated with physical, social, political, and economic factors. Aging populations, infants and children, pregnant people, and people with chronic illness are especially sensitive to heat exposure.[49,50] Combining these characteristics and existing health inequities with additional factors such as poverty, linguistic isolation,

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[42] NOAA. 2022. Climate at a Glance. *https://www.ncdc.noaa.gov/cag/statewide/time-series/4/tavg/3/8/1895-2021?base_prd=true&firstbaseyear=1901&lastbaseyear=2000*.
[43] Masters, J. 2021. Death Valley, California, breaks the all-time world heat record for the second year in a row. Yale Climate Connections. *https://yaleclimateconnections.org/2021/07/death-valley-california-breaks-the-all-time-world-heat-record-for-the-second-year-in-a-row/*.
[44] NOAA. Climate Data Online Search. Accessed on 16 March 2022. *https://www.ncdc.noaa.gov/cdo-web/search*.
[45] Governor's Office of Planning and Research (OPR), CEC, and CNRA. 2018. *California's Fourth Climate Change Assessment*. Page 23. *https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf*.
[46] OPR, CEC, and CNRA. *California's Fourth Climate Change Assessment - Statewide Summary Report. https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf*.
[47] Ostro, B., S. Rauch, and S. Green. 2011. "Quantifying the health impacts of future changes in temperature in California." National Library of Medicine. *https://pubmed.ncbi.nlm.nih.gov/21975126/*.
[48] CARB. Priority Populations. California Climate Investments. *https://www.caclimateinvestments.ca.gov/priority-populations*.
[49] Basu, R. 2009. "High Ambient Temperature and Mortality: A Review of Epidemiologic Studies from 2001 to 2008." National Library of Medicine. *https://pubmed.ncbi.nlm.nih.gov/19758453/*.
[50] Basu, R., and B. Malig. 2011. "High Ambient Temperature and Mortality in California: Exploring the Roles of Age, Disease, and Mortality Displacement." National Library of Medicine. *https://pubmed.ncbi.nlm.nih.gov/21981982/*.

housing insecurity, and the legacy of racist redlining practices, can put individuals at a disproportionately high risk of heat-related illness and death.[51,52] Rising temperatures will also speed up smog-forming chemical reactions, leading to worse asthma, reduced lung function, cardiac arrest, and cognitive decline. African American, American Indian/Alaskan Native, and Puerto Rican Californians are particularly sensitive to smog, as they are between 28.6 and 132.5 percent more likely to be diagnosed with asthma than white Californians.[53]

In addition to the dangers to public health, California's September 2022 heat wave is particularly illustrative of how more frequent extreme heat strains the state's infrastructure we depend on to adapt to a changing climate. For example, as all-time high temperature records were broken in Sacramento, San Jose, Santa Rosa and Fairfield, electricity demand for air conditioning threatened to overwhelm the state power supply.[54]

California has taken major steps to protect communities from the impacts of extreme heat. Our recent budgets invest $800 million to cool our schools and neighborhoods, including projects to reduce urban overheating. The Extreme Heat Action Plan, released in April 2022, outlines the all-of-government approach California is taking to reduce urgent risks and build long-term resilience to the impacts of extreme heat. In September 2022, Governor Newsom signed multiple bills addressing extreme heat, including AB 2238 (Rivas, Chapter 264, Statutes of 2022), which will create the nation's first extreme heat advance warning and ranking system to better prepare communities ahead of heat waves. The Administration is committed to addressing extreme heat, but we still have a lot of work to do.

Wildfires, drought, and extreme heat are some of the most pronounced climate impacts California is experiencing, but they are not the only ones. Sea level rise, rising ocean temperatures, ocean acidification, and inland flooding are also already having devastating impacts on our communities, ecosystems, and economy, and will continue to do so in the years and decades to come. The decisions and actions that we take today will determine how strongly we will feel the impacts of climate change in the future.

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[51] Hoffman, J. S., V. Shandas, and N. Pendleton. 2020. "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas." MDPI. https://www.mdpi.com/2225-1154/8/1/12/htm.

[52] U.S. Climate Resilience Toolkit. No date. Heat and Social Inequity in the United States. https://toolkit.climate.gov/tool/heat-and-social-inequity-united-states.

[53] NRDC. 2019. Climate Change and Health. Issue Brief. https://www.nrdc.org/sites/default/files/climate-change-health-impacts-california-ib.pdf.

[54] Samenow, Jason. 2022. No September on record in the West has seen a heat wave like this. *The Washington Post.* September 9. https://www.washingtonpost.com/climate-environment/2022/09/08/western-heatwave-records-california-climate/.

Imperative To Act

Consequences of Further Warming

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) found that it will not be possible to keep global warming within the threshold of 1.5°C to avoid the most severe impacts of climate change unless we make immediate and large-scale reductions in GHG emissions. It finds that atmospheric concentrations of CO_2 have increased by 50 percent since the industrial revolution, and that they continue to increase at a rate of two parts per million each year.[55] Without immediate action, the world will exceed 1.5°C (or 2.7°F) warming by the 2030s, and no later than 2040.

While every tenth of a degree matters—every incremental increase in warming brings additional negative impacts—climate-related risks to human health, livelihoods, and biodiversity are projected to increase further under 2°C (or 3.6°F) warming, compared to 1.5°C.[56] To remain below 1.5°C with limited or no overshoot of that threshold, global net anthropogenic CO_2 emissions need to be cut by about half by 2030 and reach net-zero by 2050.

If we fail to make rapid changes, we may not be able to limit global warming to 2°C,[57] and the consequences of inaction would be catastrophic. Our planet is already 1.2°C warmer than pre-industrial times due to human-induced warming, and many impacts we are already experiencing, such as sea level rise, are "irreversible" for centuries to millennia.[58] Californians with the fewest resources, who are disproportionately low-income communities and communities of color, are the most vulnerable to the impacts of climate change. While the human costs associated with health impacts can never be fully monetized, a recent report finds that the health costs of climate and air pollution in the U.S. are well over $800 billion today and will continue to grow in the coming years.[59]

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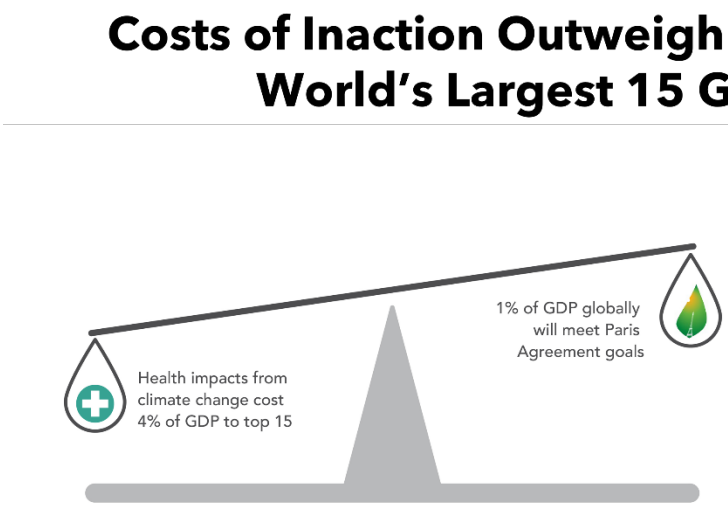
[55] IPCC. 2021. *Climate Change 2021: The Physical Science Basis.* https://www.ipcc.ch/report/ar6/wg1/.
[56] IPCC. 2018. *Special Report: Global Warming of 1.5°C.* World Meteorological Organization. https://www.ipcc.ch/sr15/.
[57] IPCC. 2021. Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis.* Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. In Press. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf.
[58] United Nations. 2021. IPCC report: 'Code red.' https://news.un.org/en/story/2021/08/1097362#:~:text=%27Code%20red%20for%20humanity%27&text=We%20are%20at%20imminent%20risk,%2C%20to%20keep%201.5%20alive.%22.
[59] Alwis, D. D., and V. S. Limaye. No date. *The Costs of Inaction*. https://www.nrdc.org/sites/default/files/costs-inaction-burden-health-report.pdf.

Any delays in action or insufficient action are a threat to public health and the environment. The impacts to our economy would be devastating as well. While not specific to California, a 2022 report from Deloitte Economics Institute finds that failing to take sufficient action to reduce emissions could result in economic losses to the U.S. of more than $14.5 trillion over the next 50 years.[60] On a hopeful note, however, the report finds that if the country invests now and in the coming years in a net-zero economy, $3 trillion could be added to the economy over the next 50 years. The U.S. annual gross domestic product (GDP) would be 2.5 percent higher in 2070 in this fast-action scenario than in the delayed action scenario. The lessons for California from these analyses are clear: invest now or pay the price later. As shown in Figure 1-2, inaction can lead to negative consequences for individuals, communities, the economy, and society as a whole. As discussed later, Governor Newsom and the Legislature have accepted this imperative and made significant investments in climate action. This Scoping Plan combined with the historic investments and policy direction from the governor and Legislature, will result in unprecedented action to address the climate crisis.

[60] Deloitte. 2022. *The Turning Point.* *https://www2.deloitte.com/content/dam/Deloitte/us/Documents/about-deloitte/us-the-turning-point-a-new-economic-climate-in-the-united-states-january-2022.pdf?id=us:2el:3dp:wsjspon:awa:WSJSBJ:2021:WSJFY22*.

Figure 1-2: The real costs of inaction[61]



Exposure to air pollution causes 7 million deaths worldwide every year and costs an estimated US$5.11 trillion in welfare losses globally. In the 15 countries that emit the most greenhouse gas emissions, the health impacts of air pollution are estimated to cost more than 4% of their GDP. Fossil fuel combustion contributes to both air pollution and climate change. Actions to meet the Paris goals would cost about 1% of global GDP.

Scoping Plan Overview

Previous Scoping Plans

The Scoping Plan is a strategy the California Air Resources Board (CARB) develops and updates at least one every five years, as required by AB 32. It lays out the transformations needed across our society and economy to reduce emissions and reach our climate targets. This Scoping Plan is the third update to the original plan that was adopted in 2008. The initial Scoping Plan laid out a path to achieve the AB 32 2020 limit of returning to 1990 levels of GHG emissions, a reduction of approximately 15 percent below business as usual.[62] The 2008 Scoping Plan included a mix of incentives, regulations, and carbon pricing, laying out the portfolio approach to addressing climate change and clearly making the case for using multiple tools to meet California's GHG targets. The 2013 Scoping Plan assessed progress toward achieving the 2020 limit and made the case for addressing

[61] Katowice, P. 2018. *Health benefits far outweigh the costs of meeting climate change goals.* WHO. https://www.who.int/news/item/05-12-2018-health-benefits-far-outweigh-the-costs-of-meeting-climate-change-goals.

[62] CARB. 2008. *Climate Change Scoping Plan.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/document/adopted_scoping_plan.pdf.

short-lived climate pollutants (SLCPs).[63] The most recent update, the 2017 Scoping Plan,[64] also assessed the progress toward achieving the 2020 limit and provided a technologically feasible and cost-effective path to achieving the Senate Bill 32 (SB 32, Pavley, Chapter 249, Statutes of 2016) target of reducing GHGs by at least 40 percent below 1990 levels by 2030.

Overview of this Scoping Plan

It is paramount that we continue to build on California's success by taking effective actions and doubling down on implementation of the strategies outlined here. As such, this Scoping Plan builds on and integrates efforts already underway to reduce the state's GHG, criteria pollutant, and toxic air contaminant emissions by identifying the clean technologies and fuels that should be phased in as the state transitions away from combustion of fossil fuels. By selecting and pursuing a sustainable and clean economic path, the state will continue to successfully execute existing programs, work to eliminate air pollution inequities, demonstrate the coupling of economic growth and environmental progress, and enhance new opportunities for engagement within the state to address and prepare for climate change.

The 2022 Scoping Plan for Achieving Carbon Neutrality (Scoping Plan) is the most comprehensive and far-reaching Scoping Plan developed to date. It identifies a technologically feasible and cost-effective path to achieve carbon neutrality by 2045 while also assessing the progress California is making toward reducing its GHG emissions by at least 40 percent below 1990 levels by 2030, as called for in SB 32 and laid out in the 2017 Scoping Plan.[65] The 2030 target is an interim but important stepping stone along the critical path to the broader goal of deep decarbonization by 2045. Modeling for this Scoping Plan shows that this decade must be one of transformation on a scale never seen before to set us up for success in 2045.

The relatively longer path assessed in this Scoping Plan incorporates, coordinates, and leverages many existing and ongoing efforts to reduce GHGs and air pollution, while identifying new clean technologies and energy. Given the focus on carbon neutrality, this Scoping Plan also includes discussion for the first time of the Natural and Working Lands (NWL) sectors as both sources of emissions and carbon sinks. Chapter 2 of this document

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[63] CARB. 2014. *First Update to the Climate Change Scoping Plan.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf.
[64] CARB. 2017. *California's 2017 Climate Change Scoping Plan.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf.
[65] CARB. 2017. *California's 2017 Climate Change Scoping Plan.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf.

includes a description of a suite of specific actions to drastically reduce GHGs across all sectors. Chapter 3 provides the air quality and economic evaluations of the actions. Chapter 4 provides a broader description of the many actions needed across all sectors to achieve carbon neutrality. Chapter 5 provides an overview of the next steps and partnerships needed to implement this Scoping Plan. Guided by legislative direction, the actions identified in this Scoping Plan reduce overall GHG emissions in California and deliver policy signals that will continue to drive investment and certainty in a low carbon economy. This Scoping Plan builds upon the successful framework established by the Initial Scoping Plan and subsequent updates while identifying new, technologically feasible, and cost-effective strategies.

Principles That Inform Our Approach to Addressing the Climate Challenge

California has decades of experience addressing the climate challenge. Through this experience, and based on extensive engagement with stakeholders through our regulatory and program development processes, we have developed a set of principles to inform our approach.

Unprecedented Investments in a Sustainable Future

The scale of transformation needed over this decade to avoid the worst impacts of climate change and meet our ambitious climate goals is extraordinary. This is why Governor Newsom and the Legislature invested over $15 billion in climate action through the 2021–2022 California Comeback Plan, and why the 2022–2023 budget marks the beginning of the California Climate Commitment—the governor's multi-year plan to invest $54 billion in climate action. The enacted budgets (Figure 1-3) and the California Climate Commitment represent investments of a historic scale and will advance precisely the type of all-of-government approaches necessary to create the whole-of-society changes described in this Scoping Plan that will enable us to avert the worst impacts of climate change.

Figure 1-3: Comprehensive California climate change investments

The *California Climate Commitment* includes the following game-changing elements:

- $10 billion for zero-emission vehicles (ZEVs), including $1.5 billion for electric school buses to protect students' health and $3 billion to build an accessible charging network. ZEV investments will particularly focus on programs such as heavy-duty vehicle and port electrification that will reduce emissions and protect public health in low-income communities.
- $2.1 billion for clean energy investments, such as long duration storage, offshore wind, green hydrogen,[66] and industrial decarbonization.
- $13.8 billion for programs that reduce emissions from the transportation sector, such as improving public transportation while also funding walking, biking, and adaptation projects.
- Over $720 million for California's higher education institutions and research that will support the next generation of climate innovations.

[66] For the purposes of this Scoping Plan, "renewable hydrogen" and "green hydrogen" are interchangeable and are not limited to only electrolytic hydrogen produced from renewables.

- Nearly $1 billion to build sustainable, affordable housing and over $1 billion to help low-income Californians realize energy cost savings through building decarbonization.
- Nearly $9 billion for wildfire risk reduction, drought mitigation, extreme heat resilience, and nature-based solutions.

These investments are incredibly important in the context of this Scoping Plan in that they accompany and help support implementation of the many policies and regulations that will continue to be necessary to achieve our 2030 and carbon neutrality targets. In addition, these incentive programs jump-start emission reduction strategies for priority sectors, sources, and technologies, leveraging private-sector investment and building sustainable, growing markets for clean and efficient technologies. Many of California's incentive programs work in concert with federal and other state programs to drive emission reductions. As an example, as California pushes to move to 100% sales of new zero emission-vehicles, including plug-in hybrid vehicles, the Newsom Administration continues to invest heavily in incentive programs that allow families, communities, and businesses to choose zero-emission vehicles. This is done while simultaneously working with the federal government, other states, and jurisdictions around the world to align policies, regulations, and incentives, creating market certainty for the automakers that serve our markets.

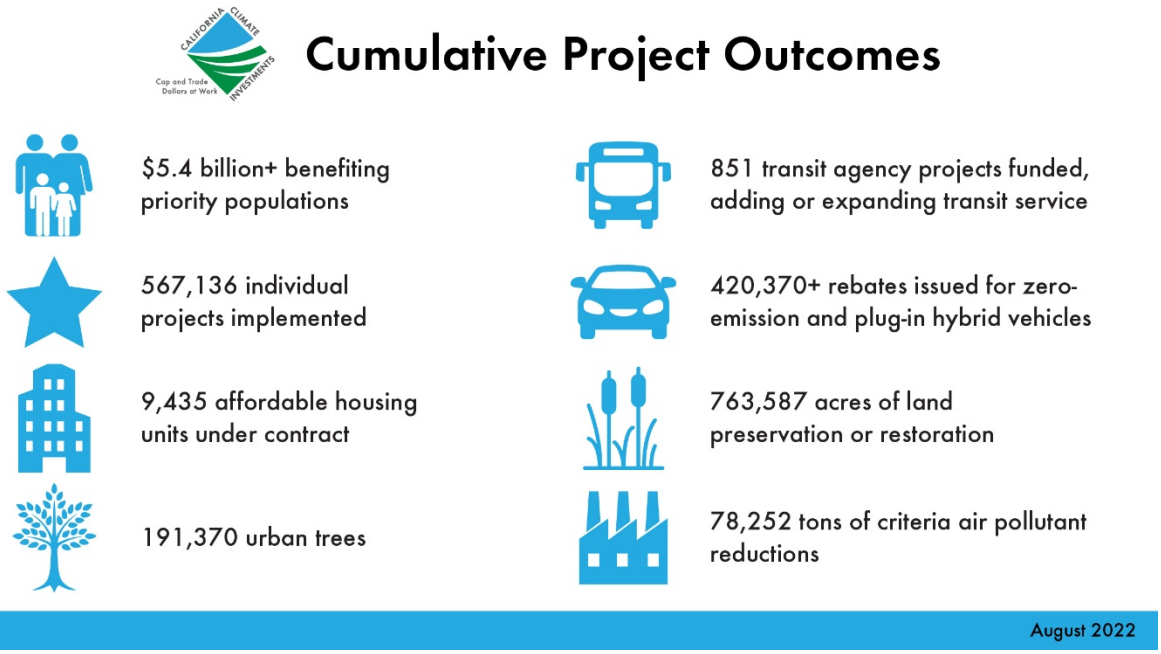
Centering Equity

Prioritizing equity is just as important as the magnitude of the climate investments California is making. Addressing climate change and advancing our equity and economic opportunity goals cannot be decoupled. In line with the governor's Executive Order[67] to take additional actions to embed equity analysis and considerations, this plan works to center equity by addressing disparities for historically underserved and marginalized communities. California strives to ensure that our climate and air research, regulations, investments, and plans include provisions that specifically address and advance equity. This includes reducing and eliminating air pollution disparities, removing barriers that can prevent frontline communities from accessing benefits, lowering costs for low-income Californians, and promoting high-quality jobs. CARB's incentive programs regularly surpass their mandated equity targets, and CARB has incorporated equity-focused provisions in our research, planning, and regulatory efforts. For instance, statute requires that a minimum of 35 percent of California Climate Investments benefit low-income households along with disadvantaged and low-income communities (referred to as *priority*

[67] Executive Department. State of California. 2022. Executive Order N-16-22. *GSS_9320_2-20220912152941 (ca.gov)*.

populations). However, 48 percent—over $5.4 billion—of implemented California Climate Investments project funding is benefiting priority populations, greatly exceeding the statutory minimums (see Figure 1-4). Senate Bill 535 (De León, Chapter 830, Statutes of 2012) and AB 1550 (Gomez, Chapter 369, Statutes of 2016) direct state and local agencies to make significant investments using auction proceeds to assist California's most vulnerable communities. Under these laws, a minimum of 25 percent of the total investments are required to be located within and provide benefits to disadvantaged communities, and at least 10 percent of the total investments must benefit low-income communities and households. Moving forward, the state will continue to devote a greater share of incentive funding to priority populations, with the light-duty vehicle incentive program as just one example. We can simultaneously confront the climate crisis and build a more resilient, just, and equitable future for all communities.

Figure 1-4: California climate investments cumulative outcomes[68,69]



Role of the Environmental Justice Advisory Committee

To inform the development of the Scoping Plan, AB 32 calls for the convening of an Environmental Justice Advisory Committee (EJ Advisory Committee) to advise CARB in developing the Scoping Plan, and any other pertinent matter in implementing AB 32. It requires that the Committee be comprised of representatives from communities with the most significant exposure to air pollution, including communities with minority populations and/or low-income populations. On January 25, 2007, CARB appointed the first

[68] CARB. 2022. California Climate Investments program implements $10.5 billion in greenhouse gas-reducing programs, expected to reduce 76 million metric tons of emissions. April 11. *https://ww2.arb.ca.gov/news/california-climate-investments-program-implements-105-billion-greenhouse-gas-reducing-projects*.

[69] SB 535 and AB 1550 require investments located in and benefiting low-income communities and households, which are termed *priority populations. Disadvantaged communities* are currently defined by CalEPA as the top 25 percent of communities experiencing disproportionate amounts of pollution, environmental degradation, and socioeconomic and public health conditions according to the Office of Environmental Health Hazard Assessment's *CalEnviroScreen tool,* plus certain additional communities including federally recognized Tribal Lands. Low-income communities and households are defined by statute as those with incomes either at or below 80 percent of the statewide median or below a threshold designated as low-income by the Department of Housing and Community Development.

Environmental Justice Advisory Committee to advise it on the Initial Scoping Plan and other climate change programs.

For this Scoping Plan, CARB reconvened the EJ Advisory Committee in May 2021. The committee is currently comprised of 14 environmental justice and disadvantaged community representatives, including the EJ Advisory Committee's first tribal representative, who was appointed in February 2022. In October 2021, the EJ Advisory Committee formally created eight workgroups. These workgroups are a space for EJ Advisory Committee members to better understand specific sectors of the Scoping Plan and to assist the EJ Advisory Committee in the development of recommendations on this Scoping Plan. In December 2021, the EJ Advisory Committee provided scenario input responses to help shape the modeling for this Scoping Plan. In February 2022, San Joaquin Valley EJ Advisory Committee members hosted their first community workshop, with over 100 attendees. In March 2022, the CARB Board held a joint public meeting with the EJ Advisory Committee to discuss their draft preliminary recommendations for this Scoping Plan. In June 2022, over 165 attendees participated in a statewide community workshop held by EJ Advisory Committee members. The full schedule of EJ Advisory Committee Meetings and meeting materials are available on CARB's website.[70] This Scoping Plan includes references where EJ Advisory Committee Final Recommendations[71] are included in the document. The final recommendations were discussed at a joint CARB and EJ Advisory Committee Hearing on September 1, 2022.

The integration of environmental justice is critical to ensure that certain communities are not left behind. The AB 32 EJ Advisory Committee provided recommendations on September 30 in advance of the final Scoping Plan. There are footnotes to indicate where there is alignment between the AB 32 EJ Advisory Committee's recommendations and this Scoping Plan. While the language in the text may not fully incorporate the specific EJ Advisory Committee's recommendation, the footnotes do acknowledge the places in the text where there is general alignment with the spirit of the EJ Advisory Committee's recommendation.

Partnering with Tribes

[70] CARB. Environmental Justice Advisory Committee Meetings and Events. *https://ww2.arb.ca.gov/environmental-justice-advisory-committee-meetings-and-events*.
[71] Environmental Justice Advisory Committee. September 30, 2022. 2022 Scoping Plan Recommendations. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/090122/finalejacrecs.pdf*.

There are 109 federally recognized tribes and over 60 non-federally recognized tribes in California.[72] In 2011, Governor Brown issued Executive Order B-10-11, recognizing and reaffirming the inherent right of tribes to exercise sovereign authority over their members and territory and directing state agencies to engage in government-to-government consultation with tribe and to work to develop partnerships and consensus.[73] In 2019, Governor Newsom issued Executive Order N-15-19, which acknowledges and apologizes on behalf of the state for the historical "violence, exploitation, dispossession and the attempted destruction of tribal communities."[74] Establishing partnerships with tribal leaders to incorporate their priorities, traditional expertise, and knowledge will be important to achieving California's climate goals. The Scoping Plan includes actions that tribal partners can voluntarily implement for sources under their jurisdiction (e.g., transitioning to zero emission fleets, installing infrastructure and control technologies, conducting climate smart land management). The Scoping Plan also uplifts the importance of having our tribal partners help guide actions that may impact tribal cultural resources and of benefitting from tribal input.

We also need alignment between state and local partners and tribes on actions related to land-use decisions. This means respecting and reinforcing tribal sovereignty and self-determination. As tribes do not always draw clear lines between the "natural" and "cultural" resources of a place, taking a holistic perspective will result in positive impacts in ability to address the complex issues of land management and regulatory undertakings.

Tribes have an intimate and historical knowledge of places and should be engaged early on to inform planning and future management related to activities that may impact tribal resources and areas including potential funding opportunities, technical assistance, and capacity building, where appropriate. Additionally, tribes should be involved in the identification of their own significant resources and areas of use. As decisions are made related to Scoping Plan undertakings, agencies should recognize and appropriately consider cultural resources and management from the beginning, not as an afterthought; and consider how the project could impact tribes.

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[72] These numbers are subject to change depending on determinations made by the Bureau of Indian Affairs (BIA) and the Native American Heritage Commission (NAHC). Please consult the most current Federal Register for a list of federally recognized tribes and the NAHC for a list of non-federally recognized tribes in California. As of the date of the Scoping Plan, the current list for federally recognized tribes is located at 87 Fed. Reg. 4636 (Jan. 28, 2022).

[73] Executive Order B-10-11. *https://www.ca.gov/archive/gov39/2011/09/19/news17223/index.html#:~:text=EXECUTIVE%20ORDER%20B-10-11%20Published%3A%20Sep%2019%2C%202011%20WHEREAS,and%20affirmed%20in%20state%20and%20federal%20law%3B%20and*.

[74] Executive Order N-15-19. *https://tribalaffairs.ca.gov/wp-content/uploads/sites/10/2020/02/Executive-Order-N-15-19.pdf*.

Finally, to the extent allowed by law, traditional ecological knowledge and culturally sensitive information should be protected, as this is information that may not be common knowledge and may not be known outside the tribe, as each tribe is unique and influenced by its local environment and cultural practices. Protection of this information will help foster productive relationships with tribes and should be included as part of the process. CARB and other agencies should continue to foster relationships with tribal partners.

Maximizing Air Quality and Health Benefits

The state has over 50 years of experience successfully cleaning the air in California by addressing criteria pollutants and toxic air contaminants from mobile and stationary sources. CARB has been a leader in measuring, evaluating, and reducing sources of air pollution that impact public health. Its air pollution programs have been adapted for national programs and emulated in other countries. Significant progress has been made in reducing diesel particulate matter (PM), which is a designated toxic air contaminant, and many other hazardous air pollutants. CARB partners with local air districts to address stationary source emissions and adopts and implements state-level regulations to address sources of criteria and toxic air pollution, including mobile sources. CARB also collaborates with federal agencies to address air pollution from sources primarily under federal jurisdiction. In many instances, actions to reduce fossil fuel combustion and achieve federal air quality standards also help to reduce GHG emissions.

However, air pollution disparities still exist, and more must be done to ensure the most vulnerable populations have safe air to breathe. California must continue to evaluate opportunities to harmonize our climate and air quality programs through innovative policymaking and by building on existing programs like the Low Carbon Fuel Standard (LCFS) and Community Air Protection Program. The LCFS includes a provision that allows electric utilities to opt-in and generate residential electric vehicle (EV) charging credits, where some of the revenues are invested back into rebate programs that address air quality and climate pollution.[75] The Community Air Protection Program[76] is the first of its kind in the country and brings together diverse stakeholders, including CARB, local air districts, and residents of environmental justice communities to increase local air monitoring and develop community-led plans to improve air quality in the communities most impacted by air pollution.

This Scoping Plan identifies actions that will deliver near-term air quality benefits to communities with the highest exposures and provide long-term GHG benefits. Many of the actions in this Scoping Plan are key elements of the 2022 State Strategy for the State

[75] CARB. LCFS Utility Rebate Programs. *https://ww2.arb.ca.gov/resources/documents/lcfs-utility-rebate-programs*.
[76] CARB. Community Air Protection Program. *https://ww2.arb.ca.gov/capp*.

Implementation Plan to meet federal air quality standards,[77] which has a primary focus of reducing harmful air pollution and achieving federal air quality targets. California's approach of leveraging air quality and GHG policies together has yielded results. A 2022 report by the Office of Environmental Health and Hazard Assessment (OEHHA)[78] that evaluated GHG and harmful air pollution emissions from the heavy-duty vehicle (HDV) and large stationary source sectors found declines in emissions in both sectors, with the greatest declines in disadvantaged communities. Both sectors are subject to state GHG and air quality policies, in addition to federal and local rules on harmful air pollution. Because of historically racist and discriminatory practices such as redlining, both types of sources are disproportionately located adjacent to vulnerable communities, which are predominantly communities of color.[79] The key findings from the OEHHA report are as follows:

- Both HDVs and facilities subject to the Cap-and-Trade Program have reduced emissions of co-pollutants, with HDVs showing a clearer downward trend when compared to stationary sources. These emission reductions have major health benefits, including a reduction in premature pollution-related deaths.
- The greatest beneficiaries of reduced emissions from both HDVs and facilities subject to the Cap-and-Trade Program have been in communities of color and in disadvantaged communities in California, as identified by CalEnviroScreen (CES). This has reduced the emission gap between disadvantaged and non-disadvantaged communities, but a wide gap still remains.
- The transition to zero-emission HDVs will expedite further emissions reductions.
- While the progress observed is encouraging, inequities persist, and federal, state, and local climate and air quality programs must do more to reduce emissions of GHGs and co-pollutants to reduce the burden of emissions on disadvantaged communities and communities of color.

It will take all tools at all levels of government, with robust enforcement, to ensure that vulnerable communities continue to see improvements in air quality until no disparities exist in air pollution across the state.

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[77] CARB. 2022 State Strategy for the State Implementation Plan. *https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy*.
[78] OEHHA. 2022. *Impacts of Greenhouse Gas Emission Limits within Disadvantaged Communities: Progress Toward Reducing Inequities. https://oehha.ca.gov/environmental-justice/report/ab32-benefits*.
[79] CalEPA. 2021. Pollution and Prejudice. *https://storymaps.arcgis.com/stories/f167b251809c43778a2f9f040f43d2f5*.

Economic Resilience

The state's efforts to tackle the climate crisis will create economic and workforce development opportunities in the clean energy economy in communities across the state. Transitioning existing skills and expanding workforce training opportunities in climate-related fields are critical for reducing harmful emissions and supporting workers in transitioning to new, high-quality jobs. The Administration's recent budgets acknowledge the challenges facing workers in industries most affected by the state's response to climate change—especially those in the fossil fuel industry. It will invest $1 billion in regional partnerships and economic diversification to create new jobs and support a local tax base and workforce transition and development once opportunities are identified. It also will invest in safety nets to protect, and support impacted communities as part of the transition to a carbon neutral economy. Specifically, the Community Economic Resilience Fund Program[80] (CERF) supports communities and regional groups in producing regional roadmaps for economic recovery and transition that prioritize the creation of accessible, high-quality jobs in sustainable industries. The budget investments create the opportunity to future-proof and increase economic resilience in the face of more frequent climate impacts and shifting economic conditions. For these investments and implementation of the Scoping Plan to be successful in supporting the transition to a carbon neutral economy, workers and affected communities must be included in ongoing dialogue to ensure a high-road transition for regional economies.

That state also recognizes it can play a more direct role in supporting a sustainable work force through its incentive programs. In 2021, Assembly Bill 680 (AB 680) (Burke, Chapter 746, Statutes of 2021) was signed into law, requiring CARB to work with the California Labor and Workforce Development Agency to update the Funding Guidelines to include new workforce standards. CARB's Funding Guidelines currently include requirements for administering agencies to, wherever possible, foster job creation within California, provide employment opportunities or job training tied to employment, and target these opportunities to priority populations. The Funding Guidelines also recommend administering agencies prioritize investments in projects that directly support jobs or a job training and placement program, and that they report the estimated employment benefits and employment outcomes for projects that meet specified criteria. These new requirements apply to agencies administering certain California Climate Investments

[80] Office of Planning and Research. Community Economic Resilience Fund. *https://opr.ca.gov/economic-development/cerf/*.

programs that receive continuous appropriations from the Greenhouse Gas Reduction Fund and fall into the following six categories of standards:

- fair and responsible employer standards,
- inclusive procurement policies,
- prevailing wage for construction work,
- community workforce agreements for construction projects over one million dollars,
- preference for projects with educational institutions or training programs, and
- creation of high-quality jobs. CARB will be updating the Funding Guidelines through a public process over the next year to operationalize these new requirements.

Partnering Across Government

The Scoping Plan is an actionable plan to identify and align programs and policies to achieve California's climate targets. To realize the outcomes and deliver results in any Scoping Plan, action is critical. For this Scoping Plan, there are also actions that rely on our federal partners to take on sources primarily under their jurisdiction (such as aviation, and federally owned/managed lands) while they also continue to develop national programs for GHG reductions. The federal government is already taking major steps to advance these types of programs. The Inflation Reduction Act of 2022[81] includes $369 billion for domestic energy production and manufacturing and is expected to lead to U.S. GHG emission reductions of roughly 40 percent by 2030. Direct incentives will include those for clean vehicles and ENERGY STAR appliances, as well as improving transportation and clean energy in underserved communities.

We also need our local partners to align on actions related to land-use decisions that support sustainable, resilient, low-carbon communities and permitting for clean energy production facilities and infrastructure; diversion of organics from landfills; and other climate-related projects. State agencies also should use the Scoping Plan to review and update their own programs and policies to support the actions identified in this Scoping Plan. Importantly, the Scoping Plan also can serve as a resource as the Legislature considers new legislative direction and funding to support the state's path to carbon neutrality and continue action to address near-term air pollution disparities.

Partnering with the Private Sector

Government cannot achieve our climate targets alone. The scale of investment needed requires both private-sector investment and partnerships with philanthropies. Public

[81] Pub.L. No. 117-169 (August 16, 2022).

sector dollars, accompanied by strong and steady policy signals, must be a catalyst for deeper and broader investments by the private sector in both reducing emissions and building the resilience of our communities. Governor Newsom is committed to working collaboratively with businesses, including small businesses, to deploy the technologies, capital, and ingenuity that are hallmarks of the private sector.

California structures our climate policies and regulations to create market signals and certainty that spur private sector investment. For example, the Governor's Executive Order on Zero-Emission Vehicles[82] set 2035 as the target year for 100 percent zero-emission vehicle sales, creating a time horizon that allows automakers to scale up zero-emission fleets and sending a clear signal to the companies and utilities that would deploy charging infrastructure. The Executive Order has been followed by development and adoption of the Advanced Clean Cars II regulation. CARB convened auto manufacturers, environmental justice groups, labor organizations, and many other stakeholders to provide input into development of the regulation in a robust and transparent manner; again, with the aim of providing certainty for producers and consumers.

California also pursues public-private partnerships (PPP) as a mechanism to advance our collective climate goals. We know these vehicles can be effective at increasing the impact of public sector dollars and helpful in moving markets in a direction aligned with state policy. A new PPP the Administration is advancing is the Climate Catalyst Revolving Loan Fund, housed at the state's Infrastructure and Economic Development Bank (IBank). The fund offers a range of financial instruments—including flexible credit and credit support—to help bridge financing gaps currently preventing advanced climate solutions from scaling in the marketplace. The Catalyst Fund's initial areas of investment include forest biomass management and utilization (unlocking innovation to reduce wildfire threats), climate-smart agriculture, and clean energy transmission. The fund leverages public sector investments by mobilizing private finance for shovel-ready projects that are stuck in the deployment phase. As such, IBank is ideally positioned as the state's all-purpose "Green Bank," with increasing connection to federal financing programs such as US DOE's Loan Programs Office and the United States Environmental Protection Agency's (U.S. EPA) Greenhouse Gas Reduction Fund.

The Catalyst Fund builds from existing IBank financing programs that are themselves increasingly focused on the climate imperative. The IBank's Infrastructure State Revolving Fund provides supportive capital to climate-aligned projects promoted by local governments and certain nonprofit entities, and will be refining its criteria and market outreach strategies to increase its level of service. IBank's bonds program has supported

[82] Executive Department. State of California. Executive Order N-79-20. *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf.*

multiple large environmental projects, including more than $2 billion in "green bonds," and is poised to help expand access to the state's deep and liquid bond capital market. Within IBank's Small Business Finance Center, the new Climate Tech Loan Guarantee program encourages commercial banks to back climate-focused small businesses, leveraging federal capital to insure a portion of the private bank's loan. And through IBank's Expanding Venture Capital Access Fund program, the state is promoting greater diversity in the venture capital community, including climate equity and climate justice.

All of these financing programs exist to leverage private capital in support of the state's climate goals, and to partner with state policy agencies driving the transition. IBank will also continue to collaborate closely with the State Treasurer's Office in its provision of capital support to climate solutions, ensuring that funding flows to programs best positioned to deliver success. This partnership of public and private capital, responsive to and in communication with the climate policy community, will ensure that California gets the maximum possible benefit from its allocation of scarce resources.

Supporting Innovation

Reaching our ambitious, deep decarbonization goals will require continued technological innovation. Investment in research, development, and deployment of clean technologies has never been more critical. Sending clear and sustained market and policy signals will encourage large and small companies alike to pursue innovation that can be scaled up and deployed here and beyond our borders. The full suite of AB 32 policies[83] has touched nearly every sector of California's economy and spurred technology innovation in the state, including the growth of technology developers, manufacturers, processors, and assemblers in many areas. Specifically, AB 32 policies and programs support both the supply side and the demand side to build new markets in California. On the supply side, AB 32 policies support businesses to demonstrate and refine technologies, and to help establish critical supply chains. On the demand side, AB 32 policies and programs provide outreach, education, and incentives—as well as disincentives—to motivate everyone from consumers to institutional purchasers to utility planners to adopt new, climate smart technologies. Innovations resulting directly from the state's climate policies include the following:

- In the past 10 years, a growing market for heavy-duty zero-emission vehicles (HD ZEVs) was established in California, and this market now represents the largest single share of North American supply and demand for HD ZEVs. Vehicle

[83] CARB. Climate Change Programs. *https://ww2.arb.ca.gov/our-work/topics/climate-change*.

and component manufacturers are making long-term investments to develop and produce HD ZEVs within California.

- Total consumption of renewable diesel in the California LCFS market has skyrocketed from approximately 1.8 million gallons in 2011 to nearly 589 million gallons in 2020. The LCFS is a key driver of market development for renewable diesel and its coproducts. While the federal renewable fuel standard (RFS) and blenders tax credit also benefit producers, an analysis of their respective contributions to market development, and interviews with industry representatives and independent experts, point to LCFS as a more important factor in market development, at least in recent years.
- In the past five years, a market for small-scale energy storage in California was created where none previously existed. As of 2020, 185 megawatts (MW) of small-scale energy storage projects have been interconnected to the grid. The significant increase in deployment in the last five years is a result of the Self-Generation Incentive Program (SGIP), which significantly reduces the upfront costs to purchase and install small-scale energy storage devices, and of growing customer interest in disaster resiliency in the face of increasing risk from wildfire and related utility outages. These systems have already provided disaster resiliency benefits for residential and non-residential customers.

We have seen how quickly market barriers can be overcome in response to strong policy signals, as occurred in the solar panel and electric vehicle battery space. Government-stated priorities have a significant role in guiding private and public research, development, and deployment. This Scoping Plan unequivocally puts the marker down on the need for innovation to continue in non-combustion technologies, clean energy, CO_2 removal options, and alternatives for SLCPs. The five-year update to the Scoping Plan allows for a periodic evaluation of new tools to add to the state's toolkit.

Engagement with Partners to Develop, Coordinate, and Export Policies

California works closely with other states, tribal governments, the federal government, and international jurisdictions to identify the most effective strategies and methods to reduce GHGs, manage GHG control programs, and facilitate the development of integrated and cost-effective regional, national, and international GHG reduction programs. For example, the state's Cap-and-Trade Program has been linked with Québec's since 2014, and CARB staff regularly engage with jurisdictions throughout the world on the design features of our Cap-and-Trade Program through memoranda of understanding (MOUs) and venues such as the International Climate Action

Partnership.[84] Low carbon fuel mandates similar to California's LCFS have been adopted by the U.S. EPA and by other jurisdictions, including Oregon, Washington, British Columbia, the European Union, and the United Kingdom. Many other jurisdictions from Japan to New Zealand, Australia, and the European Commission also continue to seek information and technical experience on our LCFS. California has and will continue to share information and encourage ambitious emissions reductions with interested jurisdictions, with a focus on China, India, Mexico, Canada, and the European Union. California's early action to reduce super-pollutants such as methane and other SLCPs was reaffirmed by the 2021 Global Methane Pledge signed by the U.S. and over 100 other countries at the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC).[85]

In addition, under the Clean Air Act, the federal government is authorized to allow California to set more stringent vehicle emissions regulations than federal standards. California's goals and regulations to transition to 100 percent sales of new zero-emission passenger vehicles by 2035 (including plug-in hybrid vehicles), to drayage trucks by 2035, and other trucks and buses where feasible by 2045 are being emulated by partner states across the U.S. and in jurisdictions around the world. CARB's Advanced Clean Cars II regulation, [86] which codifies these targets, was approved in August 2022, and already at least four other states have announced their plans to adopt this regulation. Earlier in June 2020 CARB adopted the Advanced Clean Truck regulation, which requires truck manufacturers to meet increasing sale targets of zero-emission trucks in California through 2035. Since adoption, at least five other states—20 percent of the U.S. truck market—have adopted this regulation. These kinds of coordinated policies help signal to vehicle manufacturers a widespread and growing demand for zero-emissions technology, which in turn helps scale production and lower costs for consumers.

With the Mexican Secretariat for Environment and Natural Resources (SEMARNAT), California has engaged in a technical exchange on clean vehicle policies and helped to establish Mexico's Emissions Trading System (being piloted in 2022). A 2019 MOU signed between California and Environment and Climate Change Canada enables in-depth collaboration on policies and programs to decarbonize vehicles, engines, and fuels. This partnership has led to tangible emissions reductions, from aligning vehicle emissions targets and policies to collaborating on emissions testing and research critical to enforcing

[84] International Carbon Action Partnership (ICAP). Homepage. *https://icapcarbonaction.com/en?msclkid=dac30cb7b4f511ec94ccd0f1ae323e98*.
[85] Global Methane Pledge. Homepage. *https://www.globalmethanepledge.org/*.
[86] Cal. Code Regs., tit. 13, §§ 1900,1961.2, 1961.3, 1962.2, 1962.3, 1962.4, 1962.5, 1962.6, 1962.7, 1962.8, 1965, 1968.2, 1969, 1976, 1978, 2037, 2038, 2112, 2139, 2140, 2147, and 2903; and Test Procedures located here: *https://ww2.arb.ca.gov/rulemaking/2022/advanced-clean-cars-ii*.

emissions limits for vehicle manufactures. At the national level, China has looked to California for cutting-edge requirements for car diagnostics and policies that promote zero-emissions vehicles. At a local level, Beijing has adopted California's vehicle emissions standards and several other progressive environmental regulations. California will continue and renew such efforts across China, including through a 2022 MOU signed with China's Ministry of Ecology and Environment.

Between 2021 and 2023, California also will serve as president of the Transport Decarbonisation Alliance, a global network of countries, regions, cities, and companies that come together to share experiences and technical expertise, and to increase the ambition and accelerate the deployment of targeted transportation decarbonization policies across freight, electric vehicle infrastructure, and active mobility. Throughout its presidency, California will focus its leadership on decarbonizing the cross-jurisdiction network of medium- and heavy-duty vehicles, both to ensure cleaner air in freight-adjacent communities and to stem the effects of climate change.

Over the years, California has also asserted the importance of and supported the ongoing efforts of state and local clean air and climate leadership. Through our participation in the Pacific Coast Collaborative alongside British Columbia, Washington, and Oregon,[87] the Under2 Coalition,[88] the U.S. Climate Alliance,[89] the International ZEV Alliance,[90] the Transportation Decarbonisation Alliance, and many more organizations, California has and will continue to build climate partnerships with state and local governments.

California also recognized the need to address the substantial emissions caused by the deforestation and degradation of tropical and other forests, and continues its work alongside other subnational governments as part of the Governors' Climate and Forests Task Force (GCF).[91] Founded in 2008, there are currently 39 GCF members, including states and provinces in Brazil, Colombia, Ecuador, Indonesia, Ivory Coast, Mexico, Nigeria, Peru, Spain, and the United States—all of whom are considering or operating programs to reduce emissions from deforestation, land-use, and rural development, and to benefit local and indigenous communities. CARB's California Tropical Forest Standard provides a rigorous methodology to assess jurisdiction-scale programs that reduce deforestation and to incentivize responsible action and investment.[92] The standard

[87] Pacific Coast Collaborative. Homepage. *https://pacificcoastcollaborative.org/*.
[88] Under2 Coalition. Homepage. *https://www.theclimategroup.org/under2-coalition*.
[89] United States Climate Alliance (USCA). Homepage. *https://www.usclimatealliance.org/*.
[90] ZEV Alliance. Homepage. Accelerating the Adoption of Zero-Emission Vehicles. *https://zevalliance.org/*.
[91] Governors' Climate and Forests Task Force. University of Colorado Boulder: Colorado Law. *https://www.gcftf.org/*.
[92] CARB. California Tropical Forest Standard. *https://ww2.arb.ca.gov/our-work/programs/california-tropical-forest-standard*.

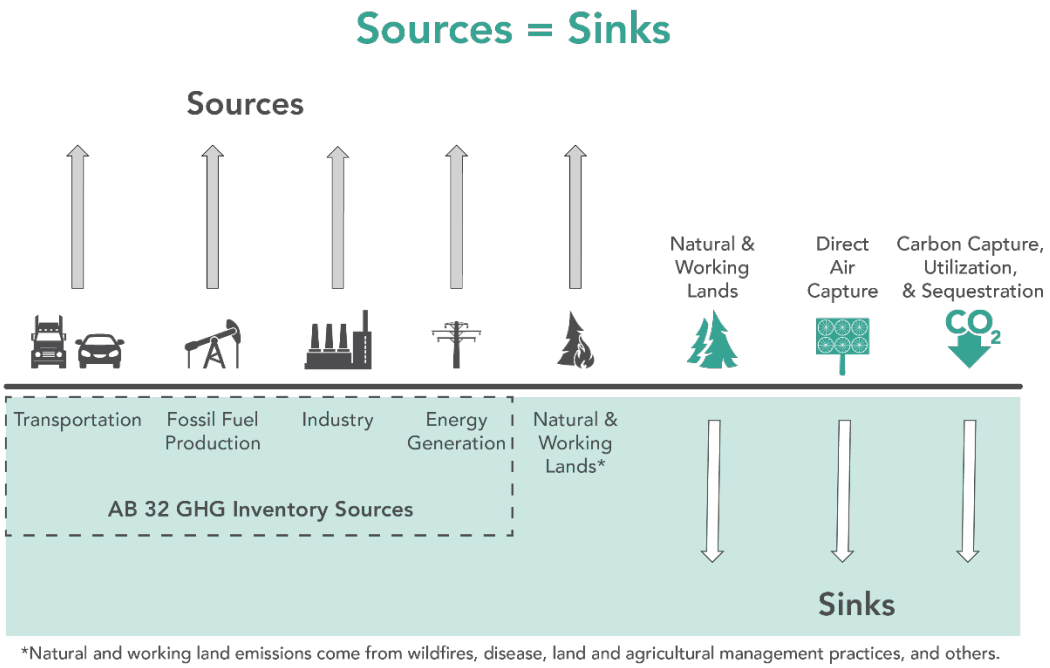
provides a strong signal to value the preservation of tropical forests over continued destructive activities such as oil exploration and extraction and ensures rigorous social and environmental safeguards for indigenous peoples and local communities.

Working Toward Carbon Neutrality

To date, California and many other regions have focused on reducing GHG emissions from the industrial, energy, and transportation sectors. As defined in statute, the state's 2020 and 2030 targets include all in-state sources of GHG emissions—and those emissions associated with imported power that is consumed in the state. By moving to a framework of carbon neutrality, the scope for accounting is expanded to include all sources and sinks. As such, carbon neutrality is achieved when the GHG fluxes are at equilibrium—when sources equal sinks. Figure 1-5 depicts the sources included in the AB 32 GHG Inventory and the new sources and sinks added in this Scoping Plan under the framework of carbon neutrality. Natural and working lands are able to sequester carbon and therefore play an increasingly important role in this framework. However, modeling for this plan shows that carbon sequestration in our natural and working lands alone will be insufficient to achieve carbon neutrality no later than 2045. Therefore, this plan also considers the role of carbon capture and sequestration, as well as biological and mechanical carbon sequestration processes that are included in the IPCC Sixth Assessment Report,[93] as necessary tools for climate change mitigation.

[93] IPCC. 2021. *Climate Change 2021: The Physical Science Basis*. https://www.ipcc.ch/report/ar6/wg1/.

Figure 1-5: Carbon neutrality: Balancing the net flux of GHG emissions from all sources and sinks



Supporting Healthy and Resilient Lands

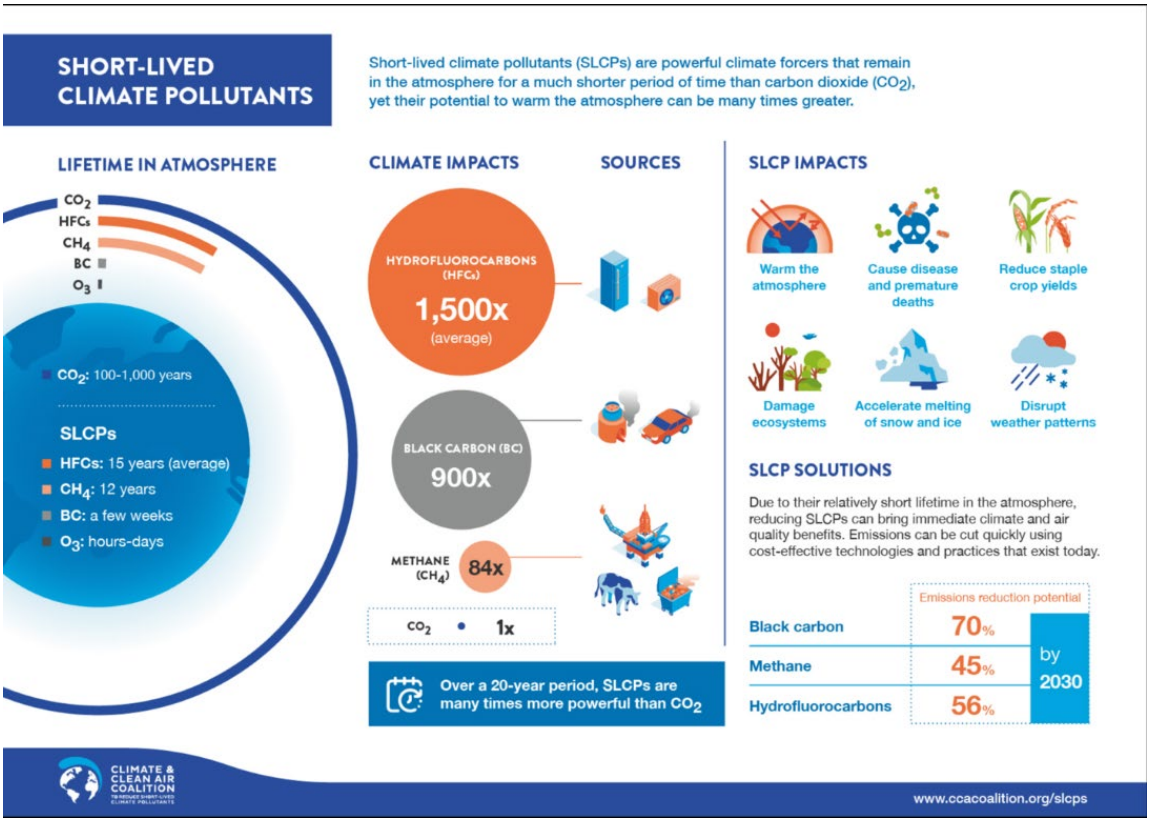
Our natural and working lands are an important piece in California's fight to achieve carbon neutrality and build resilience to the impacts of climate change. Healthy land can sequester and store atmospheric carbon dioxide in forests, grasslands, soils, and wetlands. Healthy lands can also reduce emissions of powerful short-lived climate pollutants, limit the release of future GHG emissions, protect people and nature from the impacts of climate change, and build our resilience to future climate risks. Unhealthy lands have the opposite effect—they release more GHGs than they store and are more vulnerable to future climate change impacts. Through climate smart land management that focuses on supporting healthy living systems, we can support our carbon neutrality goals, reduce emissions, advance sequestration, and support healthy and more climate-resilient lands.

Maintaining the Focus on Methane and Short-Lived Climate Pollutants

Given the urgency of climate change, the often-disproportional impacts already being felt by underserved populations across California and the world, and the need to rapidly decarbonize and avoid climate tipping points as identified in the most recent IPCC assessment, efforts to reduce short-lived climate pollutants are especially important. SLCPs include methane (CH_4), black carbon (soot), and fluorinated gases (F-gases,

including hydrofluorocarbons, or HFCs), and they are among the most harmful pollutants to both human health and the global climate. SLCPs are more potent than CO_2 in terms of their impact on climate change (and subsequently, global warming) and have a much shorter lifetime in the atmosphere than CO_2 does. That means they have an outsized impact on climate change in the near term—they are responsible for up to 45 percent of current climate forcing. It also means that targeted efforts to reduce short-lived climate pollutant emissions can provide outsized climate and health benefits, within weeks to about a decade (see Figure 1-6).

Figure 1-6: Short-lived climate pollutant impacts[94]



California has been a leader in addressing SLCP emissions. As part of the 2014 Scoping Plan,[95] CARB committed to developing a dedicated strategy to reduce SLCP emissions.

[94] Climate and Clean Air Coalition. Short-Lived Climate Pollutants (SLCPs). https://www.ccacoalition.org/en/content/short-lived-climate-pollutants-slcps.
[95] CARB. 2014. *First Update.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf.

The resulting SLCP Reduction Strategy,[96] adopted by CARB in 2017, implements targets codified in SB 1383 (Lara, Chapter 395, Statutes of 2016) to reduce methane and HFC emissions by 40 percent by 2030 and anthropogenic black carbon emissions by 50 percent. California worked with several other states through the U.S. Climate Alliance to establish a similar goal to reduce SLCP emissions in line with the requirements of the Paris Agreement,[97] identifying the potential to reduce SCLPs by 40 to 50 percent by 2030 across the U.S. Climate Alliance.[98]

Process for Developing the Scoping Plan

This Scoping Plan was developed in coordination with the Governor's Office and state agencies, in accordance with direction from the Chair and Members of CARB, through engagement with the Legislature, with advice from the EJ Advisory Committee, in consultation with tribes, and with open and transparent opportunities for stakeholders and the public to engage in workshops and other meetings. Appendix A (Public Process) includes details of the public workshops, and Chapter 5 includes details of the EJ Advisory Committee's role in the Scoping Plan update process.

Guidance from the Administration and Legislature

This Scoping Plan reflects existing and recent direction in the Governor's Executive Orders and Statutes. Table 1-1 provides a summary of major climate legislation and executive orders issued since the adoption of the 2017 Scoping Plan.

[96] CARB. 2017. *Short-Lived Climate Pollutant Reduction Strategy.* https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[97] UNFCCC. 2015. Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
[98] USCA. 2018. *From SLCP Challenge to Action: A Roadmap for Reducing Short-Lived Climate Pollutants to Meet the Goals of the Paris Agreement.* http://www.usclimatealliance.org/slcp-challenge-to-action.

Table 1-1: Major climate legislation and executive orders enacted since the 2017 Scoping Plan

Bill/Executive Order	Summary
Assembly Bill 1279 (AB 1279) (Muratsuchi, Chapter 337, Statutes of 2022) *The California Climate Crisis Act*	AB 1279 establishes the policy of the state to achieve carbon neutrality as soon as possible, but no later than 2045; to maintain net negative GHG emissions thereafter; and to ensure that by 2045 statewide anthropogenic GHG emissions are reduced at least 85 percent below 1990 levels. The bill requires CARB to ensure that Scoping Plan updates identify and recommend measures to achieve carbon neutrality, and to identify and implement policies and strategies that enable CO_2 removal solutions and carbon capture, utilization, and storage (CCUS) technologies. This bill is reflected directly in this Scoping Plan.
Senate Bill 905 (SB 905) (Caballero, Chapter 359, Statutes of 2022) *Carbon Capture, Removal, Utilization, and Storage Program*	SB 905 requires CARB to create the Carbon Capture, Removal, Utilization, and Storage Program to evaluate, demonstrate, and regulate CCUS and carbon dioxide removal (CDR) projects and technology. The bill requires CARB, on or before January 1, 2025, to adopt regulations creating a unified state permitting application for approval of CCUS and CDR projects. The bill also requires the Secretary of the Natural Resources Agency to publish a framework for governing agreements for two or more tracts of land overlying the same geologic storage reservoir for the purposes of a carbon sequestration project. The Scoping Plan modeling reflects both CCUS and CDR contributions to achieve carbon neutrality.
Senate Bill 846 (SB 846) (Dodd, Chapter 239, Statutes of 2022) *Diablo Canyon Powerplant: Extension of Operations*	SB 846 extends the Diablo Canyon Power Plant's sunset date by up to five additional years for each of its two units and seeks to make the nuclear power plant eligible for federal loans. The bill requires that the California Public Utilities Commission (CPUC) not include and disallow a load-serving entity from including in their adopted resource plan, the energy, capacity, or any attribute from the Diablo Canyon power plant. The Scoping Plan explains the emissions impact of this legislation.
Senate Bill 1020 (SB 1020) (Laird,	SB 1020 adds interim renewable energy and zero carbon energy retail sales of electricity targets to California end-use customers set at 90 percent in 2035 and 95 percent in 2040.

Chapter 361, Statutes of 2022) *Clean Energy, Jobs, and Affordability Act of 2022*	It accelerates the timeline required to have 100 percent renewable energy and zero carbon energy procured to serve state agencies from the original target year of 2045 to 2035. This bill requires each state agency to individually achieve the 100 percent goal by 2035 with specified requirements. This bill requires the CPUC, California Energy Commission (CEC), and CARB, on or before December 1, 2023, and annually thereafter, to issue a joint reliability progress report that reviews system and local reliability. The bill also modifies the requirement for CARB to hold a portion of its Scoping Plan workshops in regions of the state with the most significant exposure to air pollutants by further specifying that this includes communities with minority populations or low-income communities in areas designated as being in extreme federal non-attainment. The Scoping Plan describes the implications of this legislation on emissions.
Senate Bill 1137 (SB 1137) (Gonzales, Chapter 365, Statutes of 2022) *Oil & Gas Operations: Location Restrictions: Notice of Intention: Health protection zone: Sensitive receptors*	SB 1137 prohibits the development of new oil and gas wells or infrastructure in health protection zones, as defined, except for purposes of public health and safety or other limited exceptions. The bill requires operators of existing oil and gas wells or infrastructure within health protection zones to undertake specified monitoring, public notice, and nuisance requirements. The bill requires CARB to consult and concur with the California Geologic Energy Management Division (CalGEM) on leak detection and repair plans for these facilities, adopt regulations as necessary to implement emission detection system standards, and collaborate with CalGEM on public access to emissions detection data.
Senate Bill 1075 (SB 1075) (Skinner, Chapter 363, Statutes of 2022) *Hydrogen: Green Hydrogen: Emissions of Greenhouse Gases*	SB 1075 requires CARB, by June 1, 2024, to prepare an evaluation that includes: policy recommendations regarding the use of hydrogen, and specifically the use of green hydrogen, in California; a description of strategies supporting hydrogen infrastructure, including identifying policies that promote the reduction of GHGs and short-lived climate pollutants; a description of other forms of hydrogen to achieve emission reductions; an analysis of curtailed electricity; an estimate of GHG and emission reductions that could be achieved through deployment of green hydrogen through a variety of scenarios; an analysis of the potential for opportunities to integrate hydrogen production and applications with drinking water supply treatment needs; policy recommendations for regulatory and permitting processes

	associated with transmitting and distributing hydrogen from production sites to end uses; an analysis of the life-cycle GHG emissions from various forms of hydrogen production; and an analysis of air pollution and other environmental impacts from hydrogen distribution and end uses. This bill would inform the production of hydrogen at the scale called for in this Scoping Plan.
Assembly Bill 1757 (AB 1757) (Garcia, Chapter 341, Statutes of 2022) *California Global Warming Solutions Act of 2006: Climate Goal: Natural and Working Lands*	AB 1757 requires the California Natural Resources Agency (CNRA), in collaboration with CARB, other state agencies, and an expert advisory committee, to determine a range of targets for natural carbon sequestration, and for nature-based climate solutions, that reduce GHG emissions in 2030, 2038, and 2045 by January 1, 2024. These targets must support state goals to achieve carbon neutrality and foster climate adaptation and resilience. This bill also requires CARB to develop standard methods for state agencies to consistently track GHG emissions and reductions, carbon sequestration, and additional benefits from natural and working lands over time. These methods will account for GHG emissions reductions of CO_2, methane, and nitrous oxide related to natural and working lands and the potential impacts of climate change on the ability to reduce GHG emissions and sequester carbon from natural and working lands, where feasible. This Scoping Plan describes the next steps and implications of this legislation for the natural and working lands sector.
Senate Bill 1206 (SB 1206) (Skinner, Chapter 884, Statutes of 2022) *Hydrofluorocarbon gases: sale or distribution*	SB 1206 mandates a stepped sales prohibition on newly produced high- global warming potential (GWP) HFCs to transition California's economy toward recycled and reclaimed HFCs for servicing existing HFC-based equipment. Additionally, SB 1206 also requires CARB to develop regulations to increase the adoption of very low-, i.e., GWP < 10, and no-GWP technologies in sectors that currently rely on higher-GWP HFCs.
Senate Bill 27 (SB 27) (Skinner, Chapter 237, Statutes of 2021)	SB 27 requires CNRA, in coordination with other state agencies, to establish the Natural and Working Lands Climate Smart Strategy by July 1, 2023. This bill also requires CARB to establish specified CO_2 removal targets for 2030 and beyond as part of its Scoping Plan. Under SB 27, CNRA is to establish and maintain a registry to identify projects in the state

Carbon Sequestration: State Goals: Natural and Working Lands: Registry of Projects	that drive climate action on natural and working lands and are seeking funding. CNRA also must track carbon removal and GHG emission reduction benefits derived from projects funded through the registry. This bill is reflected directly in this Scoping Plan as CO_2 removal targets for 2030 and 2045 in support of carbon neutrality.
Senate Bill 596 (SB 596) (Becker, Chapter 246, Statutes of 2021) *Greenhouse Gases: Cement Sector: Net-zero Emissions Strategy*	SB 596 requires CARB, by July 1, 2023, to develop a comprehensive strategy for the state's cement sector to achieve net-zero-emissions of GHGs associated with cement used within the state as soon as possible, but no later than December 31, 2045. The bill establishes an interim target of 40 percent below the 2019 average GHG intensity of cement by December 31, 2035. Under SB 596, CARB must: • Define a metric for GHG intensity and establish a baseline from which to measure GHG intensity reductions. • Evaluate the feasibility of the 2035 interim target (40 percent reduction in GHG intensity) by July 1, 2028. • Coordinate and consult with other state agencies. • Prioritize actions that leverage state and federal incentives. • Evaluate measures to support market demand and financial incentives to encourage the production and use of cement with low GHG intensity. The Scoping Plan modeling is designed to achieve these outcomes.
Executive Order N-82-20	Governor Newsom signed Executive Order N-82-20 in October 2020 to combat the climate and biodiversity crises by setting a statewide goal to conserve at least 30 percent of California's land and coastal waters by 2030. The Executive Order also instructed the CNRA, in consultation with other state agencies, to develop a Natural and Working Lands Climate Smart Strategy that serves as a framework to advance the state's carbon neutrality goal and build climate resilience. In addition to setting a statewide conservation goal, the Executive Order directed CARB to update the target for natural and working lands in support of carbon neutrality as part of this Scoping Plan, and to take into consideration the NWL Climate Smart Strategy.

	Executive Order N-82-20 also calls on the CNRA, in consultation with other state agencies, to establish the California Biodiversity Collaborative (Collaborative). The Collaborative shall be made up of governmental partners, California Native American tribes, experts, business and community leaders, and other stakeholders from across the state. State agencies will consult the Collaborative on efforts to: • Establish a baseline assessment of California's biodiversity that builds upon existing data and can be updated over time. • Analyze and project the impact of climate change and other stressors in California's biodiversity. • Inventory current biodiversity efforts across all sectors and highlight opportunities for additional action to preserve and enhance biodiversity. CNRA also is tasked with advancing efforts to conserve biodiversity through various actions, such as streamlining the state's process to approve and facilitate projects related to environmental restoration and land management. The California Department of Food and Agriculture (CDFA) is directed to advance efforts to conserve biodiversity through measures such as reinvigorating populations of pollinator insects, which restore biodiversity and improve agricultural production. The Natural and Working Lands Climate Smart Strategy informs this Scoping Plan.
Executive Order N-79-20	Governor Newsom signed Executive Order N-79-20 in September 2020 to establish targets for the transportation sector to support the state in its goal to achieve carbon neutrality by 2045. The targets established in this Executive Order are: • 100 percent of in-state sales of new passenger cars and trucks will be zero-emission by 2035. • 100 percent of medium- and heavy-duty vehicles will be zero-emission by 2045 for all operations where feasible, and by 2035 for drayage trucks. • 100 percent of off-road vehicles and equipment will be zero-emission by 2035 where feasible. The Executive Order also tasked CARB to develop and propose regulations that require increasing volumes of zero-electric passenger vehicles, medium- and heavy-duty

	vehicles, drayage trucks, and off-road vehicles toward their corresponding targets of 100 percent zero-emission by 2035 or 2045, as listed above. The Scoping Plan modeling reflects achieving these targets.
Executive Order N-19-19	Governor Newsom signed Executive Order N-19-19 in September 2019 to direct state government to redouble its efforts to reduce GHG emissions and mitigate the impacts of climate change while building a sustainable, inclusive economy. This Executive Order instructs the Department of Finance to create a Climate Investment Framework that: • Includes a proactive strategy for the state's pension funds that reflects the increased risks to the economy and physical environment due to climate change. • Provides a timeline and criteria to shift investments to companies and industry sectors with greater growth potential based on their focus of reducing carbon emissions and adapting to the impacts of climate change. • Aligns with the fiduciary responsibilities of the California Public Employees' Retirement System, California State Teachers' Retirement System, and the University of California Retirement Program. Executive Order N-19-19 directs the State Transportation Agency to leverage more than $5 billion in annual state transportation spending to help reverse the trend of increased fuel consumption and reduce GHG emissions associated with the transportation sector. It also calls on the Department of General Services to leverage its management and ownership of the state's 19 million square feet in managed buildings, 51,000 vehicles, and other physical assets and goods to minimize state government's carbon footprint. Finally, it tasks CARB with accelerating progress toward California's goal of five million ZEV sales by 2030 by: • Developing new criteria for clean vehicle incentive programs to encourage manufacturers to produce clean, affordable cars. • Proposing new strategies to increase demand in the primary and secondary markets for ZEVs. • Considering strengthening existing regulations or adopting new ones to achieve the necessary GHG reductions from within the transportation sector.

	The Scoping Plan modeling reflects efforts to accelerate ZEV deployment.
Senate Bill 576 (SB 576) (Umberg, Chapter 374, Statutes of 2019) *Coastal Resources: Climate Ready Program and Coastal Climate Change Adaptation, Infrastructure and Readiness Program*	Sea level rise, combined with storm-driven waves, poses a direct risk to the state's coastal resources, including public and private real property and infrastructure. Rising marine waters threaten sensitive coastal areas, habitats, the survival of threatened and endangered species, beaches, other recreation areas, and urban waterfronts. SB 576 mandates that the Ocean Protection Council develop and implement a coastal climate adaptation, infrastructure, and readiness program to improve the climate change resiliency of California's coastal communities, infrastructure, and habitat. This bill also instructs the State Coastal Conservancy to administer the Climate Ready Program, which addresses the impacts and potential impacts of climate change on resources within the conservancy's jurisdiction.
Assembly Bill 65 (AB 65) (Petrie-Norris, Chapter 347, Statutes of 2019) *Coastal Protection: Climate Adaption: Project Prioritization: Natural Infrastructure: Local General Plans*	This bill requires the State Coastal Conservancy, when it allocates any funding appropriated pursuant to the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access For All Act of 2018, to prioritize projects that use natural infrastructure in coastal communities to help adapt to climate change. The bill requires the conservancy to provide information to the Office of Planning and Research on any projects funded pursuant to the above provision to be considered for inclusion into the clearinghouse for climate adaption information. The bill authorizes the conservancy to provide technical assistance to coastal communities to better assist them with their projects that use natural infrastructure.
Executive Order B-55-18	Governor Brown signed Executive Order B-55-18 in September 2018 to establish a statewide goal to achieve carbon neutrality as soon as possible, and no later than 2045, and to achieve and maintain net negative emissions thereafter. Policies and programs undertaken to achieve this goal shall: • Seek to improve air quality and support the health and economic resiliency of urban and rural communities, particularly low-income and disadvantaged communities. • Be implemented in a manner that supports climate adaptation and biodiversity, including protection of the state's water supply, water quality, and native plants and animals.

	This Executive Order also calls for CARB to: • Develop a framework for implementation and accounting that tracks progress toward this goal. • Ensure future Scoping Plans identify and recommend measures to achieve the carbon neutrality goal. This Scoping Plan is designed to achieve carbon neutrality no later than 2045 and the modeling includes technology and fuel transitions to achieve that outcome.
Senate Bill 100 (SB 100) (De León, Chapter 312, Statutes of 2018) *California Renewables Portfolio Standard Program: emissions of greenhouse gases*	SB 100 mandates that the CPUC, CEC, and CARB plan for 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045. This bill also updates the state's Renewables Portfolio Standard (RPS) to include the following interim targets: • 44% of retail sales procured from eligible renewable sources by December 31, 2024. • 52% of retail sales procured from eligible renewable sources by December 31, 2027. • 60% of retail sales procured from eligible renewable sources by December 31, 2030. Under SB 100, the CPUC, CEC, and CARB shall use programs under existing laws to achieve 100 percent clean electricity. The statute requires these agencies to issue a joint policy report on SB 100 every four years. The first of these reports was issued in 2021. This Scoping Plan reflects the SB 100 Core Scenario resource mix with a few minor updates.
Assembly Bill 2127 (AB 2127) (Ting, Chapter 365, Statutes of 2018) *Electric Vehicle Charging Infrastructure: Assessment*	This bill requires the CEC, working with CARB and the CPUC, to prepare and biennially update a statewide assessment of the electric vehicle charging infrastructure needed to support the levels of electric vehicle adoption required for the state to meet its goals of putting at least 5 million zero-emission vehicles on California roads by 2030 and of reducing emissions of GHGs to 40% below 1990 levels by 2030. The bill requires the CEC to regularly seek data and input from stakeholders relating to electric vehicle charging infrastructure. This bill supports the deployment of ZEVs as modeled in this Scoping Plan.

Senate Bill 30 (SB 30) (Lara, Chapter 614, Statutes of 2018) *Insurance: Climate Change*	This bill requires the Insurance Commissioner to convene a working group to identify, assess, and recommend risk transfer market mechanisms that, among other things, promote investment in natural infrastructure to reduce the risks of climate change related to catastrophic events, create incentives for investment in natural infrastructure to reduce risks to communities, and provide mitigation incentives for private investment in natural lands to lessen exposure and reduce climate risks to public safety, property, utilities, and infrastructure. The bill requires the policies recommended to address specified questions.
Assembly Bill 2061 (AB 2061) (Frazier, Chapter 580, Statutes of 2018) *Near-zero-emission and Zero-emission Vehicles*	Existing state and federal law sets specified limits on the total gross weight imposed on the highway by a vehicle with any group of two or more consecutive axles. Under existing federal law, the maximum gross vehicle weight of that vehicle may not exceed 82,000 pounds. AB 2061 authorizes a near-zero-emission vehicle or a zero-emission vehicle to exceed the weight limits on the power unit by up to 2,000 pounds. This bill supports the deployment of cleaner trucks as modeled in this Scoping Plan.

Consideration of Relevant State Plans and Regulations

Development of this Scoping Plan also included careful consideration of, and coordination with, other state agency plans and regulations, including the SB 100 Joint Agency Report,[99] the 2022 State Strategy for the State Implementation Plan,[100] Climate Action Plan for Transportation Infrastructure,[101] AB 74 Studies on Vehicle Emissions and Fuel Demand and Supply,[102,103,104] Short-Lived Climate Pollutant Strategy (SLCP Strategy),[105]

[99] CPUC, CEC, and CARB. 2021. *SB 100 Joint Agency Report.* https://www.energy.ca.gov/sb100.
[100] CARB. January 31, 2022. Draft 2022 State Strategy for the State Implementation Plan. https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf.
[101] CalSTA. 2021. *Climate Action Plan.* https://calsta.ca.gov/subject-areas/climate-action-plan.
[102] CalEPA. 2021. Carbon Neutrality Studies. https://calepa.ca.gov/climate/carbon-neutrality-studies/.
[103] Brown, A. L., et. al. 2021. *Driving California's Transportation Emissions.* https://escholarship.org/uc/item/3np3p2t0.
[104] Deschenes, O. 2021. *Enhancing equity*. https://zenodo.org/record/4707966#.YKPiaKhKi73.
[105] CARB. Short-Lived Climate Pollutants. https://ww2.arb.ca.gov/our-work/programs/slcp.

CARB's Achieving Carbon Neutrality Report,[106] Climate Smart Strategy,[107] and draft Natural and Working Lands Implementation Plan,[108] among others.

Input from Partners and Stakeholders

CARB also collaborated with other state agencies, held consultations with tribes, and solicited comments and feedback from affected stakeholders, including labor organizations and the public. The process to update the Scoping Plan began with kickoff workshops in early June 2021,[109] followed by over a dozen public workshops, including engagement with tribes,[110] and featured a series of EJ Advisory Committee and environmental justice community meetings.[111] The June 2021 workshop and several others were a joint agency effort, as there are many agencies with direct authority or jurisdiction over different sectors of the economy. Consultation with agencies also included bi-weekly, monthly, and weekly meetings.

During the summer of 2022 CARB held three community listening sessions, hosted by the CARB Chair and Board, in communities around the state, along with one virtual community listening session and one tribal listening session specifically for tribes. Many tribes provided written feedback, which was incorporated into this Scoping Plan. In addition, CARB respects tribal sovereignty and also engaged in a consultation campaign with tribes, which resulted in government-to-government consultations, and this Scoping Plan is reflective of this process.[112]

Emissions Data That Inform the Scoping Plan

Greenhouse Gas Emissions

AB 32 includes which GHGs are to be regulated, reduced, and included in the state's targets and goals. That list includes seven GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs),

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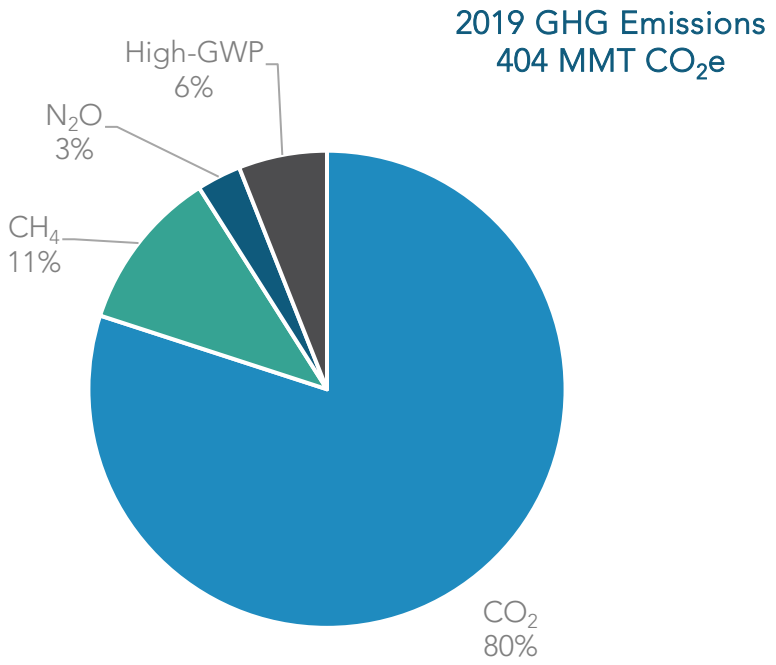
[106] Energy and Environmental Economics, Inc. 2020. *Achieving Carbon Neutrality.* https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf.
[107] CNRA. 2022. Natural and Working Lands Climate Smart Strategy. https://resources.ca.gov/Initiatives/Expanding-Nature-Based-Solutions.
[108] CARB. 2019. *Draft California 2030 Natural and Working Lands Climate Change Implementation Plan.* https://ww2.arb.ca.gov/resources/documents/nwl-implementation-draft.
[109] Appendix A (Public Process).
[110] CARB. Scoping Plan Meetings & Workshops. https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/scoping-plan-meetings-workshops.
[111] CARB. Environmental Justice Advisory Committee Meetings and Events. https://ww2.arb.ca.gov/environmental-justice-advisory-committee-meetings-and-events.
[112] CARB. 2018. Tribal Consultation Policy. October. https://www.arb.ca.gov/regact/nonreg/2018/california_air_resources_board_tribal_consultation_policy.pdf.

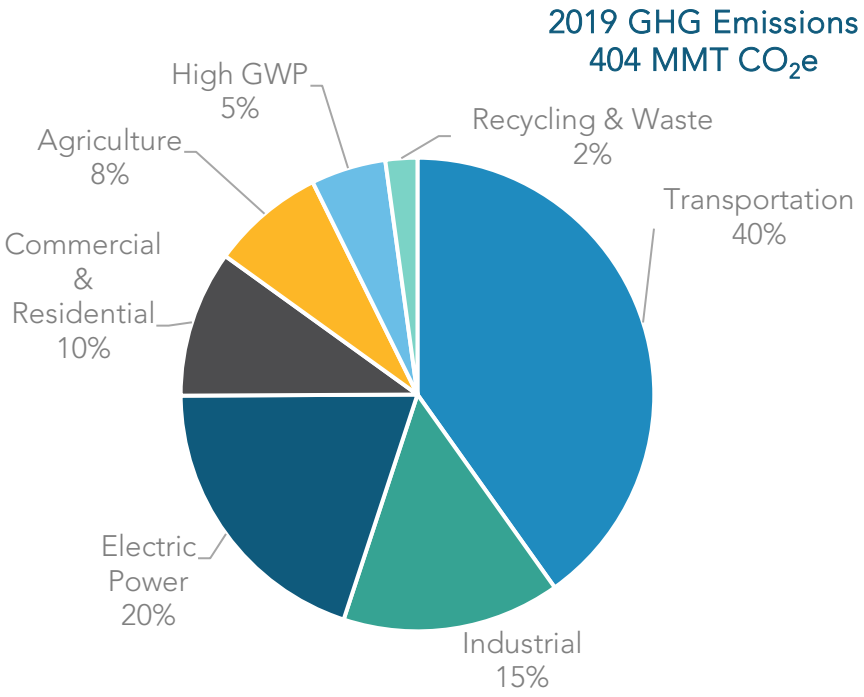
perfluorocarbons (PFCs), and nitrogen trifluoride (NF_3). Carbon dioxide is the primary GHG emitted in California, accounting for 83 percent of the total GHG emissions in 2019, as shown in Figure 1-7 below. Figure 1-8 illustrates that transportation (primarily on-road travel) is the single largest source of CO_2 emissions in the state. Upstream transportation emissions from the refinery and oil and gas sectors are categorized as CO_2 emissions from industrial sources and constitute about 50 percent of the industrial source emissions. When including these emissions, the transportation sector accounts for approximately half of statewide GHG emissions. Other significant sources of CO_2 include electricity production, industrial sources like refineries and cement plants, and residential sources like fossil gas. Figures 1-7 and 1-8 show state GHG emission contributions by GHG and sector based on the 2020 Greenhouse Gas Emission Inventory; GHG emissions for 2019 are shown because 2020 was an outlier due to the global pandemic. Emissions in Figure 1-8 are depicted by Scoping Plan sector, which includes separate categories for high-global warming potential (GWP) and recycling/waste emissions that are otherwise typically included within other economic sectors.

Figure 1-7: 2019 State GHG emission contributions by GHG[113]



[113] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020: Trends of Emissions and Other Indicators.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf.

Figure 1-8: 2019 State GHG emission contributions by Scoping Plan sector[114]



The scope of the AB 32 GHG Inventory encompasses emission sources within the state's borders, as well as imported electricity consumed in the state. This construct for the inventory is consistent with IPCC practices to allow for comparison of statewide GHG emissions with those at the national level and with other international GHG inventories. Statewide GHG emissions calculations use many data sources, including data from other state and federal agencies. However, a significant source of data comes from reports submitted to CARB through the Regulation for the Mandatory Reporting of GHG Emissions (MRR). The MRR requires facilities and entities with more than 10,000 metric tons of carbon dioxide equivalent ($MTCO_2e$) of combustion and process emissions, all facilities belonging to certain industries, and all electric power entities to submit an annual GHG emissions data report directly to CARB. Furthermore, this regulation requires that reports from entities that emit more than 25,000 $MTCO_2e$ be verified by a CARB-

[114] The High GWP sector includes high global warming potential gas emissions from releases of ozone depleting substance (ODS) substitutes, SF_6 emissions from the electricity transmission and distribution system, and gases that are emitted in the semiconductor manufacturing process. ODS substitutes, which are primarily HFCs, are used in refrigeration and air conditioning equipment, solvent cleaning, foam production, fire retardants, and aerosols.

accredited third-party verification body. More information on MRR emissions reports can be found at CARB's Mandatory Greenhouse Gas Emissions Reporting website.[115]

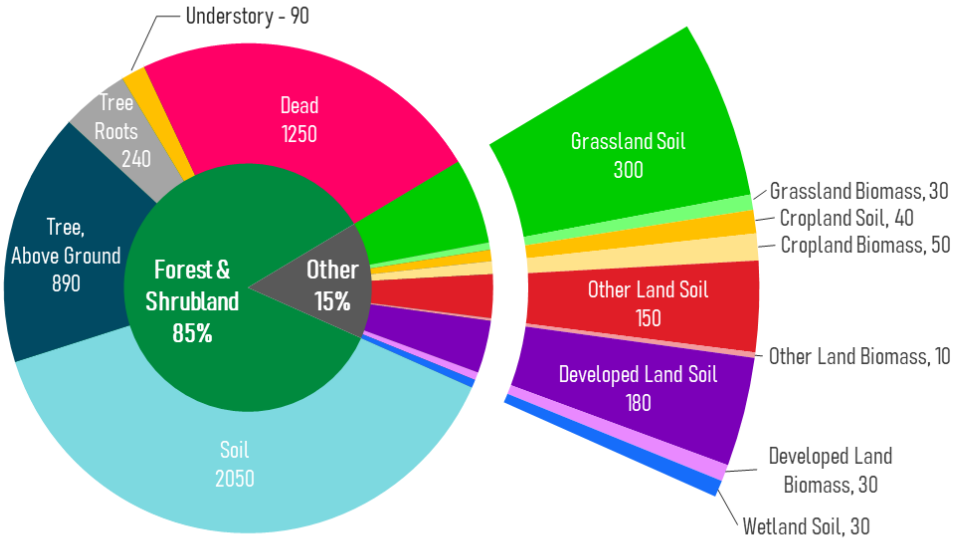
All data sources used to develop the GHG Emission Inventory are listed in CARB's inventory supporting documentation.[116]

Natural and Working Lands

For natural and working lands, the 2018 ecosystem carbon inventory (NWL Inventory)[117] shows there are approximately 5,340 million metric tons (MMT) of carbon in the carbon pools[118] (reservoirs of carbon that have the ability to both take in and release carbon) that CARB has quantified (see Figure 1-9). For purposes of comparison, 5,340 MMT of ecosystem carbon stock is equivalent to 19,600 MMT of atmospheric CO_2. Forests and shrublands contain the majority of California's carbon stock because they cover the majority of California's landscape and have the highest carbon density of any land cover type. All other land categories combined comprise over 35 percent of California's total acreage, but only 15 percent of carbon stocks. Roughly half of the 5,340 MMT of carbon resides in soils and half in plant biomass.

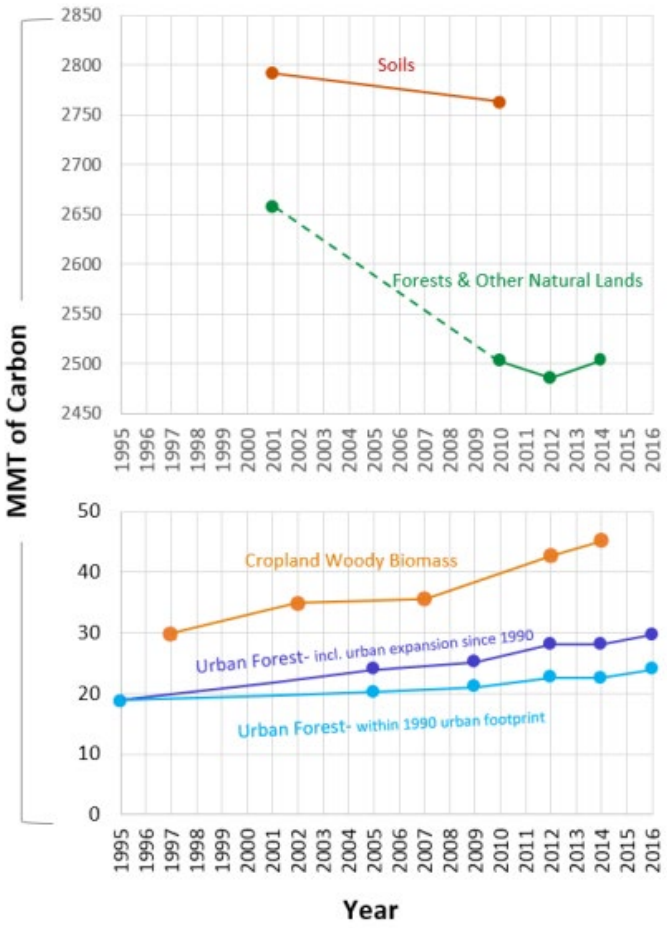
[115] CARB. Mandatory Greenhouse Gas Emissions Reporting. https://ww2.arb.ca.gov/our-work/programs/mandatory-greenhouse-gas-emissions-reporting.
[116] CARB. Current California GHG Emission Inventory Data. www.arb.ca.gov/cc/inventory/data/data.htm.
[117] CARB. 2018. *An Inventory of Ecosystem Carbon in California's Natural and Working Lands.* https://ww3.arb.ca.gov/cc/inventory/pubs/nwl_inventory.pdf.
[118] "Carbon pools" are Above-Ground Live Biomass (boles, stems, and foliage in shrubs, trees, grasses, and herbaceous vegetation), Below-Ground Live Biomass (roots in shrubs, trees, grasses, and herbaceous vegetation), Dead Organic Matter (standing or downed dead wood and litter), Harvested Wood Products (all wood and bark material that leaves harvest sites regardless of whether it is eventually incorporated into merchandisable products), and Soil Organic Matter (organic carbon in the top 30 centimeters of soil).

Figure 1-9: Carbon stocks in natural and working lands (MMT carbon)



In addition to providing an estimate of the ecosystem carbon that exists on California's landscape, the NWL Inventory also shows how those carbon stocks are changing (see Figure 1-10). The inventory attributes stock change to human activity, such as land use change, or to disturbances, such as wildfire. CARB's inventory shows these lands were a source of GHG emissions from 2001 to 2011, releasing more carbon than they stored, and then they returned to be a slight carbon sink from 2012 to 2014. These trends highlight the interannual and interdecadal variability of lands and their ability to be both a source and a sink of carbon.

Figure 1-10: Changes in carbon stock by landscape type



For natural and working lands, California's inventory is also based on IPCC methods for tracking ecosystem carbon over time, providing for comparability with other national and subnational inventories and carbon accounting. As such, the NWL Inventory is an important tool for tracking both carbon stock changes in California over time and the impacts that interventions such as those identified in this Scoping Plan, actions identified in the Climate Smart Land Strategy, and others have on NWL carbon stocks.

All data sources used to develop the NWL Inventory are listed in the technical support documentation at CARB's California Natural & Working Lands Inventory website.[119]

[119] CARB. California Natural & Working Lands Inventory. *https://ww2.arb.ca.gov/nwl-inventory*.

Black Carbon

In addition, CARB has developed a statewide emission inventory for black carbon in support of the SLCP Strategy. The inventory is reported in two categories: non-forestry (anthropogenic) sources and forestry sources.[120] The black carbon inventory is calculated using existing $PM_{2.5}$ emission inventories combined with speciation profiles that define the fraction of $PM_{2.5}$ that is black carbon. The black carbon inventory helps support implementation of the SLCP Strategy, but it is not part of California's GHG Inventory that tracks progress toward the state's climate targets under AB 32 or SB 32. The state's major anthropogenic sources of black carbon include off-road transportation, on-road transportation, residential wood burning, fuel combustion, and industrial processes. CARB estimated 2017 black carbon emissions to be approximately 8 $MTCO_2e$.[121] The majority of anthropogenic sources come from transportation—specifically, heavy-duty vehicles. The share of black carbon emissions from transportation is dropping rapidly and is expected to continue to do so between now and 2030 as a result of California's air quality programs. The remaining black carbon emissions will come largely from woodstoves/fireplaces, off-road applications, and industrial/commercial combustion. The forestry category includes non-agricultural prescribed burning and wildfire emissions.

Tracking Life-Cycle and Out-of-State Emissions

In recent years there has been increased interest in the embedded carbon in products, also known as *life-cycle emissions.* A life-cycle accounting framework refers to all of the GHG emissions generated from the sourcing, production, and transportation of products to an endpoint. In doing such assessments for a product, emissions may be associated with sourced materials and production activity outside a jurisdiction's borders. While life-cycle emissions can provide a more comprehensive picture of the emissions associated with the goods we consume and ongoing demand, life-cycle inventories are inconsistent with IPCC standards, as they would result in double counting of emissions across jurisdictions. Other countries and regions do produce their own inventory reports consistent with IPCC methods and are taking action to reduce emissions within their jurisdictions. In addition, jurisdictions often lack legal authority to regulate sources outside of their borders. Finally, it is difficult to obtain accurate data for sources and production activities outside of a region's border that would impact the accuracy of such an inventory. For these reasons, the inventory used in the Scoping Plan does not use a life-cycle

[120] SB 1383. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB1383.
[121] This is a preliminary estimate developed for this Scoping Plan. Official Black Carbon emissions estimates are provided in the SLCP inventory here: https://ww2.arb.ca.gov/ghg-slcp-inventory.

approach and remains consistent with international accounting standards and consistent with how other countries and regions track emissions within their jurisdictions.

However, GHG mitigation action may cross geographic borders as part of subnational and international collaboration, or as a natural result of implementation of regional policies. In addition to the state's existing GHG inventory, CARB will develop an accounting framework that reflects the benefits of our policies accruing outside of the state. This accounting framework will be important to better understand the true impact of the state's policies on what is emitted into the atmosphere. For example, the LCFS incentivizes GHG reductions along the entire supply chain for the production and delivery of transportation fuel imported for use in the state. However, our inventory only captures the change in emissions from the tailpipe of when that fuel is used in California and does not capture any GHG reductions that occur in the production process if the fuel is produced out of state.

Natural and working lands forestry actions are another example, where California's policies are inspiring forest management actions in other states that result in increased permanent carbon sequestration. California's NWL inventory does not capture the increased carbon stocks resulting from forestry projects happening outside of California, and the CO_2 removals resulting from these projects are not applied in either CARB's NWL inventory or CARB's AB 32 GHG Emissions Inventory. For GHG reductions outside of the state to be attributed to our programs, those reductions must be real, quantifiable, verifiable, and permanent.

It also will be important to avoid any double counting (including claims to those reductions by other jurisdictions) and to transparently indicate whether any extra-jurisdictional emissions reductions might be included in another region's inventory. CARB is collaborating with other jurisdictions to ensure GHG accounting rules are consistent with international best practices, as robust accounting rules instill confidence in the reductions claimed and maintain support for joint action across jurisdictions. The policy goals of consistency and transparency are critical as we work together with other jurisdictions on our parallel paths to achieve our GHG targets with real benefits to the atmosphere.

Tracking Progress

Historically, the AB 32 GHG Inventory has been the primary metric to track progress toward achieving climate targets.[122] However, we must now deploy clean technology at unprecedented rates. The emissions modeling underpinning this Scoping Plan and

[122] Starting with the 2022 Edition of the AB 32 GHG inventory, the inventory development now relies more directly on the annually reported and third-party verified emissions from the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions.

targets for clean technology in statute can serve as leading indicators across the economy on how our actions compare to the pace of action needed to be on track to achieve carbon neutrality. The California Climate Dashboard[123] was launched in 2022 and provides high-level metrics for clean energy production and technology deployment. Statistics such as the deployment of zero emission vehicles and clean electricity generation are just some of the examples of metrics across the economy that can be tracked, in addition to GHG emissions, to understand if the state is on track to meet its climate goals. A key indicator to track will be building of new energy infrastructure and deployment of clean technology as evaluated in the uncertainty analysis in Chapter 2. CARB will coordinate with state agencies to establish and make public similar metrics across all economic sectors to help provide transparency on the state's progress in deploying clean technology at the pace and scale needed to achieve carbon neutrality no later than 2045.

[123] CalEPA. California Climate Dashboard. *https://calepa.ca.gov/climate-dashboard/*.

Chapter 2: The Scoping Plan Scenario

This chapter describes the Scoping Plan Scenario, which for the first time includes sources in both the AB 32 GHG Inventory and Natural and Working Lands (NWL). It begins with a short description of the alternatives evaluated. Four scenarios for the AB 32 GHG Inventory and NWL were considered separately and helped to inform the Scoping Plan Scenario. Each of the alternatives were considered in terms of the important criteria and priorities that the state's comprehensive climate action must deliver, including the need for GHG reductions that are not only technologically feasible and cost-effective, but also can deliver health and economic benefits for the state. All the scenarios were set against what is called the *Reference Scenario*—that is, what the GHG emissions would look like if we did nothing at all beyond the existing policies that are required and already in place to achieve the 2030 target of at least 40 percent below 1990 levels, or those expected with no new actions in the NWL sector. For this Scoping Plan, two sets of modeling tools were used to evaluate the AB 32 GHG Inventory and NWL sectors because no single model can assess both AB 32 sectors and NWL together. As a result, two different sets of scenarios were developed for each sector type. While this chapter breaks out discussion separately for the two sector types, the Scoping Plan Scenario reflects the combined actions across both sectors by choosing an alternative from each sector type. The modeling provides point estimates; however, that does not imply precision. As discussed in the uncertainty section, several types of uncertainties are associated with any outcomes projected by the modeling results. There will be ranges of estimates associated with each point that are not shown in the graphs or results.

Scenarios for the AB 32 GHG Inventory Sectors

The Reference Scenario for the AB 32 GHG Inventory sectors shows continuing but modest GHG reductions beyond 2030 that level off toward mid-century. The comprehensive analysis of all four alternatives indicates that the Scoping Plan Scenario is the best choice to achieve California's climate and clean air goals while balancing the legislative direction on prioritizing direct emissions reductions, reducing anthropogenic emissions by at least 85 percent by 2045, being technologically feasible, and being cost-effective. It also protects public health, provides a solid foundation for continued economic growth, and drastically reduces the state's dependence on fossil fuel combustion and does not disproportionately impact disadvantaged communities. Each of the alternative scenarios was the product of a process of development informed by public input, the

governor,[124] CARB, legislative direction, and input by the EJ Advisory Committee.[125,126] Future updates to the Scoping Plan may consider new clean technologies and fuels beyond those included in this Scoping Plan.

The four scenarios evaluated shared many similarities. They each embodied the following characteristics:

- Drastic reduction in fossil fuel dependence, with some remaining in-state demand for fossil fuels for aviation, marine, and locomotion applications, and for fossil gas for buildings and industry
- Ambitious deployment of efficient non-combustion technologies such as zero emission vehicles and heat pumps
- Rapid growth in the production and distribution of clean energy such as zero carbon electricity and hydrogen
- Progressive phasedown of fossil fuel production and distribution activities as part of the transition to clean energy
- Remaining emissions of fugitive SLCPs such as refrigerants and fugitive methane
- Strong consumer adoption of clean technology and fuel options
- Removal of remaining CO_2 emissions to achieve carbon neutrality
- Some reliance on carbon capture and sequestration (CCS)

While the four scenarios had a lot in common, they also had some differences:

- Year in which carbon neutrality is achieved (2035 or 2045)
- Rate of deployment of clean technology and production and distribution of zero carbon energy
- Remaining amount of demand for fossil energy in the year carbon neutrality is achieved
- Constraints on technology and fuels deployed in certain sectors
- Consumer adoption rates of clean technologies and fuels
- Degree of reliance on CO_2 removal
- Degree of reliance on CCS

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[124] Newsom, Gavin. July 22, 2022. Letter from Governor Newsom to CARB Chair Liane Randolph. Retrieved from *https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf*.

[125] EJ Advisory Committee. December 2, 2021. EJ Advisory Committee Responses for the CARB Scenario Inputs. *https://ww2.arb.ca.gov/sites/default/files/2021-12/EJAC%20Final%20Responses%20to%20CARB%20Scenario%20Inputs_12_2_21.pdf*.

[126] CARB. January 25, 2022. Update on PATHWAYS Scenario Modeling Assumptions. *https://ww2.arb.ca.gov/sites/default/files/2022-01/Scenario%20Slides%20for%20Jan25%20EJAC%20Mtg_01242022.pdf*.

The summary below provides an overview of the alternatives designed and considered for the energy and industrial sectors in this update. Full details of each scenario considered can be found in the *Draft 2022 Scoping Plan Update*

Scoping Plan Scenario (modeling scenario Alternative 3 from the Draft): carbon neutrality by 2045, deploy a broad portfolio of existing and emerging fossil fuel alternatives and clean technologies, and align with statutes, Executive Orders, Board direction, and direction from the governor

Alternative 1: carbon neutrality by 2035, nearly complete phaseout of all combustion, limited reliance on carbon capture and sequestration and engineered carbon removal, and restricted applications for biomass-derived fuels

Alternative 2: carbon neutrality by 2035 and aggressive deployment of a full suite of technology and energy options, including engineered carbon removal

Alternative 4: carbon neutrality by 2045, deployment of a broad portfolio of existing and emerging fossil fuel alternatives, slower deployment and adoption rates than the Scoping Plan Scenario, and a higher reliance on CO_2 removal

Other considerations for the AB 32 GHG Inventory sectors include the following:

- To what extent does an alternative meet the statewide targets and any sector targets, and also deliver clean air benefits (especially in the near term) to address ongoing healthy air disparities, prioritize reductions for mobile and large stationary sources, and emphasize continued investment in disadvantaged communities?
- Does an alternative support California in building on efforts to collaborate with other jurisdictions and include exportable policies based on robust science?
- Does an alternative provide for compliance options and a cost-effective approach to reduce GHG emissions?
- Does the alternative present a realistic and ambitious path forward consistent with statute and science, and support economic opportunities, particularly in anticipated growth sectors?

Scenarios for Natural and Working Lands

For the natural and working lands sector, the Reference Scenario shows that NWL will continue to emit GHGs and lose carbon stocks into the future as the combined effects of past unhealthy management practices and climate change impact our lands. Relative to the Reference Scenario, the four NWL scenarios represent different scales of land management on seven landscapes (forests, shrublands/chaparral, grasslands, croplands, developed lands, wetlands, and sparsely vegetated lands) to support carbon neutrality.

The analysis of the four NWL scenarios shows that the Scoping Plan Scenario is the preferred choice because it prioritizes sustainable land management to sequester carbon over the long term, GHG and air pollution reductions, ecosystem health and resilience, and implementation and technological feasibility and cost-effectiveness. The Scoping Plan Scenario reduces catastrophic wildfire risk to the state; increases the health and resilience of California's forests, shrublands, and grasslands; increases soil health; and protects, restores, and enhances California's natural and working lands for future generations. The Scoping Plan Scenario takes into consideration the priority landscapes and nature-based strategies identified in California's Climate Smart Strategy[127] and reflects the state's priorities to manage lands in ways that support the multiple benefits they provide. The Scoping Plan Scenario, as well as each of the alternative NWL scenarios, were informed by input from other agencies, the public, and the EJ Advisory Committee. Additional landscapes and land management activities will be added and evaluated in future Scoping Plan updates and in response to AB 1757.

Each of the NWL scenarios have several similarities, including the following:

- Prioritizing NWL management actions on forests, shrublands, grasslands, croplands, developed lands, wetlands, and sparsely vegetated lands. These actions can reduce GHG emissions from these lands, protect ecosystems against future climate change, protect communities, and enhance the ecosystem benefits they provide to nature and society.
- Exploring the potential impacts of different levels of NWL management actions that are designed to achieve the objective associated with each scenario.
- Analyzing the carbon impacts of land management actions, climate change, wildfire, and water use on California's diverse natural and working lands through 2045.

There are also differences across the four NWL scenarios. These include:

- The level of NWL management actions taken on each landscape, such as varying the acres of healthy soils practices for croplands.
- The types of NWL management actions taken on each landscape, such as prescribed burning or thinning for forests, grasslands, and shrublands.

[127] CNRA. 2022. Natural and Working Lands Climate Smart Strategy. *https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/CNRA-Report-2022---Final_Accessible_Compressed.pdf*.

The summary below provides an overview of the alternatives designed and considered for the NWL sectors in this Scoping Plan. Full details of each scenario considered can be found in the *Draft 2022 Scoping Plan Update*.

Scoping Plan Scenario (NWL Alternative 3 from the Draft): land management activities that prioritize restoration and enhancement of ecosystem functions to improve resilience to climate change impacts, including more stable carbon stocks

NWL Alternative 1: land management activities that prioritize short term carbon stocks in our forests and through increased climate smart agricultural practices on croplands

NWL Alternative 2: land management activities representative of California's current commitments and plans

NWL Alternative 4: land management activities that prioritize reducing catastrophic wildfires in forests, shrublands, and grasslands

Evaluation of Scoping Plan Alternatives

CARB staff solicited feedback from topical experts, affected stakeholders, and the EJ Advisory Committee, including a tribal representative, at public meetings to assemble input assumptions for four carbon neutrality scenarios to model using PATHWAYS. Revisions to the Draft Scoping Plan were informed by direction in statute, the Governor's Executive Orders, public comments, and the recommendations of the EJ Advisory Committee. The three alternative scenarios were designed to explore the potential speed, magnitude, and impacts of transitioning California's energy demand away from fossil fuels. The modeling assumptions listed below identify the primary fossil fuel alternative that is commercially available and technically feasible for widespread use by 2045 for each sector. CARB assumes that any energy demand that remains after the alternative technology or fuel is applied—such as on-road internal combustion engines, industrial processes, and gas use in existing buildings that have not yet decarbonized—will continue to be met by fossil fuels, resulting in residual GHG emissions.

NWL Scoping Plan Alternatives

For the NWL sectors, staff significantly expanded the scale of the scientific analysis for NWL from previous Scoping Plan efforts. CARB staff utilized modeling tools for this expanded analysis to assess both the carbon and other ecological, public health, and economic outcomes of management actions on forests, shrublands, grasslands, croplands, developed lands, wetlands, and sparsely vegetated lands. CARB staff aligned the scenarios with both the landscape types and actions identified in other efforts called for in Governor Newsom's Executive Order N-82-20 (e.g., California's Climate Smart Strategy and Pathways to 30x30). As part of this Scoping Plan, CARB staff modeled as many of the management actions identified in the Natural and Working Lands Climate

Smart Strategy as were feasible. The management actions that were included in the model were selected because of the State of California's previous work to quantify these actions' impacts. It was not feasible to model every land management strategy for NWL, and so it is possible that larger volumes of sequestration (e.g., in soils or in oceans) could result from additional non-modeled activities. California's Natural and Working Lands Climate Smart Strategy includes a more comprehensive listing of priority nature-based solutions and management actions. It is important to note that the absence of a particular management action or its climate benefit in the modeling is not an indication of its importance or potential contributions toward meeting the target or toward supporting the carbon neutrality target for California.

Forests: Management strategies were modeled for forests: biological/chemical/ herbaceous treatments (e.g., herbicide application), clearcut, various timber harvests (e.g., variable retention, seed tree / shelterwood, selection harvesting), mastication, other mechanical treatments (e.g., piling of dead material, understory thinning), prescribed burning, and thinning. Avoided land conversion to another land use was also included in the modeling. Wildfire was modeled and is responsive to management strategies and climate conditions.

Shrublands and chaparral: Management strategies were modeled for shrublands and chaparral: biological/chemical/herbaceous treatments, prescribed burning, mechanical treatment (e.g., mastication, crushing, mowing, piling), and avoided conversion from shrubland to another land use. Wildfire was modeled and is responsive to management strategies and climate conditions.

Grasslands: Management strategies were modeled for grasslands: biological/chemical/herbaceous treatments, prescribed burning, and avoided land conversion from grasslands to another land use. Wildfire was modeled and is responsive to management strategies and climate conditions.

Croplands: Management strategies were modeled for row crops: cover cropping, no till, reduced till, compost amendment, transition to organic[128] farming, avoided conversion of annual crop agricultural land through easements, establishing riparian forest buffers, alley cropping, establishing windbreaks/shelterbelts, establishing tree and shrubs in croplands, and establishing hedgerows. For perennial crops, windbreaks/shelterbelts, hedgerows, conversion from annual crops to perennial crops, and avoided conversion to other land uses were modeled.

[128] Note: N_2O reductions from decreases in synthetic fertilizer application in organic farming were not modeled.

Developed lands: Management strategies were modeled for developed lands: Increasing tree canopy cover through planting trees and improved management of existing trees, and removing vegetation surrounding structures in accordance with the CAL FIRE Defensible Space PRC 4291.

Wetlands: Management strategies were modeled for wetlands: Restoring wetlands through submerging cultivated land in the Sacramento-San Joaquin Delta and avoided land conversion in the Sacramento-San Joaquin Delta.

Sparsely vegetated lands: Management strategies were modeled for sparsely vegetated lands: Avoided conversion of sparsely vegetated lands to another land use.

Scoping Plan Scenario

The Scoping Plan Scenario achieves GHG emission reductions that exceed the levels expected based on existing policies represented in the Reference Scenario, keeping California on track to achieve the SB 32 GHG reduction target for 2030 and become carbon neutral no later than 2045. Actions that reduce GHG emissions and transition AB 32 GHG Inventory sources away from fossil fuel combustion affect each economic sector. Actions that lead to improved carbon stocks affect each landscape.

AB 32 GHG Inventory Sectors

The AB 32 GHG Inventory Sector Reference scenario is the forecasted statewide GHG emissions through mid-century, with existing policies and programs but without any further action to reduce GHGs beyond those needed to achieve the 2030 limit. The Reference Scenario was developed based on other projections of business-as-usual conditions. Sources of data and policies included are:

- California Energy Demand Forecast[129]
- The two transportation carbon neutrality studies required by AB 74[130]
- The Mobile Source Strategy[131]
- SB 100 60 percent Renewables Portfolio Standard
- A Low Carbon Fuel Standard carbon intensity reduction target of 20 percent

Policies that are under study or design, such the Advanced Clean Fleets regulation, are not included. The Reference Scenario reflects current trends and expected performance of policies identified in the 2017 Scoping Plan—some of which are performing better (such as the RPS and LCFS) and others that may not meet expectations (such as vehicle miles traveled [VMT] reductions and methane capture). Figure 2-1 provides the modeling results for a Reference Scenario for the AB 32 GHG Inventory sectors compared to the Scoping Plan Scenario.

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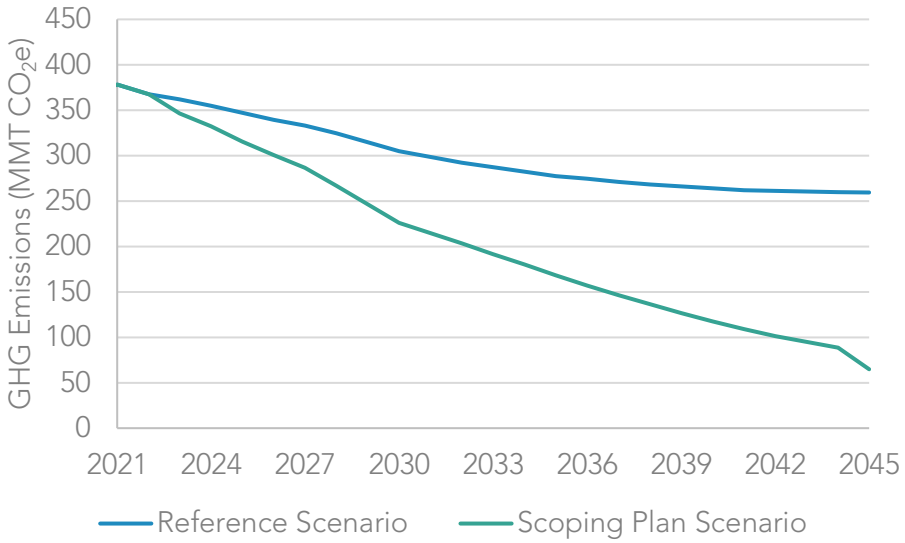
[129] California Energy Commission (CEC). 2020. *2019 Integrated Energy Policy Report.* https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2019-integrated-energy-policy-report.

[130] Brown et al. 2021. *Driving California's Transportation Emissions.* https://escholarship.org/uc/item/3np3p2t0 and Deschenes et al. 2021. *Enhancing equity.* https://zenodo.org/record/4707966#.YI72RNrMKUn.

[131] CARB. 2021. 2020 *Mobile Source Strategy.* https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf.

Figure 2-1: Reference and Scoping Plan Scenario GHG emissions[132]



The Scoping Plan Scenario is summarized in Table 2-1. The table shows the types of technologies and energy needed to drastically reduce GHG emissions from the AB 32 Inventory sectors. It also includes references to relevant statutes and Executive Orders, although it is not comprehensive of all existing new authorities for directing or supporting the actions described. Each action is expected to both reduce GHGs and help improve air quality, primarily by transitioning away from combustion of fossil fuels. The Scoping Plan Scenario achieves the AB 1279 target of 85 percent below 1990 levels by 2045 and identifies a need to accelerate the 2030 target to 48 percent below 1990 levels.

[132] The drop in emissions in 2045 reflects both the need to achieve an 85% reduction below 1990 levels in anthropogenic emissions per AB 1279 and Governor Newsom's request for a 100 MMT CO2e carbon removal and capture target in 2045. This was modeled by extending CCS to electric sector emissions.

Table 2-1: Actions for the Scoping Plan Scenario: AB 32 GHG Inventory sectors

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
GHG Emissions Reductions Relative to the SB 32 Target[133]	40% below 1990 levels by 2030	SB 32: Reduce statewide GHG emissions. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Smart Growth / Vehicle Miles Traveled (VMT)	VMT per capita reduced 25% below 2019 levels by 2030, and 30% below 2019 levels by 2045	SB 375: Reduce demand for fossil transportation fuels and GHGs, and improve air quality. In response to Board direction and EJ Advisory Committee recommendations
Light-duty Vehicle (LDV) Zero Emission Vehicles (ZEVs)	100% of LDV sales are ZEV by 2035	EO N-79-20: Reduce demand for fossil transportation fuels and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory 2035 target aligns with the EJ Advisory Committee recommendation.

[133] While the SB 32 GHG emissions reduction target is not an Action that is analyzed independently, it is included in this table for reference.

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Truck ZEVs	100% of medium-duty (MDV)/HDV sales are ZEV by 2040 (AB 74 University of California Institute of Transportation Studies [ITS] report)	EO N-79-20: Reduce demand for fossil transportation fuels and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Aviation	20% of aviation fuel demand is met by electricity (batteries) or hydrogen (fuel cells) in 2045. Sustainable aviation fuel meets most or the rest of the aviation fuel demand that has not already transitioned to hydrogen or batteries.	Reduce demand for petroleum aviation fuel and reduce GHGs. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory In response to Governor Newsom's July 2022 letter to CARB Chair Liane Randolph
Ocean-going Vessels (OGV)	2020 OGV At-Berth regulation fully implemented, with most OGVs utilizing shore power by 2027. 25% of OGVs utilize hydrogen fuel cell electric technology by 2045.	Reduce demand for petroleum fuels and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Port Operations	100% of cargo handling equipment is zero-emission by 2037. 100% of drayage trucks are zero emission by 2035.	Executive Order N-79-20: Reduce demand for petroleum fuels and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Freight and Passenger Rail	100% of passenger and other locomotive sales are ZEV by 2030. 100% of line haul locomotive sales are ZEV by 2035. Line haul and passenger rail rely primarily on hydrogen fuel cell technology, and others primarily utilize electricity.	Reduce demand for petroleum fuels and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Oil and Gas Extraction	Reduce oil and gas extraction operations in line with petroleum demand by 2045.	Reduce GHGs and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Petroleum Refining	CCS on majority of operations by 2030, beginning in 2028 Production reduced in line with petroleum demand.	Reduce GHGs and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Electricity Generation	Sector GHG target of 38 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) in 2030 and 30 $MMTCO_2e$ in 2035 Retail sales load coverage[134] 20 gigawatts (GW) of offshore wind by 2045 Meet increased demand for electrification without new fossil gas-fired resources.	SB 350 and SB 100: Reduce GHGs and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory In response to Governor Newsom's July 2022 letter, Board direction, and EJ Advisory Committee recommendation
New Residential and Commercial Buildings	All electric appliances beginning 2026 (residential) and 2029 (commercial), contributing to 6 million heat pumps installed statewide by 2030	Reduce demand for fossil gas and GHGs, and improve ambient and indoor air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory In response to Governor Newsom's July 2022 letter

[134] SB 100 speaks only to retail sales and state agency procurement of electricity. The *2021 SB 100 Joint Agency Report* reflects the agency authors' understanding that other loads—wholesale or non-retail sales and losses from storage and transmission and distribution lines—are not subject to the law.

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Existing Residential Buildings	80% of appliance sales are electric by 2030 and 100% of appliance sales are electric by 2035. Appliances are replaced at end of life such that by 2030 there are 3 million all-electric and electric-ready homes—and by 2035, 7 million homes—as well as contributing to 6 million heat pumps installed statewide by 2030.	Reduce demand for fossil gas and GHGs, and improve ambient and indoor air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory In response to Governor Newsom's July 2022 letter
Existing Commercial Buildings	80% of appliance sales are electric by 2030, and 100% of appliance sales are electric by 2045. Appliances are replaced at end of life, contributing to 6 million heat pumps installed statewide by 2030.	Reduce demand for fossil gas and GHGs, and improve ambient and indoor air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory In response to Governor Newsom's July 2022 letter
Food Products	7.5% of energy demand electrified directly and/or indirectly by 2030; 75% by 2045	Reduce demand for fossil gas and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Construction Equipment	25% of energy demand electrified by 2030 and 75% electrified by 2045	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Chemicals and Allied Products; Pulp and Paper	Electrify 0% of boilers by 2030 and 100% of boilers by 2045. Hydrogen for 25% of process heat by 2035 and 100% by 2045 Electrify 100% of other energy demand by 2045.	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Stone, Clay, Glass, and Cement	CCS on 40% of operations by 2035 and on all facilities by 2045 Process emissions reduced through alternative materials and CCS	SB 596: Reduce demand for fossil energy, process emissions, and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Other Industrial Manufacturing	0% energy demand electrified by 2030 and 50% by 2045	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Combined Heat and Power	Facilities retire by 2040.	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Agriculture Energy Use	25% energy demand electrified by 2030 and 75% by 2045	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions
Low Carbon Fuels for Transportation	Biomass supply is used to produce conventional and advanced biofuels, as well as hydrogen.	Reduce demand for petroleum fuel and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory
Low Carbon Fuels for Buildings and Industry	In 2030s biomethane[135] blended in pipeline Renewable hydrogen blended in fossil gas pipeline at 7% energy (~20% by volume), ramping up between 2030 and 2040 In 2030s, dedicated hydrogen pipelines constructed to serve certain industrial clusters	Reduce demand for fossil energy and GHGs, and improve air quality. AB 197: direct emissions reductions for sources covered by the AB 32 Inventory

[135] *Biomethane* is also known as renewable natural gas (RNG).

Sector	Action	Statutes, Executive Orders, Other Direction, Outcome
Non-combustion Methane Emissions	Increase landfill and dairy digester methane capture. Some alternative manure management deployed for smaller dairies Moderate adoption of enteric strategies by 2030 Divert 75% of organic waste from landfills by 2025. Oil and gas fugitive methane emissions reduced 50% by 2030 and further reductions as infrastructure components retire in line with reduced fossil gas demand	SB 1383: Reduce short-lived climate pollutants.
High GWP Potential Emissions	Low GWP refrigerants introduced as building electrification increases, mitigating HFC emissions	SB 1383: Reduce short-lived climate pollutants.

Natural and Working Lands

The Reference Scenario for NWL represents the amount of land management that occurred between 2001 and 2014, and projects the outcomes from maintaining the 2001–2014 levels of land management until 2045. The management and land use practices that occur within the Reference Scenario were derived from empirical data used by staff. For forests, shrublands/chaparral, and grasslands, the Reference Scenario constitutes approximately 250,000 acres of annual statewide treatments. For croplands, the Reference Scenario represents no healthy soil practices because during this period the healthy soil program did not yet exist. For land use change within all land types that consider land use change, historical rates of land conversion from 2001–2014 also were taken from empirical data and modeled into the future for the Reference Scenario.

Table 2-2 summarizes the Scoping Plan Scenario. The table also includes references to relevant statutes and Executive Orders where available.

Table 2-2: Actions for the Scoping Plan Scenario: NWL sectors

Sector	Action	Statutes, Executive Orders, Outcome
Natural and Working Lands	Conserve 30% of the state's NWL and coastal waters by 2030. Implement near- and long-term actions to accelerate natural removal of carbon and build climate resilience in our forests, wetlands, urban greenspaces, agricultural soils, and land conservation activities in ways that serve all communities—and in particular low-income, disadvantaged, and vulnerable communities.	EO N-82-20 and SB 27: CARB to include an NWL target in the Scoping Plan. AB 1757: Establish targets for carbon sequestration and nature-based climate solutions. SB 1386: NWL are an important strategy in meeting GHG reduction goals.

Sector	Action	Statutes, Executive Orders, Outcome
Forests and Shrublands	At least 2.3 million acres[136] treated statewide annually in forests, shrublands/chaparral, and grasslands, comprised of regionally specific management strategies that include prescribed fire, thinning, harvesting, and other management actions. No land conversion of forests, shrublands/chaparral, or grasslands.	Restore health and resilience to overstocked forests and prevent carbon losses from severe wildfire, disease, and pests. Improve air quality and reduce health costs related to wildfire emissions. Improve water quantity and quality and improve rural economies. Provide forest biomass for resource utilization. EO B-52-18: CARB to increase the opportunity for using prescribed fire. AB 1504 (Skinner, Chapter 534, Statutes of 2010): CARB to recognize the role forests play in carbon sequestration and climate mitigation.

[136] The 2.3 million acre target is what the Scoping Plan modeling shows would be needed to realize the carbon stock target called for in this Scoping Plan by 2045.

Sector	Action	Statutes, Executive Orders, Outcome
Grasslands	At least 2.3 million acres[137] treated includes increased management of grasslands interspersed in forests to reduce fuels surrounding communities using management strategies appropriate for grasslands. No land conversion of forests, shrublands/chaparral, or grasslands.	Help to achieve climate targets, improve air quality, and reduce health costs.
Croplands	Implement climate smart practices for annual and perennial crops on ~80,000 acres annually. Land easements/ conservation on annual crops at ~5,500 acres annually. Increase organic agriculture to 20% of all cultivated acres by 2045 (~65,000 acres annually).	Reduce short-lived climate pollutants. Increase soil water holding capacity. Increase organic farming and reduce pesticide use. SB 859: Recognizes the ability of healthy soils practices to reduce GHG emissions from agricultural lands. Target increased in response to Governor Newsom's direction to prioritize sustainable land management.

[137] The 2.3 million acre target is what the Scoping Plan modeling shows would be needed to realize the carbon stock target called for in this Scoping Plan by 2045.

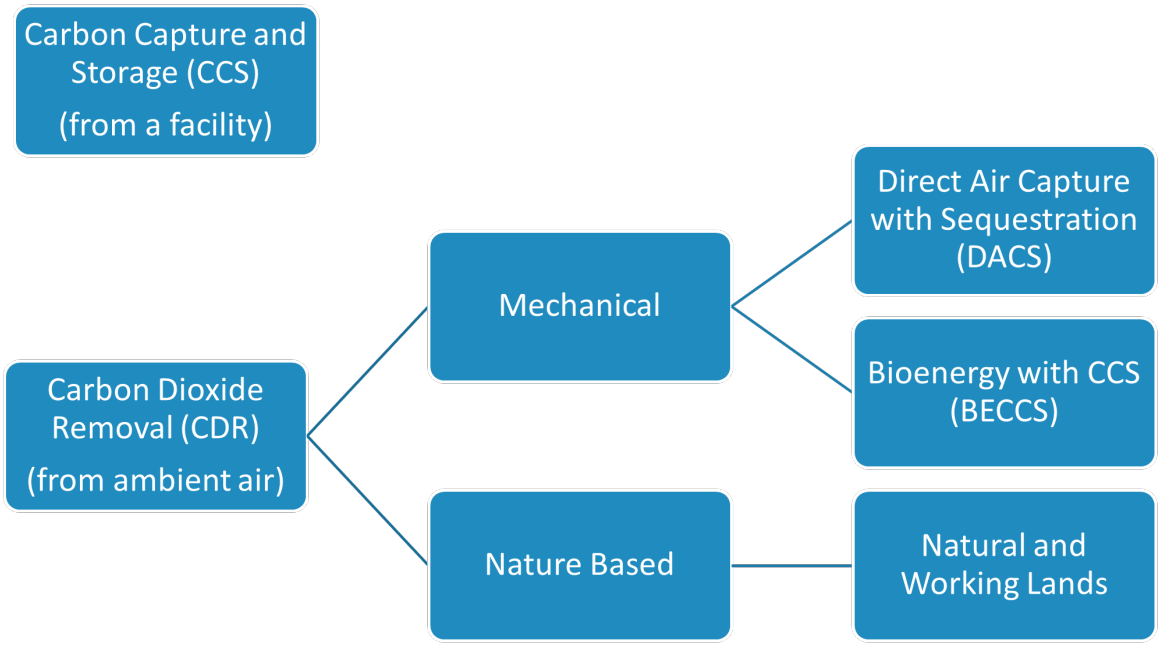
Sector	Action	Statutes, Executive Orders, Outcome
Developed Lands	Increase urban forestry investment by 200% above current levels and utilize tree watering that is 30% less sensitive to drought. Establish defensible space that accounts for property boundaries.	Increase urban tree canopy and shade cover. Reduce heat island effects and support water infrastructure. Reduce fire risk via defensible space. AB 2251 (Calderon, Chapter 186, Statutes of 2022): Increase urban tree canopy 10% by 2035. Target increased in response to AB 2251 and Governor Newsom's direction on CO_2 removal targets in his July 2022 letter.
Wetlands	Restore 60,000 acres of Delta wetlands.	Increase carbon sequestration and reduce short-lived climate pollutants. Helps to reverse land subsidence while improving flood protection and providing critical habitat.
Sparsely Vegetated Lands	Land conversion at 50% of the Reference Scenario land conversion rate.	Reduce the rate of land conversion to more GHG-intensive land uses.

Strategies for Carbon Removal and Sequestration

To achieve carbon neutrality, any remaining emissions must be compensated for using carbon removal and sequestration tools. The following discussion presents more detail

on the options available to capture and sequester carbon. Carbon removal and sequestration will be an essential tool to achieve carbon neutrality, and the modeling clearly shows there is no path to carbon neutrality without carbon removal and sequestration. Governor Newsom also recognized the importance of CO_2 removal strategies and directed CARB to establish CO_2 removal and carbon capture targets of 20 $MMTCO_2$ and 100 $MMTCO_2$ by 2030 and 2045, respectively, as well as signing 2022 legislation on carbon removal and sequestration, including: AB 1279, SB 905, SB 1137, and AB 1757. Carbon removal and sequestration can take different forms. Figure 2-2 illustrates the types of carbon removal and sequestration included in this Scoping Plan. There are numerous other carbon removal options undergoing research, development, and pilot deployment. As these options mature and new approaches emerge, they can be considered in future Scoping Plan updates.

Figure 2-2: Forms of carbon removal and sequestration considered in this Scoping Plan



The Role of Carbon Capture and Sequestration

Carbon capture and sequestration (CCS) will be a necessary tool to reduce GHG emissions and mitigate climate change while minimizing leakage and minimizing emissions where no technological alternatives may exist. CCS is a process by which large amounts of CO_2 are captured, compressed, transported, and sequestered. CCS projects are paired with a source of emissions, as the CCS project captures CO_2 as it leaves a facility's smokestack. CCS projects are often paired with large GHG-emitting facilities such as energy, manufacturing, or fuel production facilities. The sequestration component

of CCS includes CO_2 injection into geologic formations (such as depleted oil and gas reservoirs and saline formations), as well as use in industrial materials (e.g., concrete). CCS is distinct from biological sequestration, which is typically accomplished through NWL management and conservation practices that enhance the storage of carbon or reduce CO_2 emissions with nature-based approaches. CCS is also distinct from mechanical CO_2 removal technologies, where CO_2 is removed directly from the atmosphere using mechanical and/or chemical processes.

CARB adopted a CCS Protocol in 2018 as part of amendments to the Low Carbon Fuel Standard.[138] At this time, no CCS projects have been implemented or have generated any credits under that protocol. However, CCS projects have been implemented elsewhere since the 1970s, largely on coal-fired power plants, with over two dozen projects operational around the world. Over 100 are at the stages of advanced or early development and are expanding beyond coal-fired plants to fossil gas, fuel production, and electricity generation facilities.[139] CCS projects are in development for addressing emissions from fuel, gas, energy production, and chemical production. As of November 2019, more than half of global large-scale CCS facilities (representing approximately 22 $MMTCO_2$/yr in capacity[140]) were in the U.S., mostly as a result of sustained governmental support for these technologies.[141] This support includes the federal 45Q tax credit for CCS[142,143] and research and deployment grants from federal agencies.[144, 145] California's deep sedimentary rock formations in the Central Valley represent world-class

[138] CARB. 2022. Carbon Capture & Sequestration. *https://ww2.arb.ca.gov/our-work/programs/carbon-capture-sequestration*.
[139] Global CCS Institute. 2021. *Global Status of CCS 2021.* *https://www.globalccsinstitute.com/wp-content/uploads/2021/11/Global-Status-of-CCS-2021-Global-CCS-Institute-1121.pdf*.
[140] IHS Markit. August 2021. Carbon Removal Potential: An Overview. *https://ww2.arb.ca.gov/sites/default/files/2021-08/ihsmarkit_presentation_sp_engineeredcarbonremoval_august2021.pdf*.
[141] Beck, Lee. 2019. *Carbon capture and storage in the USA: The role of US innovation leadership in climate-technology commercialization.* *https://academic.oup.com/ce/article/4/1/2/5686277*.
[142] Congressional Research Service. 2021. Carbon Storage Requirements in the 45Q Tax Credit. IF11639. *https://crsreports.congress.gov/product/pdf/IF/IF11639*.
[143] The Inflation Reduction Act of August 2022 expands and enhances the 45 Q tax credit for CCS. Pub.L. No. 117-169 (August 16, 2022).
[144] U.S. Department of Energy. 2020. U.S. Department of Energy Announces $131 Million for CCUS Technologies. *https://www.energy.gov/articles/us-department-energy-announces-131-million-ccus-technologies*.
[145] U.S. Department of Energy. 2021. Funding Opportunity Announcement 2515, Carbon Capture R&D for Natural Gas and Industrial Point Sources, and Front-End Engineering Design Studies for Carbon Capture Systems at Industrial Facilities and Natural Gas Plants. *https://www.energy.gov/fecm/articles/funding-opportunity-announcement-2515-carbon-capture-rd-natural-gas-and-industrial*.

CO_2 storage sites that would meet the highest standards, with storage capacities of at least 17 billion tons of CO_2.[146,147]

In this Scoping Plan, CCS is included to address emissions from limited sectors, including electricity generation, cement production facilities, and refineries, to ensure anthropogenic emissions are reduced by at least 85 percent below 1990 levels in 2045, as directed in AB 1279. While the modeling outputs show CCS not being applied to the electricity sector until 2045, CCS could be implemented earlier on the electricity sector with a similar ramp up over time as that for refineries and cement plants. An earlier application of CCS in the electricity sector would yield additional reductions in years prior to 2045. In addition, CCS can support hydrogen production until such time as there is sufficient renewable power for electrolysis and an abundant water source.

Cement plants have emissions associated with combustion and process-related activities. Combustion emissions account for approximately 40 percent of the total emissions at cement plants. The remaining emissions are related to process-related activities. Due to the high heat content needed to produce cement, there is currently no technically feasible alternative to combustion. SB 596 calls for a 40 percent reduction in GHG intensity in cement emissions from 2019 levels by 2035, and then net zero emissions by 2045. To meet in-state demand, the state relies on cement both produced in state and imported. There are seven cement plants operating in California.[148] To minimize emissions leakage and address emissions from cement plants, the Scoping Plan Scenario includes CCS for cement plants. Additional reductions will need to be pursued and considered as part of implementation of SB 596, which calls for CARB to develop a comprehensive strategy by July 1, 2023, for the state's cement sector to achieve net-zero emissions of GHGs associated with cement used within the state as soon as possible, but no later than December 31, 2045. This effort began in the summer of 2022 and included sector specific workshops.

Even with implementation of EO N-79-20, and despite all of the ambitious efforts in the Scoping Plan Scenario, there will remain some demand for petroleum fuels for legacy vehicles on road applications, and in aviation, rail, and marine applications. Petroleum refineries will need to implement technology to decarbonize their operations and reduce their emissions. This Scoping Plan also assumes CCS at petroleum refineries as one of those potential strategies. Currently, there are seventeen petroleum refineries operating

[146] For comparison purposes, California's emitted 418.2 million metric tons of CO_2e in 2019.
[147] Lawrence Livermore National Laboratory. 2020. *Getting to Neutral: Options for Negative Carbon Emissions in California.* Revision 1. https://www-gs.llnl.gov/content/assets/docs/energy/Getting_to_Neutral.pdf.
[148] CARB. Mandatory GHG Reporting – Reported Emissions. https://ww2.arb.ca.gov/mrr-data

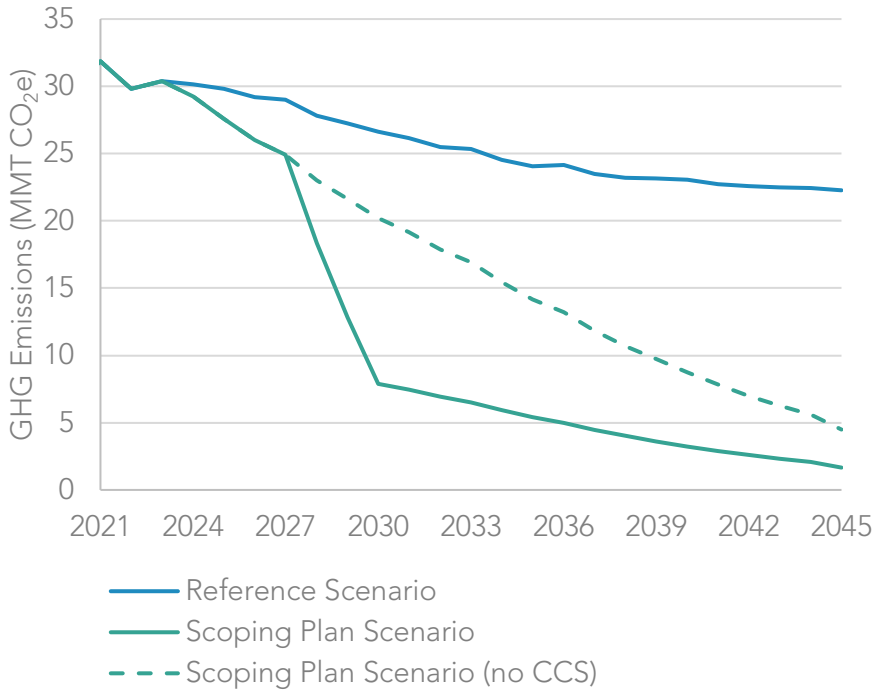
in the state.[149] On the supply side, the modeling assumes all in-state demand is met through some very limited refining activities in California. Figure 2-3 shows the emissions from the refining sector with and without CCS. If CCS is not deployed, the emissions would be directly emitted into the atmosphere, and CO_2 removal by NWL or direct air capture would need to increase to compensate for the sector's emissions.

Refineries can have a variety of point sources that emit CO_2—such as steam methane reformers for producing hydrogen, combined heat and power units, and catalytic crackers—that are best suited for CCS. Each configuration of a refinery can be unique to its footprint, onsite operations, and the types of crude oils processed. There are newer technologies with smaller footprints[150] that can be deployed in modular configurations to capture CO_2 in space-constrained and multiple-point-source facilities such as refineries. CCS can provide a path to reducing GHG emissions from these facilities to meet petroleum demand while avoiding leakage and until such time as some refineries can be transitioned to produce clean energy to support the transition away from fossil fuels.

While the Scoping Plan modeled deployment of CCS on refineries and identifies significant emissions reductions that can be achieved, the refineries in California are large and complex. The actual deployment of CCS at these facilities as modeled in the Scoping Plan is uncertain. It will be important to closely monitor the evolution of CCS deployment in the refinery sector and, in the next Scoping Plan update, to evaluate the progress toward use in this sector to determine whether the projected reductions will be achieved.

[149] CARB. Mandatory GHG Reporting. *https://ww2.arb.ca.gov/mrr-data*.
[150] Carbon Clean. Modular Carbon Capture Systems for Industry. https://www.carbonclean.com/modular-systems?hsLang=en.

Figure 2-3: Petroleum refining emissions with and without carbon capture and sequestration



This Scoping Plan also calls for accelerating the transition from combustion of fossil fuels to hydrogen. Hydrogen can be produced through electrolysis with renewable electricity or through steam methane reformation of biomethane. There is a high degree of uncertainty around the availability of solar to support both electrification of existing sectors and the production of hydrogen through electrolysis. Producing hydrogen required under the Scoping Plan Scenario with electrolysis would require about 10 gigawatts (GW)[151] of additional solar capacity. If steam methane reformation is paired with CCS, the hydrogen produced could potentially be low carbon. Additionally, the biomethane used to generate hydrogen could be sourced from gasification of forest or agricultural waste resulting from forest management and other NWL management practices, which could also lead to net negative carbon outcomes. Steam methane reformation paired with CCS can thus ensure a rapid transition to hydrogen and increase hydrogen availability until such time as

[151] The Draft Scoping Plan included an estimate for solar capacity (40 GW) to support only electrolysis to produce all hydrogen in the Proposed Scenario. The Scoping Plan now includes steam methane reformation of biomethane and biomass gasification with CCS to produce hydrogen, along with electrolysis from off-grid solar. See Appendix H (AB 32 GHG Inventory Sector Modeling) for additional details.

electrolysis with renewables can meet the ongoing need, assuming there is also sufficient water supply. Additional background and next steps for CCS can be found in Chapter 4.

The EJ Advisory Committee has raised multiple concerns related to the inclusion of CCS and mechanical CDR in the Scoping Plan. Concerns range from potential negative health and air quality impacts in communities from operation of facilities utilizing CCS that continue to emit other emissions, to safety concerns related to potential leaks, to the viability of the current technology. Additionally, the EJ Advisory Committee has policy concerns about the strategy and wants to ensure that engineered carbon removal is not used as a substitute for strategies to achieve emissions reductions onsite and that it does not result in delays in phasing out fossil fuel use. Given these and other concerns and the importance of building public awareness, CARB recognizes the need for a multi-stakeholder process including other state, federal, and local agencies; tribes; independent experts; and community residents to further understand and address community concerns related to CCS. CARB hosted a CCS Symposium with U.S. EPA Region 9 and the Stanford Doerr School of Sustainability to discuss some of these critical issues with community members and other participants. As CARB begins the process of implementing SB 905 in 2023, that will provide an opportunity for further engagement.

In the context of CCS deployment, the Council of Environmental Quality (CEQ) also highlighted the need to further assess and quantify potential impacts on local criteria air pollutants and other emissions resulting from carbon capture retrofits at industrial facilities in response to concerns regarding potential cumulative emissions from single and/or multiple sources.[152] An October 2020 Stanford report[153] discussed how the potential post-combustion capture for CO_2 could also reduce emissions of criteria air pollutant emissions from certain facilities. Exploring these potential outcomes will be important to ensure deployment of CCS does not exacerbate air pollution impacts in communities and maximizes any air pollution benefits. The need for these types of evaluations is also included in SB 905.

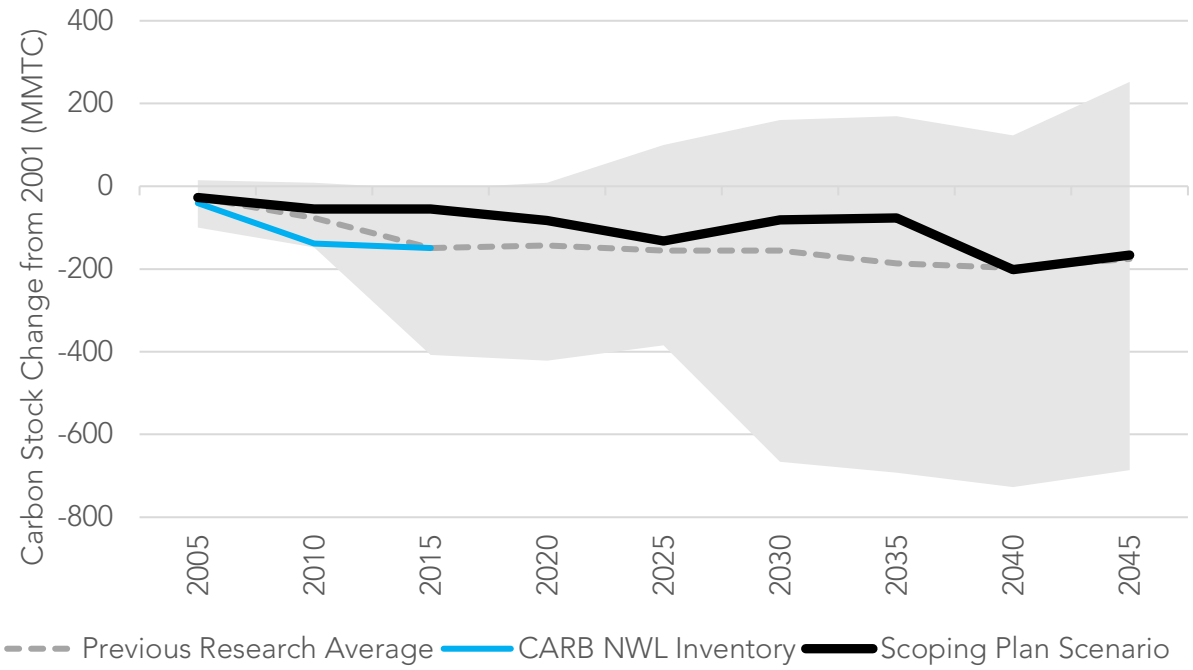
The Role of Natural and Working Lands Emissions and Sequestration

California's NWL assessments highlight the importance of increasing the pace and scale of NWL actions to ensure that our ecosystems are better equipped to withstand future climate change so they continue to provide the benefits that nature and society depend

[152] Carbon Capture, Utilization, and Sequestration Guidance. 87 Fed. Reg. 8808 (Feb. 16, 2022), *2022-03205.pdf (govinfo.gov)*.
[153] Stanford Center for Carbon Storage. 2020. *An Action Plan for Carbon Capture and Storage in California: Opportunities, Challenges, and Solutions.* October. *https://sccs.stanford.edu/ccs-in-ca/full-report-form?msclkid=6f9177f6c57811ecbebc473e75203b21*.

upon for survival. As climate change increases the likelihood of extreme wildfires, drought, heat, and other impacts, carbon stocks in California's NWL will face increased risks and impacts. We know from previous climate change and Scoping Plan work[154] that lands can be a net source of GHG emissions or a net sink, and that the magnitude of carbon stock changes and GHG emissions and sequestration from NWL are dependent on the effects of climate change and land management. The expanded modeling conducted for this Scoping Plan shows that NWL are projected to be a net source of emissions through 2045 and indicates a probable decrease of carbon stocks into the future. This projection is further corroborated by previous, independent research that has reached the same conclusion, showing a range of varying levels of carbon stock loss. Figure 2-4 shows the modeling results of the Scoping Plan Scenario overlaid with the NWL inventory and findings from independent research.

Figure 2-4: Comparison of the Scoping Plan Scenario (NWL) with existing research



The modeling indicates that immediate and aggressive climate action can reduce the environmental impacts that would occur in the absence of this action. The results of the modeling demonstrate that regular NWL management over the next two decades can

[154] CARB. 2019. January 2019. *Draft California 2030 Natural and Working Lands Climate Change Implementation Plan*. https://ww2.arb.ca.gov/sites/default/files/2020-10/draft-nwl-ip-040419.pdf.

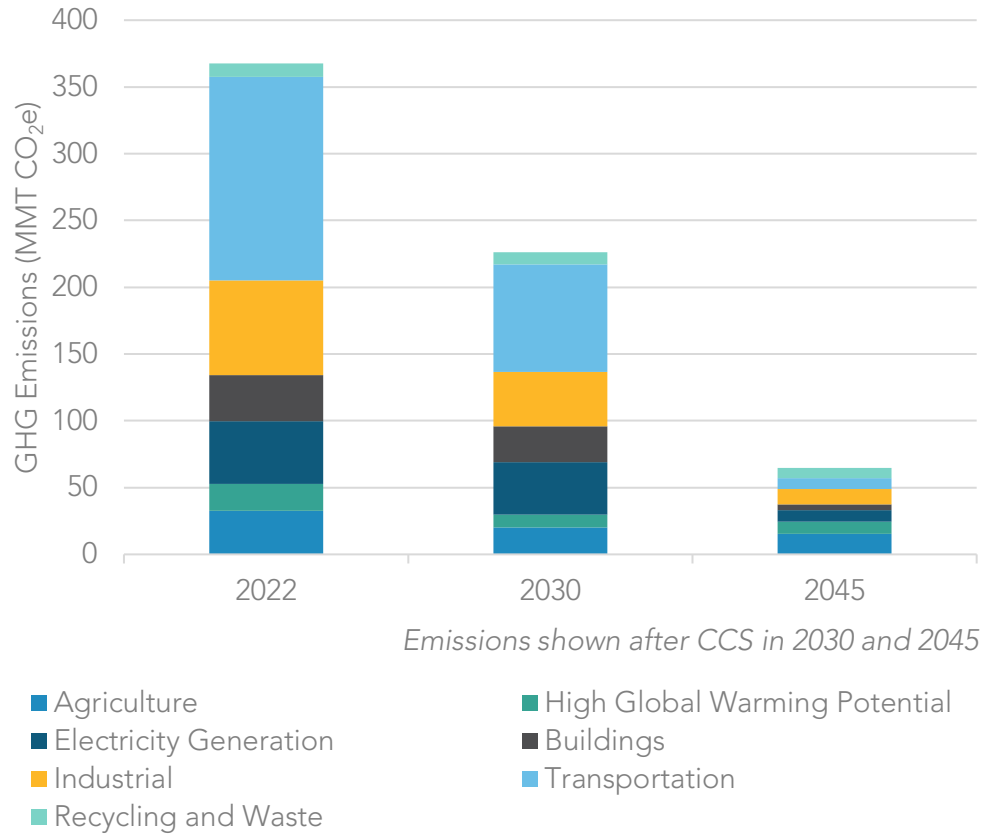
increase carbon stocks from the Reference Scenario trajectory, reduce GHG emissions from lands, and improve ecosystem and public health. This effort is the most comprehensive scientific effort taken by any government to include NWL within its overall climate strategy. Even so, we know that uncertainty exists about future climate and economic forces and the impacts they may have on our ecosystems, so it is important that the state take decisive and aggressive action to improve and diversify ecosystem structures and management.

The effects of climate change, including increased drought, wildfire, and extreme heat, play a significant role in determining the future of California's carbon stocks. And while management actions will help to reduce the impact that climate change will have on California, it is clear from the analysis that NWL sinks and sources are highly variable from year to year, and short time frames do not adequately demonstrate the impact that climate and management are having on ecosystems. For the purposes of climate planning, therefore, it is best to focus on carbon stock changes over longer periods rather than focusing on sequestration or emissions on shorter time frames. The Scoping Plan Scenario is estimated to result in additional NWL emissions of 7 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) annually from 2025–2045. The Reference Scenario is estimated to result in annual emissions of 9 $MMTCO_2e$ over the same time period, and so the Scoping Plan Scenario slows the rate of emissions and provides an approximate 2 $MMTCO_2e$ in additional annual sequestration relative to the Reference Scenario. Because NWL are projected to be a net emissions source, the annual NWL emissions of approximately 7 $MMTCO_2e$ from the Scoping Plan Scenario will need to be compensated by additional CO_2 removal approaches to ensure California can achieve carbon neutrality by 2045.

The Role for Carbon Dioxide Removal (Direct Air Capture)

Even if anthropogenic emissions are reduced to at least 85 percent below 1990 levels by 2045 as called for by AB 1279, there will still be residual emissions in the AB 32 GHG Inventory sectors in 2045 that must be addressed in order to achieve the California's carbon neutrality target. Figure 2-5 includes the emissions by sector for the AB 32 GHG Inventory Sectors in 2022, 2030, and 2045 for the Scoping Plan Scenario.

Figure 2-5: Residual emissions in 2022, 2030, and 2045 for the Scoping Plan Scenario[155]



To achieve carbon neutrality, mechanical CDR will therefore need to be deployed. Because NWL management is not estimated to be a significant carbon removal path in the near term, additional CDR options will be needed. *Mechanical CDR* refers to a range of technologies that capture and concentrate ambient CO_2. Direct air capture (DAC) is one available option that is under development today and could be widely deployed. Note that, unlike CCS, DAC technologies are not designed to be attached to a specific source or smokestack. These technologies include chemical scrubbing processes that capture CO_2 through absorption or adsorption separation processes. Another carbon removal

[155] The High GWP sector includes high global warming potential gas emissions from releases of ozone depleting substance (ODS) substitutes, SF_6 emissions from the electricity transmission and distribution system, and gases that are emitted in the semiconductor manufacturing process. ODS substitutes, which are primarily hydrofluorocarbons (HFCs), are used in refrigeration and air conditioning equipment, solvent cleaning, foam production, fire retardants, and aerosols.

option that involves rapid mineralization of CO_2 at the Earth's surface is called *mineral carbonation.*[156] As is the case with CCS, mechanical CDR technologies will need governmental or other incentive support to overcome technology and market barriers. In the United States, the U.S. Department of Energy announced financing specifically for DAC in March 2020[157] and March 2021.[158] Additionally, almost $9 billion in CCS support was included in the $ 1 trillion Infrastructure Investment and Jobs Act of 2021.[159] This includes funding to establish four DAC hubs. The Inflation Reduction Act of 2022[160] increases the value of the 45Q tax credit to USD 85 per metric ton of CO_2 captured and stored in geologic formations from some industrial applications and USD 180 per metric ton for DAC with storage in geologic formations. In 2021, there were approximately 19 DAC facilities globally.[161]

Ultimately, the role for mechanical CDR will depend on the success of reducing emissions directly at the source in the AB 32 GHG Inventory sectors and the ability of the NWL to sequester carbon. However, mechanical CDR also provides an opportunity to not just achieve carbon neutrality, but also remove legacy GHG emissions from the atmosphere. As such, increased deployment of DAC can help achieve net negative emissions. This would further help avoid the most damaging impacts of climate change. While the federal incentives for DAC provide some support for this technology, the only California program that recognizes this technology is the LCFS program. Permitting must also happen across different levels of government and across multiple state agencies. Energy availability must also be addressed if DAC is to be implemented in remote areas. Additional information and next steps on DAC can be found in Chapter 4.

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[156] The National Academies Press. 2018. Direct Air Capture and Mineral Carbonation Approaches for Carbon Dioxide Removal and Reliable Sequestration: Proceedings of a Workshop–in Brief. *https://nap.nationalacademies.org/catalog/25132/direct-air-capture-and-mineral-carbonation-approaches-for-carbon-dioxide-removal-and-reliable-sequestration#:~:text=National%20Academies%20of%20Sciences%2C%20Engineering%2C%20and%20Medicine%3B%20Division,concentrate%20carbon%20dioxide%20%28CO%202%29%20from%20ambient%20air*.

[157] U.S. Department of Energy. 2020. Department of Energy to Provide $22 Million for Research on Capturing Carbon Dioxide from Air*. https://www.energy.gov/articles/department-energy-provide-22-million-research-capturing-carbon-dioxide-air*.

[158] U.S. Department of Energy. 2021. DOE Invests $24 Million to Advance Transformational Air Pollution Capture. *https://www.energy.gov/articles/doe-invests-24-million-advance-transformational-air-pollution-capture*.

[159] Pub.L. No. 117-58 (November 15, 2021). *https://www.congress.gov/bill/117th-congress/house-bill/3684/text*.

[160] Pub.L. No. 117-169 (August 16, 2022). *https://www.congress.gov/bill/117th-congress/house-bill/5376/text*.

[161] International Energy Agency (IEA). 2022. Direct Air Capture – Analysis. *https://www.iea.org/reports/direct-air-capture*.

Carbon Dioxide Removal and Capture Targets for 2030 and 2045

Recognizing the importance of CO_2 removal, Governor Newsom and the Legislature identified the need for targets to send policy and regulatory signals to pilot, deploy, and scale action for those efforts. Governor Newsom requested that CARB set a CO_2 removal and capture target of 20 MMT for 2030 and 100 MMT for 2045, first prioritizing sequestration in NWL. And while this Scoping Plan prioritizes and recommends significant increased climate-smart action on all NWL to support carbon neutrality and healthy and resilient lands, the modeling indicates that, across all NWL, lands will be a net source of emissions when accounting for both carbon sequestration and GHG (CO_2, CH_4, and N_2O) emissions from lands.

Some landscapes, however, are projected to have a net increase in carbon stocks under the Scoping Plan Scenario between 2025 and 2045 relative to the reference case, indicating that NWL actions can help California achieve Governor Newsom's CO_2 removal targets. Carbon stocks in urban forests and grasslands are projected to increase relative to historical levels from implementation of the 2022 Scoping Plan. To support the governor's CO_2 removal targets, CARB estimates that lands would contribute an average of 1.5 MMT of CO_2 removals each year between 2025 and 2045. Any carbon sequestration contributions from lands need to reflect both long-term storage and an overall net increase in carbon stocks over time to ensure these NWL actions are contributing toward California's achievement and maintenance of carbon neutrality over time.

CARB will work to update and revise these estimates as part of implementation of AB 1757, which was signed by the governor in September 2022 and requires that CARB and the California Natural Resources Agency (CNRA) work with an expert advisory committee to determine an ambitious range of carbon sequestration targets by January 1, 2024, for the years 2030, 2038, and 2045.

For the AB 32 GHG Inventory sectors, the Scoping Plan Scenario modeling indicates that the scenario would meet or exceed the 2030 SB 32 target through GHG reduction policies without the need for CDR. CDR will, however, be necessary to increase ambition for an accelerated 2030 target and in increasing amounts over the following decades to achieve carbon neutrality by 2045.[162] Given the likelihood of NWL to be a net source of emissions, and the need for CDR to compensate for residual emissions to achieve carbon neutrality

[162] The modeled scenarios assume that residual emissions will be compensated using DAC technologies by including the direct cost in terms of dollars per ton CO_2 removed. The energy source for DAC is not modeled, but renewable electricity and/or hydrogen produced from electrolysis are zero carbon options consistent with the carbon neutrality targets in this Scoping Plan.

by 2045, California will need increasing deployment of mechanical CDR over the coming decades. In the immediate future, scaling nature-based CDR approaches also can help to provide some CO_2 removal quickly while mechanical CDR is scaled up between now and 2045. Table 2-3 provides estimates of CO_2 removal and capture needed in 2030[163] and 2045.

[163] As identified in Chapter 1, SB 27 (Skinner, Chapter 237, Statues of 2021) directed CARB to "establish carbon dioxide removal targets for 2030 and beyond" as part of this Scoping Plan. CARB is establishing these targets to satisfy both the requirements of SB 27 and the directive from Governor Newsom to establish CO_2 removal targets for 2030 and 2045.

Table 2-3: GHG emissions and removals needed to achieve carbon neutrality and meet the 20 $MMTCO_2$ removal and capture target in 2030 and the 100 $MMTCO_2$ removal and capture target in 2045.[164]

	2030 ($MMTCO_2e$)	2045 ($MMTCO_2e$)
GHG Emissions	233	72
AB 32 GHG Inventory Sector Emissions	226	65
Net NWL GHG Emissions Across All Landscapes (annual average from 2025–2045)	7	7
Carbon Capture and Sequestration (CCS): Avoided GHG Emissions from Industry and Electric Sectors	(13)	(25)
Carbon Dioxide Removal (CDR) including natural and working lands carbon sequestration,[165] Direct Air Capture, and Bioenergy with CCS (BECCS).	(7)	(75)
Net Emissions (GHG Emissions + CDR)	226	(3)

In 2030, the CO_2 removal and capture target is 20 MMT, but because the SB 32 target only encompasses the AB 32 GHG Inventory sectors, only CCS that reduces GHG emissions on AB 32 sources count toward achieving more ambitious GHG emission reductions in 2030. In 2045, the CO_2 removal and capture must compensate for any residual emissions from the AB 32 Inventory sectors and NWL emissions to support achieving carbon neutrality while also totaling at least 100 MMT. It is important to note that NWL, particularly forests, need a natural wildfire cycle to remain healthy. While the modeling projected wildfires, and implementing the Scoping Plan will result in a reduction in future wildfire emissions, getting to zero wildfires in the sector is not the goal, nor the

[164] Modeled estimates from the Scoping Plan Scenario indicate the relative quantity of emissions and removals to achieve carbon neutrality and meet carbon removal and capture targets. These estimates are not intended to imply precision, as the required policies are yet to be implemented and all models have some uncertainty in their forecasts.

[165] For the purposes of quantifying how to achieve the governor's 20 MMT and 100 MMT CO_2 removal and capture target, CARB included 1.5 $MMTCO_2e$ sequestration from NWL, which is the sequestration from urban forests. This is included as CO_2 removal because it is this sequestration that CARB can consider as having some permanence. Permanence is necessary for incorporating NWL into carbon neutrality. The net NWL emissions of 7 $MMTCO_2e$, identified in the second row of Table 2-3, includes *all* emissions and sinks from all NWL landscapes, which is inclusive of the 1.5 $MMTCO_2e$ sequestration. CARB will develop an accounting framework to accommodate NWL carbon stocks.

right approach to a sustainable forestry sector. In contrast in 2045, the reductions from programs and policies are estimated to reduce emissions by 169 $MMTCO_2e$ from business as usual.

The 2030 target for engineered CDR also provides a near term milestone for California and can serve as an important marker for progress in deploying CDR to support California's carbon neutrality goal. Preliminary estimates indicate that, globally, capacity from already announced projects will range from about 2 million metric tons per year ($MMTCO_2/y$) to 8 $MMTCO_2/y$ from bioenergy paired with CCS, and from about 2,000 metric tons per year ($MTCO_2/y$) to 1 $MMTCO_2/y$ from DACs by 2027,[166] which indicates that California's 2030 target is an ambitious, but achievable, goal.

Scenario Uncertainty

Greenhouse Gas Emissions Modeling

Several types of uncertainty are important to understand in both forecasting future emissions and estimating the benefits of emission reduction actions. In developing this Scoping Plan we forecasted a reference scenario and estimated the GHG emissions outcome of the AB 32 GHG Inventory sectors using the PATHWAYS[167] model. Inherent in the reference scenario modeling is the expectation that many of the existing programs will continue in their current form, and that the expected drivers for GHG emissions, such as energy demand, population growth, and economic growth, will match our current projections.

However, there is also the expectation that each of the policies included and implemented to achieve the 2030 target in the 2017 Scoping Plan will deliver their exact outcomes. It is unlikely the future will precisely match our projections, and this will lead to uncertainty in the forecast. For example, we never could have foreseen and forecasted economic and emissions impacts related to the extended disruptions from the COVID-19 pandemic. Thus, the single "reference" or "forecast" line should be understood to represent one possible future in a range of possible predictions. For this Scoping Plan, PATHWAYS utilized inputs that reflect technically feasible levels of deployment or adoption of low- or zero-carbon fuels and technologies. Each of the input assumptions provided to PATHWAYS has some uncertainty, which also contributes to uncertainty in the resulting reference scenario.

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[166] IHS Markit. August 2021. Carbon Removal Potential. *https://ww2.arb.ca.gov/sites/default/files/2021-08/ihsmarkit_presentation_sp_engineeredcarbonremoval_august2021.pdf*.
[167] See Appendix H (AB 32 GHG Inventory Sector Modeling).

Similarly, for the NWL modeling, CARB used a mix of individual modeling tools[168] to estimate the carbon and other ecological, public health, and economic outcomes. The Reference scenario assumes that the level of land management actions that occurred between 2001 and 2014 for forests, shrublands, grasslands, croplands, developed lands, wetlands, and sparsely vegetated lands continues into the future. Alternative scenarios assessed the effect of increasing levels of management actions from the reference scenario beginning in 2025. There is a great deal of uncertainty about exactly how lands are currently managed, and a larger uncertainty about how they may be managed in the future. For NWL, it is unlikely that the future will precisely match the carbon stock outcomes CARB has projected, particularly given the uncertainties around current and future land management and the effects climate change will have on our lands. For any modeling exercise these uncertainties exist; however, this modeling effort brings together the best available science, data, and models to quantify the impact our actions may have on the landscape under an unknown future.

Implementation

As this Scoping Plan is designed to chart a path to achieving carbon neutrality, additional work will be required to fully design and implement any policies and actions identified in this plan. During the subsequent development of policies, the Legislature, CARB, and other state agencies will learn more about the technologies and their costs, as well as how each industry works, as a more comprehensive evaluation is conducted in coordination with stakeholders, including community engagement. Significant areas of uncertainty include permitting wait times[169] and local ordinances that might limit or slow the build-out of utility scale renewables.[170,171] In another example, times to reach commercial operations for solar projects after securing an interconnection agreement also have increased in recent years, to 3.5 to 5.5 years.[172]

The level of natural and working lands climate action identified in this Scoping Plan is ambitious. Achieving the level of action needed to result in the quantified carbon,

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[168] See Appendix I (Natural and Working Lands Technical Support Document).
[169] CEC. 2021. *SB 100 Joint Agency Report.* https://www.energy.ca.gov/sb100#anchor_report.
[170] Roth, Sammy. 2019. "California's San Bernardino County slams the brakes on big solar projects." *Los Angeles Times.* https://www.latimes.com/business/la-fi-san-bernardino-solar-renewable-energy-20190228-story.html?fbclid=IwAR2qHGq3bahHme6SFErLsnyFi9UPIfBHIhvnOh3dU3OM7kUTMcEqYfN3pQA.
[171] Chediak, Mark. 2021. "California NIMBYs Threaten Biden's Clean Energy Goals." *BNN Bloomberg.* https://www.bnnbloomberg.ca/california-nimbys-threaten-biden-s-clean-energy-goals-1.1634351?msclkid=668c9ae9c11311ec92e34035ea157ad4.
[172] Rand, Joseph, et al. 2022. Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2021. Power Point Presentation. Lawrence Berkeley National Laboratory. https://emp.lbl.gov/sites/default/files/queued_up_2021_04-13-2022.pdf.

emissions, health, and economic outcomes within this Scoping Plan requires coordination, investment, and partnerships across all levels of government and sectors of the economy. It is possible that not all of the actions at the identified level will begin in 2025. This uncertainty will result in diminished levels of beneficial outcomes quantified in the Scoping Plan Scenario. The levels of NWL action identified in this Scoping Plan represent CARB's assessment of the pace and scale of action needed to achieve the carbon stock targets and CO_2 removal targets identified in this Scoping Plan.

The Scoping Plan Scenario identifies that 2.3 million acres of forests, shrubland, and grassland management annually would achieve substantial levels of fire emissions reductions and the concomitant health and economics benefits. Currently, 1 million acres of forest treatment annually is the joint federal and state government goal (500,000 acres each). This target of one million acres annually by 2025 is for the purposes of increasing forest health and wildfire resilience in the near term, whereas the 2.3 million acre target is what the Scoping Plan modeling shows would be needed to realize the carbon stock target called for in this Scoping Plan by 2045. By identifying 2.3 million acres of climate action annually in forests, shrublands, and grasslands, this Scoping Plan emphasizes the importance of that 1 million acre annual goal as a milestone on the way to even more action and improved fire and air quality outcomes. The modeling indicates that substantial improvements to statewide fire emissions will occur at levels of action greater than 1 million acres per year. If these levels of action do not occur starting in 2025, the Scoping Plan has quantified climate benefits that will still occur, but to a lesser extent. In terms of fire emissions, compared to the Reference Scenario, 2.3 million acres of forest, shrubland and grassland management will result in a 10% reduction in wildfire emissions. At 1 million acres per year, this decreases to a 2.5% reduction. If 1 million acres per year is also not accomplished, then the emissions and health benefits are even lower.

Climate action in other NWL sectors also generates many co-benefits. Climate action identified in this Scoping Plan is aimed at not only fighting climate change but also improving air quality and public health. The climate action identified in the agricultural sector, for example, should result in decreased pesticide and synthetic fertilizer use. This decrease of synthetic chemical use in agriculture across California also should result in improved public health, especially for communities that work and live in and around agricultural lands. However, as with the forestry sector, the benefits of climate action in agricultural lands and in any other land are dependent on how much implementation takes place. Ramping up increased healthy soils practices and increasing organic agriculture in California will require continued and sustained implementation by private industry and public agencies. For example, achieving the carbon stock outcomes for the annual crops called for in this Scoping Plan would require deployment and maintenance of healthy soils practices on 80,000 additional acres of croplands in California every year between 2025 and 2045. For context, CDFA's Healthy Soils Program, which is an incentive program

supporting healthy soils practices, took almost four years of sustained funding to achieve approximately 50,000 acres total under healthy soils practices.[173]

Given the uncertainty around the modeling assumptions, and performance uncertainty as specific policies are fully designed and implemented, estimates associated with the Scoping Plan Scenario are certain to be different than what is ultimately implemented. One way to mitigate for this is to develop policies that can adapt and increase certainty in GHG emissions reductions. Periodic reviews of progress toward achieving the 2030 target and longer term deeper decarbonization, as well as performance of specific policies, also provide opportunities for the state to consider any changes to ensure we remain on course to achieve the 2030 target and carbon neutrality. The need for this periodic review process was anticipated in AB 32, as it calls for updates to the Scoping Plan at least once every five years. For this Scoping Plan, the metrics provided on the rate of deployment of clean fuels and technologies, along with the annual AB 32 GHG Inventory, provide additional information that can be used to assess progress on sectors and aggregate emissions. This is also true of CARB's NWL carbon inventory. An uncertainty analysis for achieving an accelerated 2030 target is provided toward the end of this chapter.

Targeted Evaluations for the Scoping Plan: Oil and Gas Extraction and Refining

To achieve California's air quality and climate goals, we must end our dependence on petroleum. This will not happen overnight. There are about 28 million combustion engine heavy- and light-duty trucks and passenger vehicles in California, and these are almost always replaced at their end of life. The ZEV Executive Order (EO N-79-20) calls for 100 percent new ZEV car sales beginning in 2035 and a 100 percent ZEV medium- and heavy-duty fleet sales by 2045 where feasible. The result is an ongoing, albeit shrinking, pool of vehicles that will continue to require petroleum fuels. To avoid leakage, as called for in AB 32, and to meet that remaining demand for petroleum fuel, a complete phaseout of oil and gas extraction and refining is not possible by 2045. This Scoping Plan assumes a phasedown in both oil and gas extraction as well as petroleum refining in line with the reduction in demand for in-state on-road petroleum fuel demand. Since the transportation sector is the largest source of GHG emissions and harmful local air pollution, we must continue to research and invest in efforts to deploy zero emissions technologies and clean fuels, and to reduce VMT. An assessment of ongoing progress and efforts to reduce

[173] California Department of Food and Agriculture. 2021. *Incentives Program 2017–2020 Summary by the Numbers.* https://www.cdfa.ca.gov/oefi/healthysoils/docs/HSP_Incentives_program_level_data_funded_projects.pdf.

demand for petroleum fuels and of opportunities to phase down oil and gas extraction and refining will be included in the next Scoping Plan update.

In addition to supplying in-state demand, California is a net exporter of gasoline, diesel, and jet fuel. California pipelines supply the Nevada and Arizona regions[174] with approximately 87 million barrels gasoline equivalent of refined products annually.[175] California pipelines deliver approximately 85% of Nevada's and 40% of Arizona's refined product. Most finished fuels flowing from California to Nevada and Arizona are currently produced by California refineries. To manage the phasedown of oil and gas extraction and petroleum refining in California, exports of finished fuels must be considered and factored into that process, in addition to the declining in-state demand. The authorities and considerations related to supply and demand of petroleum fuels span federal, state, and local agencies. If supply of fossil fuels is to decline along with demand, a multi-agency discussion is needed to systematically evaluate and plan for the transition to ensure that it is equitable.

This inter-agency work should also consider related topics, such as the following:

- Direct and indirect job and economic impacts
- Demand for other liquid fuel types such as renewable fuels, and expected volumes
- Legal considerations
- Public health benefits
- Demand and supply strategies for petroleum fuels, including how to avoid short term supply constraints that may impact low-income consumers

Some of these topics were also discussed as part of two studies[176] supported by the California Environmental Protection Agency, which can serve as a starting point for a working group to analyze these questions and develop policy recommendations.

Oil and Gas Extraction

On April 23, 2021,[177] Governor Newsom directed CARB to evaluate the phaseout of oil and gas extraction no later than 2045 as part of this Scoping Plan. As noted above, this Scoping Plan still has some California demand for finished fossil fuels (gasoline, diesel,

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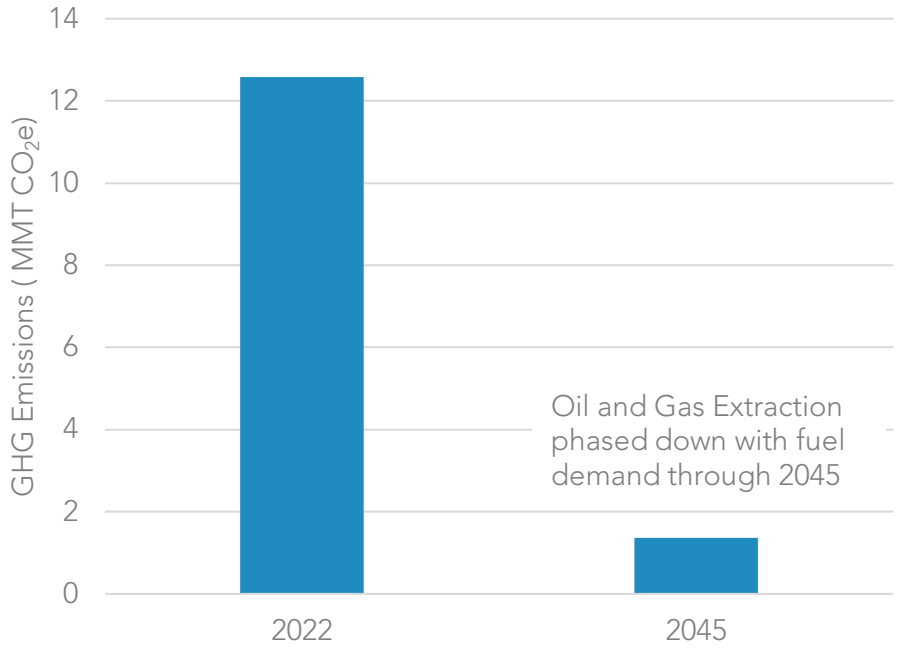
[174] CEC. August 2021. A Primer on California's Pipeline Infrastructure. *Petroleum Watch.* https://www.energy.ca.gov/sites/default/files/2021-08/August_Petroleum_Watch_ADA.pdf.
[175] CEC. March 2020. *Petroleum Watch.* https://www.energy.ca.gov/sites/default/files/2020-03/March_2020_Petroleum_Watch.pdf.
[176] CalEPA. 2021. Carbon Neutrality Studies: https://calepa.ca.gov/climate/carbon-neutrality-studies/.
[177] Governor Newsom. April 23, 2021. Governor Newsom Takes Action to Phase Out Oil Extraction in California. Press Release. https://www.gov.ca.gov/2021/04/23/governor-newsom-takes-action-to-phase-out-oil-extraction-in-california/.

and jet fuel) in 2045. This demand is primarily for transportation, including for sectors that are directly regulated by the state and some that are subject to federal jurisdiction, such as interstate locomotives, marine, and aviation. As discussed more fully below, while significant GHG reductions from oil and gas extraction could be achieved as demand for fossil fuels is reduced due to strategies in this Scoping Plan, it is not feasible to phase out oil and gas production fully by 2045 given this remaining demand.

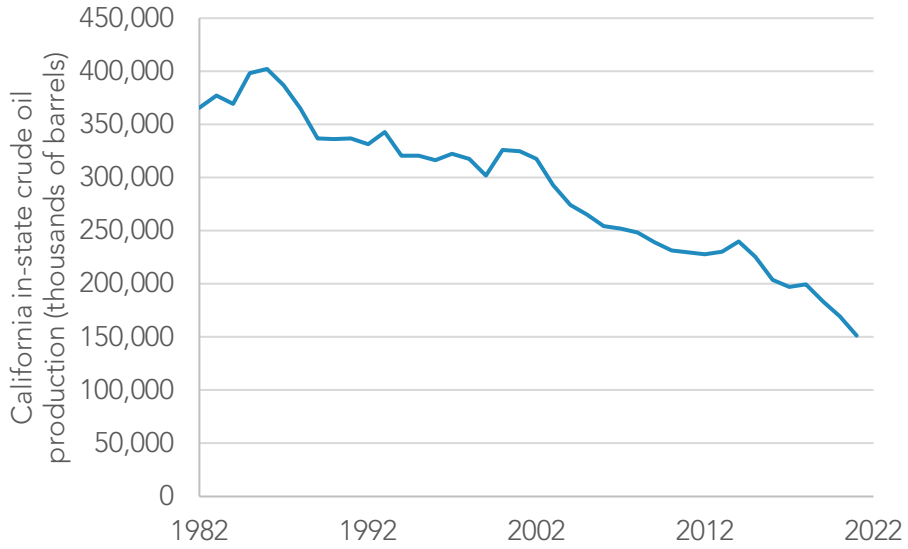
In the Scoping Plan Scenario, with successful deployment of zero carbon fuels and non-combustion technology to phase down petroleum demand, GHG emissions from oil and gas extraction could be reduced by approximately 89 percent in 2045 from 2022 levels if extraction decreases in line with in-state finished fuel demand. If in-state extraction were to be phased out fully, the future petroleum demand by in-state refineries would be met through increased crude imports to the state relative to the Scoping Plan Scenario. AB 32 defines leakage as, "a reduction in emissions in greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state." AB 32 also requires any actions undertaken to reduce GHGs to "minimize leakage." Increases in imported crude could result in increased activity outside California to extract and transport crude into California. Therefore, our analysis indicates that a full phaseout of in-state extraction could result in GHG emissions leakage and in-state impacts to crude oil imported into the state. Figure 2-6 compares the 2022 emissions from this sector with the modeled results when the sector is phased down with in-state petroleum demand.

Figure 2-6: Oil and gas extraction sector GHG emissions in 2022 and 2045 when activity is phased down with in-state fuel demand



According to California Energy Commission (CEC) data used in Figure 2-7, the total oil extracted in California peaked at 402 million barrels in 1986. Since then, California crude oil production has decreased by an average of 6 million barrels per year, to about 200 million barrels in 2020. This steadily decreasing production of crude in California is expected to continue as the state's oil fields deplete.

Figure 2-7: California in-state crude oil production[178]



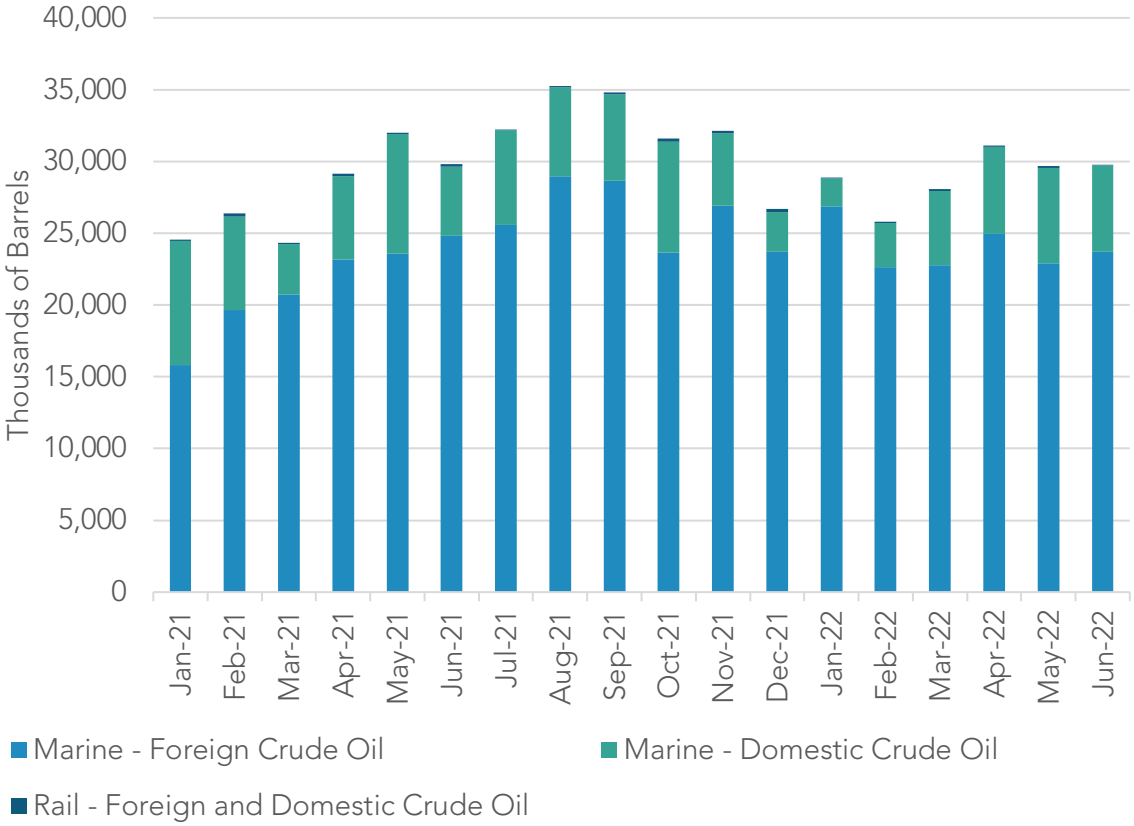
A UC Santa Barbara report estimated that, under business-as-usual conditions, California oil field production would decrease to 97 million barrels in 2045.[179] The business-as-usual model assumed no additional regulations limiting oil extraction in California.

Any crude oil demand by California refineries not met by California crude oil will be met by marine imports of Alaskan and foreign crude.[180] As shown in Figure 2-8, approximately 99 percent of crude imports into California are delivered by marine transportation. The

[178] CEC. No date. Oil Supply Sources to California Refineries. Accessed April 21, 2022. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/oil-supply-sources-california-refineries.
[179] University of California, Santa Barbara. 2021. Enhancing Equity While Eliminating Emissions in California's Supply of Transportation Fuels.
[180] CEC. 2020. *Petroleum Watch: How Petroleum Products Move.* March. https://www.energy.ca.gov/sites/default/files/2020-03/March_2020_Petroleum_Watch.pdf, and CEC. 2020. *Petroleum Watch: What Types of Crude Oil Do California Refineries Process?* February. https://www.energy.ca.gov/sites/default/files/2020-02/2020-02_Petroleum_Watch_ADA_0.pdf.

remaining imports occur by rail.[181] There are no pipelines that bring crude oil into California from out of state.[182]

Figure 2-8: Crude oil imports by transportation type[183]



Crude oil delivered by marine tankers is delivered to onshore storage tanks and subsequently to refineries via pipeline. Most crude oil produced in California is delivered to California refineries by pipeline. Using historical trends, any increases in imported crude above historic levels would result in increased deliveries through the marine ports. This increased activity could require more infrastructure to store and move larger volumes of crude to the refineries in state.

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[181] CEC. June 2021. Crude Oil Imports by Transportation Type. Accessed March 16, 2022. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/crude-oil-imports-source.
[182] CEC. 2020. *Petroleum Watch: How Petroleum Products Move.* March. https://www.energy.ca.gov/sites/default/files/2020-03/March_2020_Petroleum_Watch.pdf.
[183] CEC. June 2021. Crude Oil Imports. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/crude-oil-imports-source.

California refineries import a variety of crude oils to meet refinery needs. California petroleum refineries are generally designed to process relatively heavy crude relative to other U.S. refineries. In 2018, crude inputs to California refineries had an average American Petroleum Institute (API) gravity of 26.18 and an average sulfur content of 1.64 percent. Processing significantly lighter or heavier crude blends would require significant changes to a refinery.[184] Most crude imported from Alaska and the Middle East is relatively light (API gravity > 30) compared to California crude (API gravity < 20).[185] If California crude production is insufficient to meet the demand at California refineries, then California refineries will need access to a similarly heavy source of crude so that the average API gravity of crude remains within their established operating window. South American crude oil imports into California are the heaviest relative to other regions, and therefore they may be the most likely to replace decreased California crude oil supply.[186]

In summary, the modeling indicates that demand for petroleum will persist due to legacy fleets that will not be replaced until end of life. The modeling also shows what the GHG emissions reductions would be if oil and gas extraction activities were phased down in line with the reduction of in-state petroleum demand. Trend data shows that oil and gas extraction already has been on the decline and will continue to decline. It is possible to anticipate the likely regions and types of crude that would be imported to meet in-state petroleum demand if in-state extraction was fully phased out by 2045. Importantly, activity at the ports would increase, and new infrastructure would be needed to store and deliver crude to in-state refineries. And while GHG emissions from this sector would go to zero in our AB 32 GHG Inventory with a full phaseout, emissions related to the production and transport of crude to California might increase elsewhere, resulting in emissions leakage.

As the state continues to reduce demand for petroleum, efforts to protect public health for communities located near oil and gas extraction sites must also continue. In October 2021, Governor Newsom directed action to prevent new oil drilling near communities and

[184] CEC. 2020. *Petroleum Watch: What Types of Crude?* February. https://www.energy.ca.gov/sites/default/files/2020-02/2020-02_Petroleum_Watch_ADA_0.pdf.
[185] CEC. 2020. *Petroleum Watch: What Types of Crude?* February. https://www.energy.ca.gov/sites/default/files/2020-02/2020-02_Petroleum_Watch_ADA_0.pdf.
[186] CEC. 2020. *Petroleum Watch: What Types of Crude?* February. https://www.energy.ca.gov/sites/default/files/2020-02/2020-02_Petroleum_Watch_ADA_0.pdf.

expand health protections.[187,188] In 2022, the Legislature passed, and the governor signed, SB 1137 to protect communities from existing and any new oil and gas extraction activities through 3,200 foot setbacks.

Petroleum Refining

In the Scoping Plan Scenario CARB modeled a phasedown of refining activity in line with petroleum demand. Meeting petroleum demand means sufficient availability of finished fuel (gasoline, diesel, and jet fuel). Crude is processed at in-state refineries to produce finished fuel. In response to stakeholder requests,[189] this evaluation focuses on the Scoping Plan Scenario, but with an evaluation of a complete phasedown of refinery operations in state.

The Scoping Plan Scenario results in California petroleum refining emissions of 4.5 $MMTCO_2e$ in 2045; a reduction of approximately 85 percent relative to 2022 levels, which is in line with the decline in in-state finished fuel demand.[190] Emissions from refining can be reduced further through the application of CCS technology, as shown in Figure 2-9. If in-state refining is phased down to zero and the demand for the finished fuels produced by that refining persists, imported finished fuels may be needed to meet the remaining in-state demand.[191] The current data shows unmet demand for liquid petroleum transportation fuels would most likely be met by marine imports. A CEC report notes, "The only way for California to receive large amounts of crude and refined products is by marine."[192]

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[187] Office of Governor Gavin Newsom. 2021. California Moves to Prevent New Oil Drilling Near Communities, Expand Health Protections. *https://www.gov.ca.gov/2021/10/21/california-moves-to-prevent-new-oil-drilling-near-communities-expand-health-protections-2/?msclkid=6c0da86bc58e11ecb81cf596d4d8a735*.

[188] California Department of Conservation Geologic Energy Management Division. October 2021. Draft Rule for Protection of Communities and Workers from Health and Safety Impacts from Oil and Gas Production Operations. *https://www.conservation.ca.gov/calgem/Pages/Public-Health.aspx?msclkid=45660232cf2511ecb1c56119097e3b0c*.

[189] California Environmental Justice Alliance. October 22, 2021. Comment on 2022 Scoping Plan Update - Scenario Inputs Technical Workshop. *https://www.arb.ca.gov/lists/com-attach/68-sp22-inputs-ws-WzhdPlI5AjACW1Qx.pdf*.

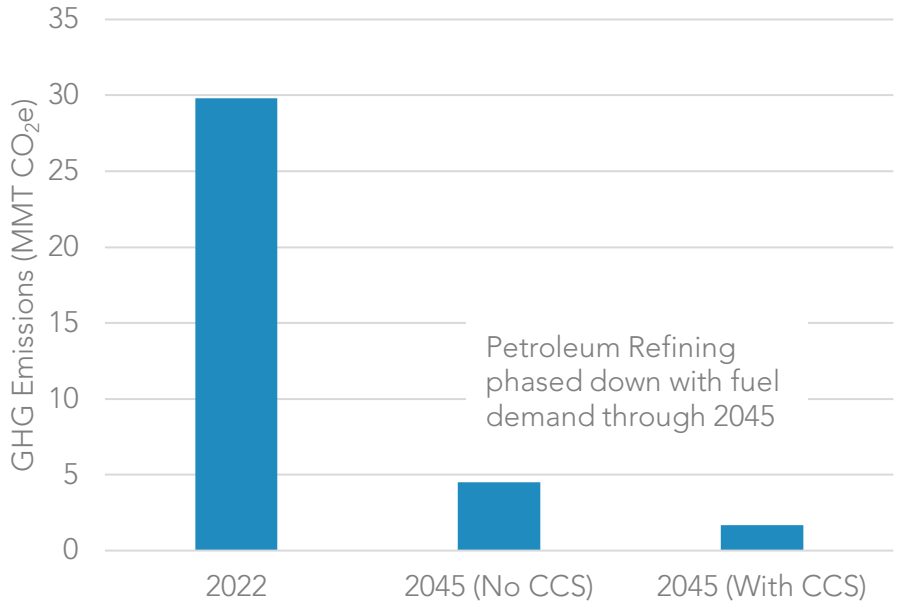
[190] This reduction in demand does not assume any need for ongoing operations to support exports to neighboring states.

[191] If demand assumes an ongoing need to support exports to neighboring states, the residual demand would require a five-fold increase in finished fuel imports.

[192] CEC. 2020. *Petroleum Watch: How Petroleum Products Move.* March. *https://www.energy.ca.gov/sites/default/files/2020-03/March_2020_Petroleum_Watch.pdf*.

There are currently no pipelines capable of bringing refined products to the state, and rail imports of refined products have historically made up less than 1 percent of all imports.[193] Significant increases in marine imports would likely require significant reconfiguring, retrofitting, or replacement of crude pipelines and storage tanks at current marine terminals, and possible reconfiguring of existing finished fuel infrastructure to account for changes in volumes and locations of supply points.

Figure 2-9: Petroleum refining sector GHG emissions in 2022 and 2045 (with and without CCS) when activity is phased down with fuel demand



If California's finished fuel demand is not met by continued refining activity in California, the state would need to import finished fuels to meet the ongoing demand. This would likely result in a two- to five-fold increase in the number of finished fuel ship deliveries to marine terminals. Marine tankers delivering refined products are often much smaller than crude oil tankers, so changes in fuel use and emissions cannot be easily estimated from the change in both the type and the number of ship deliveries.[194]

[193] CEC. 2020. *Petroleum Watch: How Petroleum Products Move.* March. https://www.energy.ca.gov/sites/default/files/2020-03/March_2020_Petroleum_Watch.pdf.
[194] Personal communication with CEC staff, March 2022; U.S EIA. 2017. *World Oil Transit Chokepoints*. 3. https://www.eia.gov/beta/international/regions-topics.php?RegionTopicID=WOTC.

If refining ceased in California, the rail and marine deliveries currently needed to support both refining processes and the export of waste products, such as petroleum coke, would cease.

In summary, the modeling indicates that demand for petroleum will persist through 2045. The modeling also shows what the GHG emissions reductions would be if refining activities were phased down in line with the reduction in in-state petroleum demand. CCS can further reduce emissions for this sector. Importantly, activity at the ports would increase, and new infrastructure would be needed to store and deliver finished fuel across the state, if in-state refining were fully phased down by 2045. And while GHG emissions from this sector would go to zero in our AB 32 GHG Inventory with a full phaseout, emissions related to the refining and transport of finished fuel to California might increase elsewhere, resulting in emissions leakage.

Progress Toward Achieving the Accelerated 2030 Target

The 2017 Scoping Plan laid out a path to achieving the SB 32 target of at least a 40 percent reduction of GHG emissions below 1990 levels by 2030 that focused on reducing emissions in the state and was technologically feasible and cost-effective, reflecting statutory direction. Many of the programs to achieve the 2030 target increased in stringency beginning January 1, 2021. However, the 2030 target must be increased to help achieve the deeper reductions needed to meet the state's statutory carbon neutrality target specified in AB 1279 and Executive Order B-55-18.

Starting in 2020 and extending into 2022, the COVID-19 pandemic impacts reverberated across the globe in a multitude of ways, including the devastating loss of millions of lives. The pandemic also had a significant impact on GHG emissions by virtue of its impact on global economies and lifestyle changes for Californians, with extended work and school disruptions. Thus, assessing our progress toward meeting our SB 32 target is confounded by the unprecedented nature of the pandemic. Nevertheless, an assessment of progress toward the 2030 target is critical, in particular the accelerated 2030 target called for in this Scoping Plan, since achieving the accelerated 2030 target would make the state well positioned to achieve its carbon neutrality goals and bring critical near-term air quality benefits to address historical and ongoing disparities in access to healthy air. Because there is only one year of data available for this decade, the analysis takes a prospective look using projected emissions over the remainder of this decade.

Estimating GHG emissions in 2030 requires projecting the effect of policies or measures that are currently deployed and undergoing implementation. Table 2-4 shows three distinct estimates of GHG emissions in 2030 that were created at different times and used different modeling approaches.

Table 2-4: Estimates of 2030 GHG emissions

Scenario Description	2030 GHG Emissions ($MMTCO_2e$)
2017 Scoping Plan: the projected outcome from implementing policies identified in the 2017 Scoping Plan that was approved by the CARB Board in December 2017.	320
Reference Scenario: the assessment of current trends and expected performance of policies identified in the 2017 Scoping Plan, as of February 2022, using the PATHWAYS model (E3).	305
Reference Scenario (Rhodium): the analysis of projected emissions from 2021 to 2030 from state and federal policies implemented as of July 2022, including the estimated impact of the Inflation Reduction Act and Advanced Clean Cars II using RHG-NEMS and other Rhodium Taking Stock 2022 methods (https://rhg.com/wp-content/uploads/2022/07/Taking-Stock-2022_US-Emissions-Outlook.pdf).	324

These three estimates of 2030 GHG emissions differ, which is expected. The estimates reflect different outcomes of the current and future impact of policies and measures. They also vary due to fundamental differences in the way these models work. For example, PATHWAYS is an economy-wide, scenario-based GHG accounting tool that tracks energy demands and supplies in line with scenario assumptions and is benchmarked to historical values. RHG-NEMS optimizes both the supply and demand sides of the energy system while factoring in consumer constraints and dynamic economic and energy systemwide feedback. Importantly, while these point estimates give the appearance of certainty and accuracy, there is significant uncertainty in future emissions projections that is documented thoroughly in each of the three emissions scenarios described above. No model can predict the future given unforeseen factors such as notable economic swings and implementation delays for programs. However, the range of emissions estimates provides a useful indication of possible outcomes from successful implementation of policies and measures.

An important source of uncertainty is the impact of delayed implementation of policy measures and market actions. The successful rate of deployment of clean technology and fuels—including consumer adoption patterns, economic recovery from the pandemic, and the permitting and build-out of necessary new assets and reuse of existing assets to produce and deliver clean energy—is essential to reach GHG emission reduction targets. Any delays will only increase GHG emissions in 2030.

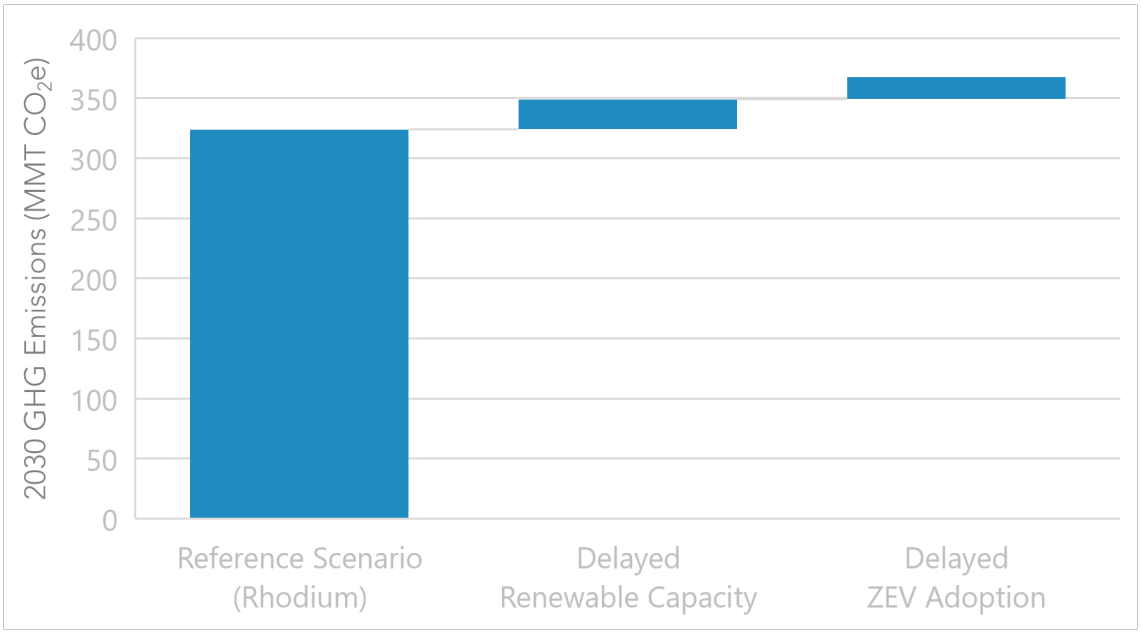
It is important to note that incentives, carbon pricing, and regulations all can result in similar types of responses including, but not limited to:

- Build-out of clean energy and infrastructure
- Deployment of clean technology
- Reduced demand for fossil energy
- Efficiency improvements

As such, the uncertainty analysis discussion focuses on implementation (technology and infrastructure deployment), and not any specific programs or policies. It is successful implementation that must ultimately happen for emissions reductions to be realized.

The uncertainty analysis described in Appendix J (Uncertainty Analysis) quantifies the impact of delayed permitting and building of renewable generation and transmission in the power sector and delayed adoption of ZEVs across all vehicle fleets in the transportation sector. The Reference Scenario (Rhodium) estimates emissions in 2030 to be 324 MMTCO2e. A five-year delay in renewable capacity would increase emissions by 8 percent in 2030 (25 MMTCO2e) relative to the Reference Scenario. If similar delays in clean energy production and deployment occur in other sectors, a larger increase in emissions relative to the reference scenario would be expected, jeopardizing the state's ability to achieve the 2030 target. Similarly, a delay in consumer adoption of zero emission vehicles (LDV, MDV, HDV) would increase emissions by 6 percent in 2030 (19 MMTCO2e) relative to the Reference Scenario. Delays in transitioning to electric equipment and appliances in homes and businesses would also lead to increased emissions in 2030. Figure 2-10 illustrates the impact on projected emissions in 2030 associated with delayed renewable capacity and delayed transportation vehicle electrification.

Figure 2-10: Impact of delayed implementation on 2030 GHG emissions[195]



Appendix J (Uncertainty Analysis) includes additional details on the assumptions and model used for the uncertainty analysis and the risks to achieve the emissions reductions from 2022 to 2030 that are anticipated in the Scoping Plan Reference Scenario. While the analysis focuses on renewable capacity and transportation, the analysis identifies a common set of themes that can impact emissions reductions across economic sectors, including permitting, technology availability, and consumer adoption. The impact of delayed emissions reductions will vary by sector and by the specific policy at risk of delay.

We give these quantitative examples of the impact implementation delays can have on GHG reductions, but almost every economic sector will have the need for permitting to enable at least a 40 percent reduction below 1990 levels. If we consider the increased ambition of the Scoping Plan Scenario, which identifies an accelerated 2030 target, the same types of uncertainty manifest themselves in successful implementation of the Scoping Plan Scenario, with the added need for CCS and CDR and a need to grow other energy sectors such as hydrogen.

[195] The implementation delay scenarios were modeled separately and do not necessarily reflect the combined impact of delayed renewable capacity and transportation vehicle electrification.

Cap-and-Trade Program Update

Since the adoption of the first Scoping Plan in 2008, carbon pricing in the form of a Cap-and-Trade Program has been part of the portfolio to achieve the state's GHG reduction targets, and it will remain critical as we work toward carbon neutrality. This section provides an update on the program and its role in achieving the 2030 target.

The Cap-and-Trade Program first came into effect in 2012, under AB 32, and included declining allowance caps through 2020. In 2017, AB 398[196] was passed by a supermajority in the Legislature and included prescriptive direction on the design of the program from 2021 through 2030. The AB 398 Cap-and-Trade Program came into effect on January 1, 2021, and it included the following changes:

- Doubling of stringency with an annual cap decline of 4 percent per year from 2021–2030
- AB 398 price ceiling
- AB 398 redesigned allowance price containment reserve with two tiers
- AB 398 100 percent leakage assistance factor for industry
- AB 398 lower offset limits: Usage limit cut from 8 percent to 4 percent, and half of offsets must provide direct benefits to California

The reduction in the role of offsets in the program was in recognition of ongoing concerns raised by environmental justice advocates regarding the ability of companies to use offsets for compliance instead of investing in actions on site to reduce GHG emissions that could also potentially reduce criteria or toxic emissions.[197,198] Note that data show the relationship between facility emissions of GHGs and co-pollutants is highly variable by sector and pollutant.[199] Changes to the allowance price containment reserve and the addition of the price ceiling were included to ensure protections against price spikes in the program, while the changes to the leakage assistance factors were to ensure the maximum protection against leakage in the program. The original design of the program included an auction floor price that increases by 5 percent plus inflation each year, and

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[196] Assembly Bill 398 (Garcia, Chapter 135, Stats. of 2017). California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.

[197] OEHHA. 2022. *Impacts of Greenhouse Gas Emission Limits Within Disadvantaged Communities*. https://oehha.ca.gov/media/downloads/environmental-justice/impactsofghgpoliciesreport020322.pdf.

[198] The OEHHA report also found that companies that use the most offsets often own the facilities that contribute to local $PM_{2.5}$ exposure. However, there was no causal relationship found to indicate that implementation of the Cap-and-Trade Program was contributing to increases in local air pollution. Also see: CARB. FAQ Cap-and-Trade Program. https://ww2.arb.ca.gov/resources/documents/faq-cap-and-trade-program.

[199] OEHHA. 2022. *Impacts of Greenhouse Gas Emission Limits Within Disadvantaged Communities*. https://oehha.ca.gov/media/downloads/environmental-justice/impactsofghgpoliciesreport020322.pdf.

that escalation factor is retained in the post-2020 program and is also applied to the allowance price containment reserve and price ceiling. These features, combined with the self-ratcheting mechanism for unsold allowances at auctions,[200] help to ensure the program is able to handle periods of high and low demand for allowances while continuing to ensure a steadily increasing price signal for regulated entities to invest in GHG reduction technologies.

As a result of achieving the 2020 target several years earlier than mandated by law, there are unused allowances in circulation. CARB estimated the amount to be approximately 310 million allowances after the conclusion of the third compliance period (2018–2020).[201] AB 398 had also called for a similar analysis, which was completed in 2018.[202] This bank represents approximately 5 percent of the total number of vintage 2013–2030 allowances issued within the joint market. This bank of allowances can only remain banked if year-over-year the covered emissions are declining by 14 MMT. If the annual decline in actual emissions is less than 14 MMT, regulated entities will need to use the banked allowances to cover their compliance obligations. It is likely that the existing bank of 310 million allowances will be needed over the early part of this decade and will be exhausted by the end of the decade. During the same period, prices for allowances will continue to increase at least 5 percent plus inflation year-over-year, sending a steadily increasing price signal to spur investment in onsite reductions for covered entities.

With the passage of AB 1279, the state has a statutory target to achieve carbon neutrality no later than 2045. This Scoping Plan demonstrates that planning on a longer time frame for the new carbon neutrality target means we must accelerate our near-term ambition for 2030 in order to be on track to achieve our longer-term target. CARB will use the modeling for this Scoping Plan to assess what changes may be warranted to the Cap-and-Trade or other programs to ensure we are on track to achieve an accelerated 2030 target. Since the original adoption of the Cap-and-Trade regulation, the program has been amended eight times through a robust public process. Moreover, then-California Environmental Protection Agency Secretary Jared Blumenfeld testified at a Senate hearing in 2022 that CARB will report back to the Legislature by the end of 2023 on the status of the allowance supply with any suggestions on legislative changes to ensure the number of allowances

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[200] The self-ratcheting mechanism temporarily removes unsold allowances from the market until either sufficient demand manifests for two consecutive auctions and they are incrementally reintroduced at future auctions, or they are permanently removed from general circulation if demand remains low.
[201] CARB. 2022. BR 18-51 Cap-and-Trade Allowance Report. Attachment A. *https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/Allowance%20Report_Reso18_51.pdf*.
[202] CARB. 2018. Staff Report: Initial Statement of Reasons: Proposed Amendments to the Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation. September 4. *https://www.arb.ca.gov/regact/2018/capandtrade18/ct18398.pdf?_ga=2.134288305.1735610122.1664813952-1100516233.1657841496*.

is appropriate to help the state achieve its 2030 target of at least 40% below 1990 levels. As part of that status update, CARB will also provide information on any potential program changes that may be needed to allowance supply to help achieve an accelerated target for 2030 identified in this Scoping Plan as necessary to achieve carbon neutrality no later than 2045. Engaging in this process in 2023 will allow for the consideration of this Scoping Plan, inclusion of additional data points for the second year of operation of the AB 398-designed program (which only came into force in January 2021), and an opportunity to hold public workshops.

It is also worth noting that the COVID-19 pandemic had significant impacts on economic activity in California and elsewhere.[203] Emissions were significantly lower in 2020 due to the impacts of the global pandemic. There is an expectation that emissions will increase as the economy recovers and behaviors continue to shift from the impacts of the ongoing pandemic. As a result, 2020 should be regarded as an outlier in the emissions trends. This scenario of increasing emissions is similar to what happened in the first compliance period for Cap-and-Trade, where the state economy was recovering from the Great Recession and does not correlate to a problem with the structure of this program or other programs that cover emissions related to the manufacturing or transportation sectors. In any assessment of this and other programs, it is essential to consider external factors such as economic activity and availability of zero carbon energy such as hydropower, among others.

To better understand the role of the Cap-and-Trade Program in achieving the 2030 target, Table 2-5 compares the 2030 GHG emissions estimates from the three reference scenarios described in Table 2-4. The 2017 Scoping Plan projection is from the PATHWAYS model for the Scoping Plan Scenario approved by the Board in late 2017. It excludes the contribution of the Cap-and-Trade Program, without any consideration of uncertainty factors (i.e., a characterization of the uncertainty that a given GHG reduction measure included in the 2017 Scoping Plan will actually achieve the GHG reductions it is projected to deliver). The Reference Scenario represents what GHG emissions would look like if we did nothing beyond the existing policies that are required and already in place to achieve the 2030 target; this scenario is based on the recent PATHWAYS modeling, excluding the contribution of the Cap-and-Trade Program, and without any consideration of uncertainty factors. It indicates that GHG emissions will be lower over this decade than originally projected when the 2017 Scoping Plan was approved. The

[203] CARB. November 4, 2021. Mandatory Greenhouse Gas Reporting - 2020 Emissions Year Frequently Asked Questions. *https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/2020mrrfaqs.pdf?_ga=2.264251343.1760432228.1650736660-1644197524.1577749754*.

Reference Scenario (Rhodium) which also does not include uncertainty bounds, is the modeling used for the uncertainty analysis above.

Importantly, PATHWAYS is not able to explicitly model a carbon pricing policy, and therefore the Cap-and-Trade Program is not represented in the 2017 Scoping Plan or the Reference Scenario. Carbon pricing is included in RHG-NEMS, which reflects state and federal policies included in the U.S. Energy Information Administration (EIA) Annual Energy Outlook 2022 and the National Energy Systems Model (NEMS), which is the basis for RHG-NEMS.[204]

As detailed in EIA's documentation, California's Cap-and-Trade Program is represented through increased energy prices, which flow across economic sectors.[205] However, many of the emissions covered by the California Cap-and-Trade Program are not energy- and fuel-related emissions. Given that, the energy systems model RHG-NEMS was used to model the impact of California Cap-and-Trade on the energy system. However, RHG-NEMS does not explicitly model the entire program, which includes non-energy related emissions from the industrial, agricultural, waste, and transportation sectors.

[204] U.S. EIA. 2022. *Summary of Legislation and Regulations Included in the Annual Energy Outlook 2022.* March. *https://www.eia.gov/outlooks/aeo/assumptions/pdf/summary.pdf*.
[205] U.S. EIA. 2022. Electricity Market Module. *https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf*.

Table 2-5: Comparison of 2017 Scoping Plan and two Reference Scenarios

	2030 GHG Emissions ($MMTCO_2e$) (2017 Scoping Plan)	2030 GHG Emissions ($MMTCO_2e$) (Reference Scenario)	2030 GHG Emissions ($MMTCO_2e$) (Reference Scenario-Rhodium)
Reference Scenarios	320	305	324
Gap to Accelerated 2030 Target under the Scoping Plan Scenario (226)[206]	94	79	98

Under the Scoping Plan Scenario, in 2030 California emissions are anticipated to be 48% below 1990 levels. This represents an acceleration of the current SB 32 target of a 40% reduction below 1990 levels. Table 2-5 includes the gap between the different reference scenarios and the accelerated 2030 target achieved under the Scoping Plan Scenario. It also shows that depending on the modeling, there are a range of potential emissions levels in 2030 prior to accounting for the full impact of the Cap-and-Trade Program on emissions. That range is from 305 to 324 $MMTCO_2e$ in 2030. That represents a 19 $MMTCO_2e$ spread, or about 8.4 percent of the accelerated 2030 target of 226 $MMTCO_2e$. Importantly, none of these scenarios includes all of the actions identified in the Scoping Plan Scenario for this Scoping Plan; many of those actions, such as SB 596, CCS, and a more stringent LCFS program, will only begin to happen in this decade, and their contributions toward meeting the accelerated 2030 target are therefore not included in the reference scenarios. The actual emissions for the remainder of this decade will therefore likely be lower than in each of the scenarios in Table 2-5 once policies and regulations are in place to support an accelerated 2030 target. However, the degree of this difference between actual and projected emissions will differ across the modeled reference scenarios.

[206] Table 3 from the 2017 Scoping Plan included a range of 34 to 79 $MMTCO_2e$ for reductions needed from the Cap-and-Trade Program to achieve a 2030 target of 40 percent below 1990 levels.

Regardless of the uncertainty and differences in the models, it is clear additional GHG reductions must happen over this decade to achieve an accelerated 2030 target. This will require an evaluation of all major programs to assess the need to increase their stringency between now and 2030. As the actual reductions from non-Cap-and-Trade Program measures increase, California will be less reliant on the Cap-and-Trade Program to "fill the gap" to meet an accelerated 2030 reduction target. For example, CARB is developing a proposal to increase the stringency of the LCFS program for 2030, the recently adopted Advanced Clean Cars II regulation is more stringent than modeled for the 2030 40 percent target in the 2017 Scoping Plan, and SB 596 requires specific reductions in the cement sector over this decade and beyond. However, we also know we are not on track to achieve the VMT reduction called for in the 2017 Scoping Plan and will need to double down to achieve the even more ambitious target called for in the Scoping Plan Scenario. Also, we will need additional actions over the coming years to reduce short-lived climate pollutants to meet the emission reductions called for in SB 1383.

Collectively, any additional legislation or prescriptive policies for sectors, delays in successful implementation of non-Cap-and-Trade programs and policies, increases in incentive program funding, and delays in economic recovery from the pandemic will continue to affect the role the Cap-and-Trade Program will need to play over this decade to meet the state's GHG reduction obligations. In summary, the Cap-and-Trade Program must continue to be able to scale across a range of possibilities. With passage of AB 1279 and the need to accelerate the 2030 target, CARB will initiate a public process to utilize the modeling results from this Scoping Plan, specifically the Scoping Plan Scenario, to evaluate and potentially propose changes to the design of the Program, including the annual caps. This process will ensure that the Program supports an increased ambition for 2030 while retaining the ability to scale as other factors, such as changing economic conditions and implementation of non Cap-and-Trade programs, impact the actual emissions at the sources covered by the Program. Any changes to the Program must continue to support a well-designed system that continues to send a steadily increasing price signal, minimizes for leakage, reduces emissions in the covered sectors toward the state's targets, is cost-effective and technologically feasible, and avoids energy rate spikes. Importantly, the Program should support air quality benefits, especially in overly burdened communities, and not exacerbate existing air quality disparities.

Chapter 3: Economic and Health Evaluations

This chapter provides two approaches for quantifying the economic and health outcomes of the Scoping Plan Scenario. One approach is to consider the combined impact of all measures[207] in a scenario. The other approach is required by AB 197, where each measure within a scenario is evaluated independently. In addition to these two evaluation approaches, this chapter also includes a discussion of the Public Health implications for the Scoping Plan Scenario, an overview of the Climate Vulnerability Metric, and the Environmental Analysis conducted in accord with the California Environmental Quality Act (CEQA).

It is important to note that all of the analyses in this chapter use a variety of data sources, but because the modeling is economy-wide at the state level, none of them produce community specific detail outputs. The AB 32 GHG Inventory Sector analysis relies on PATHWAYS data at the state level that is proportionally applied across all regions of the state to translate changes in state level fuel combustion to local level changes. The NWL analysis similarly utilizes a variety of data sources and a suite of models that produce data that are scaled up to the statewide level. All of the models, except the Wildland Urban Interface (WUI) defensible space model, which is conducted at the county level, create aspatial projections that are not applicable at the community level.

Economic Analysis

As part of the process to develop this Scoping Plan, alternative scenarios that transition energy needs away from fossil fuels and achieve carbon neutrality no later than 2045 were developed. Alternative scenarios that assess the impact of different land management strategies on carbon stocks in NWL were also developed. These alternatives are described in Appendix C (AB 197 Measure Analysis). The following sections describe the Scoping Plan Scenario in terms of direct cost, the economy, employment, and health outcomes.[208]

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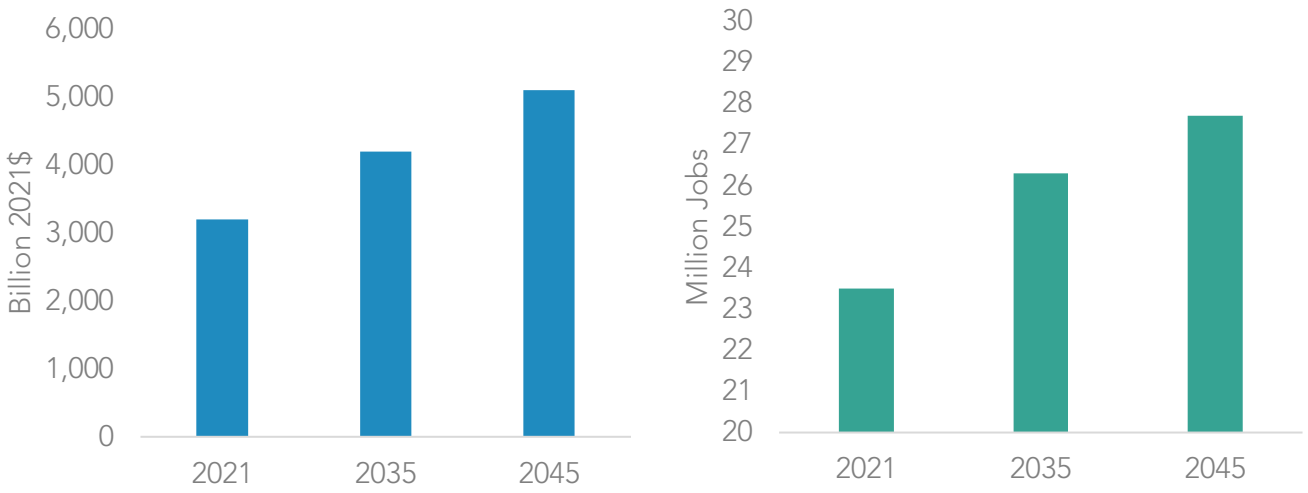
[207] AB 197 calls for the evaluation of "measures." This Scoping Plan treats each action and its variants on stringency as measures for the purposes of this chapter. Appendix C (AB 197 Measure Analysis) lists the measures and corresponding modeling assumptions for each alternative and the Scoping Plan Scenario. The modeling assumptions for the Scoping Plan Scenario are summarized in Table 2-1.

[208] For the Draft 2022 Scoping Plan Update, achieving carbon neutrality in 2035 and 2045 was evaluated. The AB 32 GHG Inventory sector direct cost, the economy, employment, and health outcomes were assessed in those years. Similarly, the Scoping Plan Scenario assessments that are presented in this chapter were made for years 2035 and 2045.

The California economy is growing, and it is projected to continue to grow about 2 percent each year, from $3.2 trillion in 2021 to $5.1 trillion in 2045, as shown in Figure 3-1. Similarly, employment in California is anticipated to grow 0.7 percent per year, from 23.5 million jobs in 2021 to 27.7 million jobs in 2045. It is in this context, termed the *Reference Scenario,* that CARB evaluates the Scoping Plan Scenario in terms of its impact on economic growth and employment. The projections shown in Figure 3-1 were produced by CARB to evaluate the incremental impact of regulations.

Figure 3-1: Projected California gross state product (left) and employment growth (right) from 2021 to 2035 and 2045



Source: California Air Resources Board

Transitioning away from fossil fuels to alternatives and increasing action on NWL will affect employment opportunities, household spending, businesses, and other economic aspects of our lives. Sectors expected to see growth include renewable electricity and hydrogen production, while other sectors may shrink. The deployment of clean technology may require higher upfront costs for things like heat pumps and induction stoves, but those could be offset by energy efficiency savings. Employment and economic development in NWL-related industries and sectors are expected to increase as land management actions increase, especially for the Forestry sector (in which a significant increase is called for under the Scoping Plan Scenario). The net impact of these actions on employment and jobs is presented in this chapter.

Estimated Direct Costs

One key metric is the direct cost, or net investment, reflecting any savings that result from actions. Similar approaches were used to estimate direct costs for the AB 32 GHG Inventory sectors and for the NWL, as described in this section.

AB 32 GHG Inventory Sectors

Transitioning away from fossil fuels requires investment in new equipment and infrastructure throughout the economy. It involves developing the capacity to produce fuels and electricity from renewable sources rather than producing fossil energy. This transition also takes time. One approach is to eliminate combustion of fossil fuels by replacing all equipment in a specified year. Another approach is to establish a future point at which all sales of new equipment rely on alternative energy sources and allow the transition to occur over time as equipment is replaced upon its end of life.

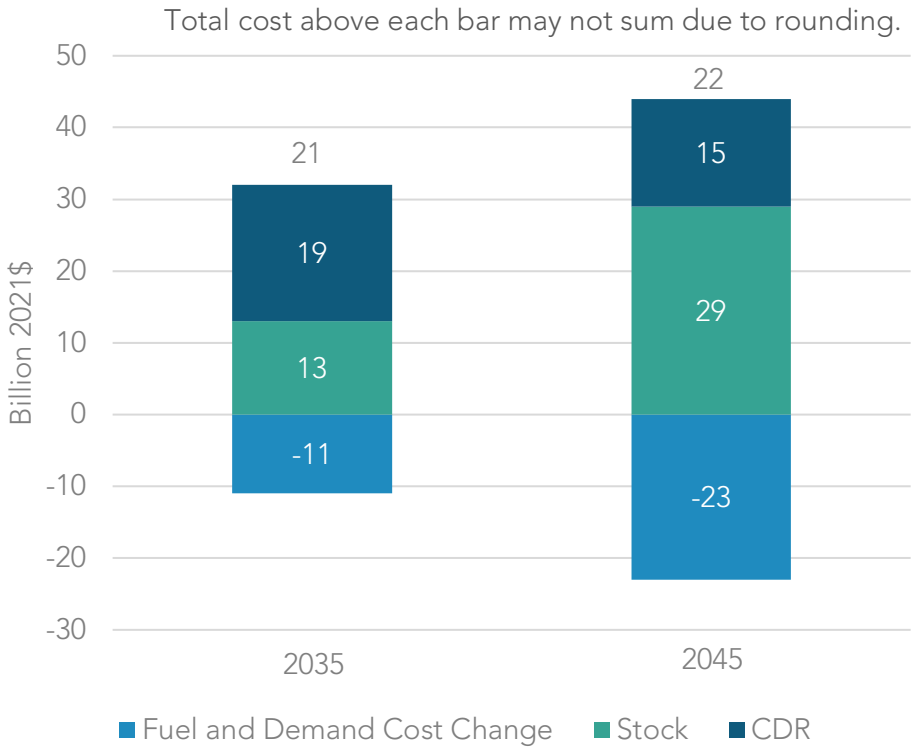
To evaluate the investment required through 2045, the PATHWAYS model was used to represent equipment stock and its turnover to non-fossil fuel alternatives over time. The annualized, incremental cost of infrastructure in excess of the annualized cost of the Reference Scenario[209] was computed for each year from 2022 through 2045. These costs were computed by first taking the absolute cost in each year—which includes both new equipment investment and also expenditures on energy, operations, and maintenance in each year—and then levelizing the costs (in the same way car or house payments are annualized or spread out over time) to arrive at an annualized cost. Fuel savings, and resulting cost savings, associated with changing energy demand—from gasoline to electricity for vehicles, for example—are included as a result of this methodology. Carbon dioxide removal includes DAC technology powered primarily by off-grid solar, BECCS to produce hydrogen or other fuels, and NWL sequestration, as discussed in Chapter 2.[210]

Figure 3-2 shows the stock investment cost, fuel/efficiency savings, and CDR cost. The Scoping Plan Scenario allows end-of-life transition of equipment. The cost of investing in new equipment is partially offset by savings associated with efficiency gains and reduced demand for fuels like gasoline. This is particularly relevant in the transportation sector, which leads to the majority of savings in 2045 in the Scoping Plan Scenario, which models near complete electrification of transport relying only on end-of-life replacement of vehicles. Appendix H (AB 32 GHG Inventory Sector Modeling) includes additional detail on direct costs in each sector and how costs change over time.

[209] The Reference Scenario described in Chapter 2 and in Appendix H (AB 32 GHG Inventory Sector Modeling) was the basis for the direct cost comparison.

[210] The energy source for DAC is not modeled, but renewable electricity and/or hydrogen produced from electrolysis are zero-carbon options consistent with the carbon neutrality targets in this Scoping Plan. The economic analysis associated the investment in DAC with the solar industry for consistency with the carbon neutrality targets.

Figure 3-2: Cost and savings relative to the growing California economy for the Scoping Plan Scenario in 2035 and 2045 (AB 32 GHG Inventory sectors)



Natural and Working Lands

For NWL, the direct costs of each management strategy were estimated using available academic literature, monitoring and reporting data, survey data, and cost data from existing subsidy programs on the per acre cost of implementing the management strategy. These cost data, in combination with the acreage of each management strategy under the scenarios, provided estimates of the overall direct cost to either the government or the private sector. The direct costs are independent of the policy lever used to implement the action and do not include many important benefits and externalities of the actions. They are assumed to be constant for each scenario and into the future. Avoided or secondary costs, such as those from reductions in wildfire suppression expenses, are not included. Appendix I (NWL Technical Support Document) includes additional direct cost details.

Table 3-1 includes the direct cost estimates for the Scoping Plan Scenario compared to the Reference Scenario.[211] Direct costs for the NWL sector are expected to be significant due to the ambitious level of action for each land type.

Table 3-1: Cost and savings relative to a growing California economy for the Scoping Plan Scenario (NWL)

Measure	Scoping Plan Scenario: Average Direct Annual Cost, 2025–2045 (millions $/year)
Forests / Shrublands / Grasslands	1,780
Annual Croplands	284
Perennial Croplands	4
Urban Forest	4,230
Wildland Urban Interface (WUI)	114
Wetlands	28
Sparsely Vegetated Lands	4
Totals	6,460
Note: Table values may not add to total due to rounding.	

CARB estimates that all jurisdictions, including private landowners, currently spend approximately $4 billion dollars annually on planting, maintenance, sidewalk repair, tree removal, and other expenses related to urban forests, and that reaching the theoretical maximum tree cover would require increasing that spending by a factor of 20. The cost of the Scoping Plan Scenario is predominantly a mix of urban forests and forests, shrubland, and grasslands spending.

[211] The Reference Scenario described in Chapter 2 and in Appendix I (NWL Technical Support Document) was the basis for the direct cost comparison.

Economy and Employment

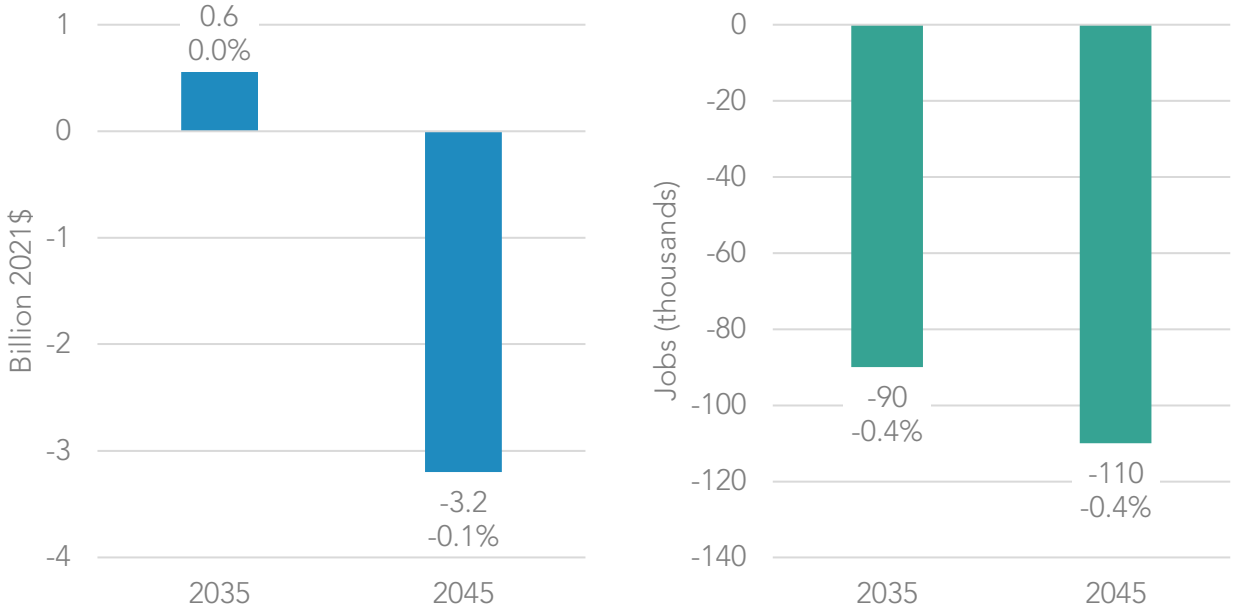
Two different models were used to estimate the overall impact that investing in a transition away from fossil fuels and in our NWL may have on the growing California economy. The transition away from fossil fuels was evaluated using the IMPLAN economic analysis model. The NWL investments were evaluated using the REMI PI+ economic model. These models provide similar outputs relative to the same economic and employment forecasts used to develop a Reference Scenario for use in each model.

AB 32 GHG Inventory Sectors

To estimate the overall impact that investing in a transition away from fossil fuels may have on the California economy, CARB used the IMPLAN model. Additional detail regarding the model, assumptions, and methodology are included in Appendix H (AB 32 GHG Inventory Sector Modeling). The IMPLAN model is a multisector representation of private industries in the U.S. economy that maps economic relationships across industries, households, and governments. This model translates direct costs and savings associated with transitioning away from fossil fuels with indirect effects such as wages, purchases of goods and services, business tax impacts, and supply chain effects. In addition, the induced effects of household purchases, local and import purchases, wages paid, and household tax impacts are estimated. This comprehensive assessment of the interactions between capital investment in fossil fuel alternatives and household purchases provides an indication of the response of the California economy to the Scoping Plan Scenario.

The Scoping Plan Scenario results in a small impact on the Gross State Product (GSP) and employment relative to the Reference Scenario, as shown in Figure 3-3. Economic growth is largely unaffected by the Scoping Plan Scenario in 2035 and slowed by 0.1 percent in 2045. Employment growth is also slowed a small amount, 0.4 percent in 2035 and in 2045, and employment still grows. Assuming annual growth rates of 0.7 percent means there would be more than 193,000 additional jobs in 2045.

Figure 3-3: Gross state product (left) and employment (right) relative to a growing California economy for the Scoping Plan Scenario in 2035 and 2045 (AB 32 GHG Inventory sectors)



California households will see increased costs from the purchase of new capital stock and savings from reduced spending on fuel, as shown in Figure 3-2. Households also will face increased costs associated with CDR, costs associated with energy efficiency measures, and commercial stock purchases—all of which are assumed to be passed directly to consumers. The impact to California households, however, is not limited to these direct costs, as changes in relative prices, employment, and wages can affect household well-being. Personal income, which captures the direct, indirect, and induced impacts, is a metric commonly used to evaluate the impact of policies on households.

Personal income in California is projected to grow from $2.7 trillion in 2021 to $3.6 trillion in 2035 and $4.4 trillion in 2045. Household projections are based on California Department of Finance population projections, which estimate the state's population to grow an average of 0.3 percent each year from 2021 to 2045.[212] California households are projected to increase from 13.3 million in 2020 to 14.6 million in 2035 and 15.0 million in 2045.

[212] California Department of Finance. Population Projections (Baseline 2019). https://dof.ca.gov/forecasting/demographics/projections/.

While the transition away from combustion of fossil fuels will improve air quality for all Californians (and even, more so in overly burdened communities), the economic impacts of the Scoping Plan Scenario are unlikely to be equal among Californians. Table 3-2 presents the change in income by household income group relative to the Reference Scenario in 2035 and 2045. While in 2035 there is a net decrease in personal income of $600 million, total income for households that make less than $100,000 per year is estimated to decline by $4.1 billion dollars, and the total income for households that make more than $100,000 per year will increase by $3.5 billion under the Scoping Plan Scenario. In 2045, although there is no net change in personal income across all California households, results vary by income level. Total income for households that make less than $100,000 per year are estimated to decline by $5.3 billion dollars, while the total income for households that make more than $100,000 per year will increase by $5.3 billion under the Scoping Plan Scenario.

Table 3-2: Income Impacts by California household income group in 2035 and 2045 for the Scoping Plan Scenario (AB 32 GHG Inventory Sectors)

Household Income Group ($2021)	Percentage of 2021 California Households[213]	Change in Income (Billion $2021)	
		2035	2045
Less than $50,000	30	-2.9	-3.9
$50,000 to $100,000	27	-1.2	-1.4
$100,000 to $200,000	28	2.5	4.0
More than $200,000	15	1.0	1.3
Total	100	-0.6	0.0

[213] U.S. Census Bureau. 2021. Household Income. California. https://data.census.gov/cedsci/table?q=california%20income.

In addition to income level, there is likely to be an impact to California personal income that varies based on race/ethnicity.[214] Table 3-3 shows the percentage of households within each income group based on eight race/ethnicity categories identified in the American Community Survey 2021. As shown in Table 3-2, households in lower income groups are anticipated to see negative impacts, while households in higher income groups are anticipated to see positive impacts from the Scoping Plan Scenario in both 2035 and 2045. Because more than 60% of households in the race/ethnicity categories of Hispanic, Black alone, Native Hawaiian (HI) or Pacific Islander, American Indian or Alaskan Native, Other, and Two or More make less than $100,000 per year, these populations generally are likely to experience reduced income. White and Asian households will generally experience both increased and decreased income because these households are distributed more evenly across all four income groups.

The state recognizes the need to ensure that accessibility to clean technology and energy do not further exacerbate health and opportunity gaps for low-income households and communities of color. The Climate Change Investments program exceeds the statutory minimums to invest in projects to benefit disadvantaged communities.[215] Utilities implement programs for reduced energy bills for qualifying low-income customers.[216] There are also resources for waste and water bills that leverage federal funds.[217] CARB also coordinated with the CPUC to ensure that the Climate Credit[218] funded from the sale of Cap-and-Trade allowances provided to utilities on behalf of ratepayers is credited equally to households and not based on how much energy is used. These are just a few examples of how the state is designing and implementing programs to avoid increasing existing disparities. The state must continue to find ways to relieve economic burdens on low-income households.

[214] The number of households in each bracket and the race/ethnicity categories are from American Community Survey 2021 results. Population changes through 2035 and 2045 are not forecast. U.S. Census Bureau. 2021. Household Income. California. *https://data.census.gov/cedsci/table?q=california%20income*.
[215] CARB. Priority Populations — California Climate Investments. *https://www.caclimateinvestments.ca.gov/priority-populations*.
[216] CPUC. CARE/FERA Program. *https://www.cpuc.ca.gov/lowincomerates/*.
[217] California Department of Community Services and Development. Low Income Household Water Assistance Program. *https:/www.csd.ca.gov/lihwap*.
[218] CPUC. California Climate Credit - FAQ. *https://www.cpuc.ca.gov/industries-and-topics/natural-gas/greenhouse-gas-cap-and-trade-program/california-climate-credit/california-climate-credit---faq*.

Table 3-3: Percentage of households in each race/ethnicity category by household income group

Household Income Group ($2021)	Households in Income Group (%)							
	White Not Hispanic	Hispanic	Black Alone	Asian Alone	Native HI or Pacific Islander	American Indian or Alaskan Native	Other	Two or More
Less than $50,000	26	35	45	25	30	35	37	32
$50,000 to $100,000	25	32	27	21	31	33	33	30
$100,000 to $200,000	29	25	21	30	30	26	24	27
More than $200,000	19	7	7	24	9	7	5	11

Natural and Working Lands

The macroeconomic impact of the NWL scenario was evaluated separately in the REMI PI+ model. For the Scoping Plan Scenario, the macroeconomic impact was modeled by assuming that economic activity in the relevant industries grows in proportion to the proposed implementation spending in that industry. All funds for implementing the actions were assumed to be sourced from within the state. For urban forests, the funds were modeled as being sourced from a combination of state government and private property owners in proportion to the current estimated private/public spending ratio. For all other actions, funds were assumed to be sourced from the state government. In each modeled scenario, government spending and income to property owners were reduced relative to the Reference Scenario in proportion to the annual costs of implementation. None of the proposed spending was modeled as being sourced from increased taxes. Additional details on the methodology for evaluating macroeconomic impacts are in Appendix I (NWL Technical Support Document).

While the macroeconomic model does count the increased economic activity in the affected industries as part of GSP, it does not quantify many of the important economic, health, and environmental benefits that would occur if these actions were implemented. While these benefits—like the reduced use of pesticides, value of urban trees, and increased recreational opportunities—would be very significant, they are outside the scope of the macroeconomic model.

The macroeconomic model also makes projections about the total level of employment in the state. The model forecasts that the Scoping Plan Scenario, which greatly increases the level of NWL management actions, channels economic activity toward related industries and would lead to a slight increase in total employment. (Table 3-4). While the model does aim to accurately represent many labor market dynamics, including adjustments of wages and migration rates, it does not account for many costs that might be associated with dramatically scaling up employment in a particular industry, such as the cost of job training.

Table 3-4: Gross state product and employment relative to a growing California economy for the Scoping Plan Scenario in 2035 / 2045 (NWL)

	Scoping Plan Scenario (%)
Gross State Product	0.00 / 0.01
Employment	0.12 / 0.10
Personal Income	-0.04 / -0.04
Personal Income per Capita	-0.04 / -0.14

Health Analysis

Air quality is affected by pollutant emissions from various processes associated with energy systems, including the combustion of fossil fuels, as well as the combustion of vegetation biomass from NWL during wildfires. Pollutants that are important contributors to degraded air quality in California include nitrogen oxides (NO_x), particulate matter (PM), reactive organic gases (ROG), and others. Further, in the atmosphere these pollutants are transported away from the locations of the emissions by wind and other phenomena, and undergo chemical reactions that result in the formation of new pollutants such as ground-level ozone and fine particulate matter ($PM_{2.5}$). Both primary (emitted) and secondary (formed) pollutants are important from a public health standpoint and contribute to the incidence of air pollution-related mortality and disease within California populations. Measures focused on GHGs do not incorporate specific targets to reduce emissions of $PM_{2.5}$ or air toxics like benzene. These co-pollutants, which are emitted from many of the same pollution sources as GHGs, affect local air quality and pose known risks to public health, such as the risk of asthma and cardiovascular disease. Generally, for stationary sources, certain harmful pollutants are regulated via local rules and regulations that are reflected in permits for stationary sources and are enforced by local air districts, with CARB also regulating air toxics contaminants from stationary sources with the air districts.

AB 32 GHG Inventory Sectors

To assess health impacts for the AB 32 GHG Inventory sectors, an integrated modeling approach was used to quantify and value the air pollution-related public health benefits of the Scoping Plan Scenario relative to the Reference Scenario. Additional details about the models, assumptions, and methodology are included in Appendix H (AB 32 GHG Inventory Sector Modeling). Using output from the PATHWAYS model, projections of pollutant emissions to 2045 were developed for stationary, area, and mobile source emissions using a detailed base year CARB pollutant emissions inventory. Further, the emissions are processed, including for where and when they occur in California, using the Sparse Matrix Operator Kernels Emissions (SMOKE) model. For example, on-road vehicle emissions were allocated along existing roadways, and refining emissions were assigned to the locations of existing refineries. It should be noted that the emissions projections represent statewide average reductions associated with high-level assumptions about alternative fuels and technologies. For example, emissions occurring from refineries to produce liquid fuels are reduced in line with petroleum demand. This reduction is applied equally to all refineries in the Scoping Plan Scenario and does not specify individual facility responses to changing demand. Similarly, the Scoping Plan Scenario does not specify which refineries transition to biofuel production or where new electricity generation facilities are built.

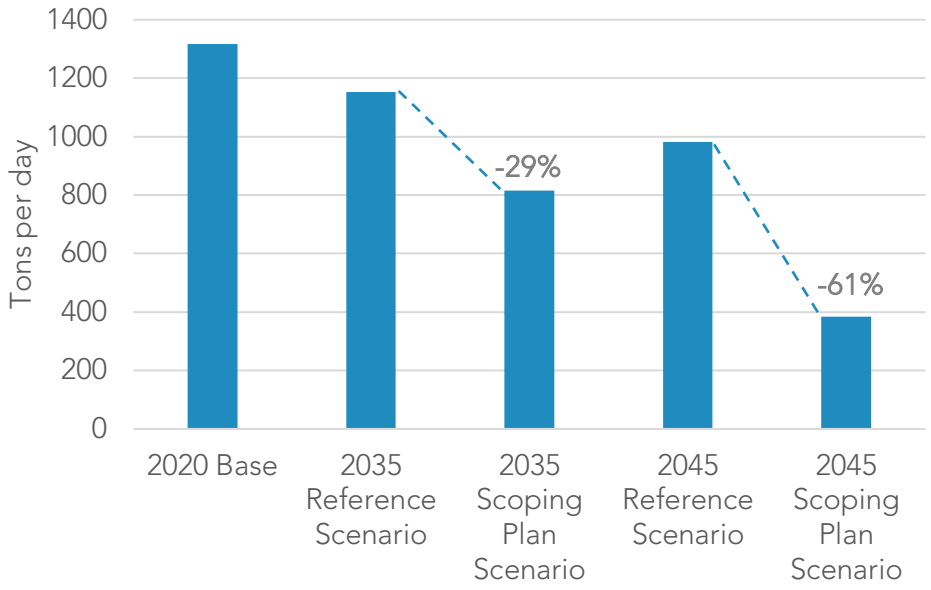
Next, emission changes were translated into impacts on atmospheric pollution levels, including ground-level ozone and $PM_{2.5}$, via an advanced photochemical air quality model called the Community Multiscale Air Quality (CMAQ) model, which accounts for atmospheric chemistry and transport. A comprehensive assessment of how pollutant concentrations are impacted throughout the year was achieved by simulating all months in 2035 and 2045 for the Scoping Plan Scenario.[219] Health benefits were estimated using the U.S. EPA's environmental Benefits Mapping and Analysis Program (BenMAP) model to translate pollutant changes into avoided incidence of mortality, hospital admissions, emergency room visits, and other outcomes as a result of reduced exposure to ozone and $PM_{2.5}$. These outcomes are associated with an economic value in order to aggregate health impacts.

The Scoping Plan Scenario shows a substantial reduction in pollutant emissions relative to the Reference Scenario, including NO_x, $PM_{2.5}$, and ROG. Reductions in NO_x are shown in Figure 3-4. Even under a business-as-usual trajectory, emissions are reduced from present levels by 26 percent in 2045 in the Reference Scenario, demonstrating the impact of current regulations and trends in energy sectors. The Scoping Plan Scenario further reduces NO_x

[219] This annual approach differs from the episodic modeling approach applied to the Proposed Scenario and Alternatives in the Draft 2022 Scoping Plan Update. Appendix H (AB 32 GHG Inventory Sector Modeling) describes both approaches.

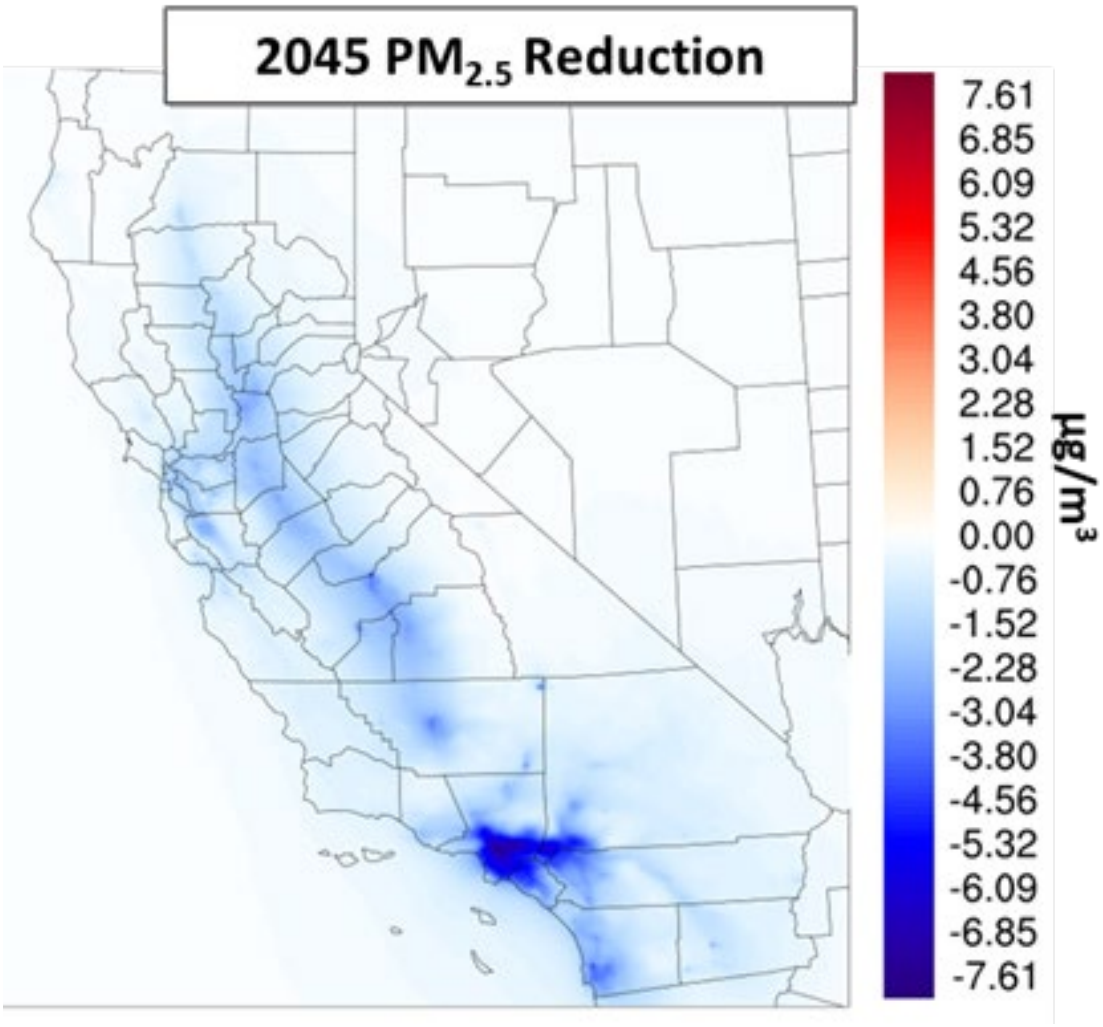
emissions from the Reference Scenario by 29% in 2035 and 61% in 2045. Emission reductions occur throughout the state with particular prominence in urban areas, including the South Coast Air Basin, due to the large presence and activity of emission sources. Appendix H (AB 32 GHG Inventory Sector Modeling) contains additional information about the pollutant emissions modeling and results.

Figure 3-4: Illustration of NOx emission reductions from current levels for the Reference Scenario and the Scoping Plan Scenario (AB 32 GHG Inventory sectors)



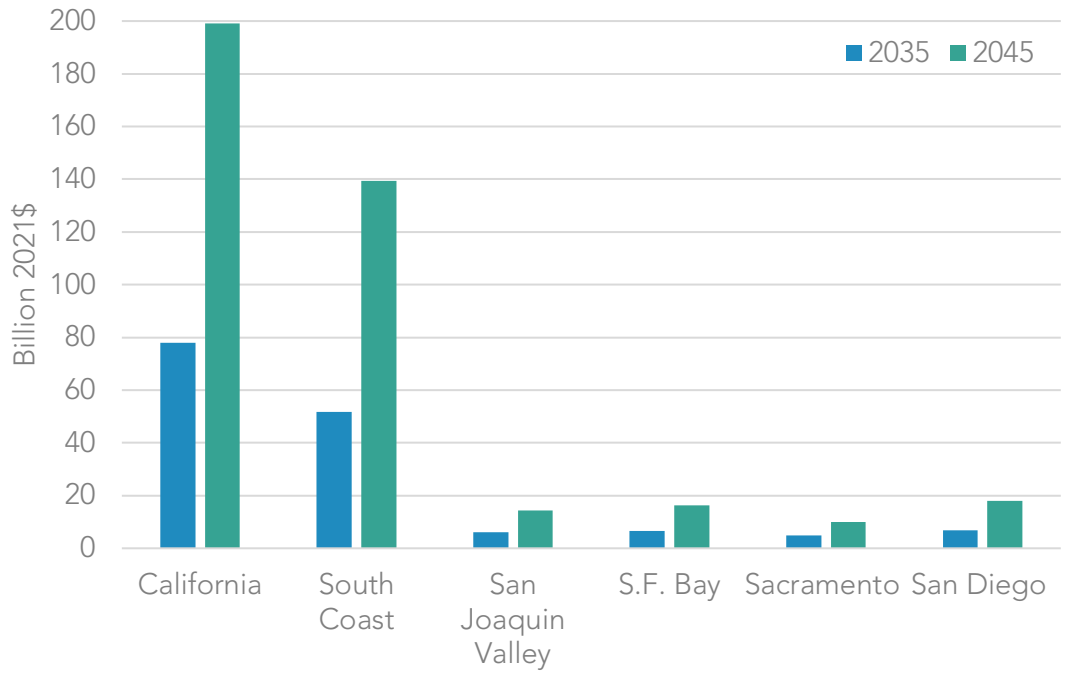
The emission reductions achieve important improvements in air quality throughout California, including reductions in the levels of ozone and $PM_{2.5}$. Reductions in annual $PM_{2.5}$ levels are shown in Figure 3-5. The greatest reductions are evident in Southern California, the San Joaquin Valley, the San Francisco Bay area, and the Greater Sacramento area due to the large presence and activity of emission sources, meteorology, topography, and others. To highlight the extent of the air quality improvements: reductions reach nearly 8 micrograms per cubic meter ($\mu g/m^3$) in 2045 and lead to 76% fewer exceedances of the health-based National Ambient Air Quality $PM_{2.5}$ standard of 12 $\mu g/m^3$. Similarly, ozone improvements reach 19 parts per billion (ppb) and yield 62% fewer exceedance events. Furthermore, the locations of improvements carry important implications for human health as these areas support large urban populations and generally experience the most degraded ozone and $PM_{2.5}$ pollution. Appendix H (AB 32 GHG Inventory Sector Modeling) provides details regarding the atmospheric modeling and results, including differences in ozone and $PM_{2.5}$.

Figure 3-5: Difference in annual average $PM_{2.5}$ (µg/m^3) in the Scoping Plan scenario relative to the Reference scenario in 2045 (AB 32 GHG Inventory sectors)



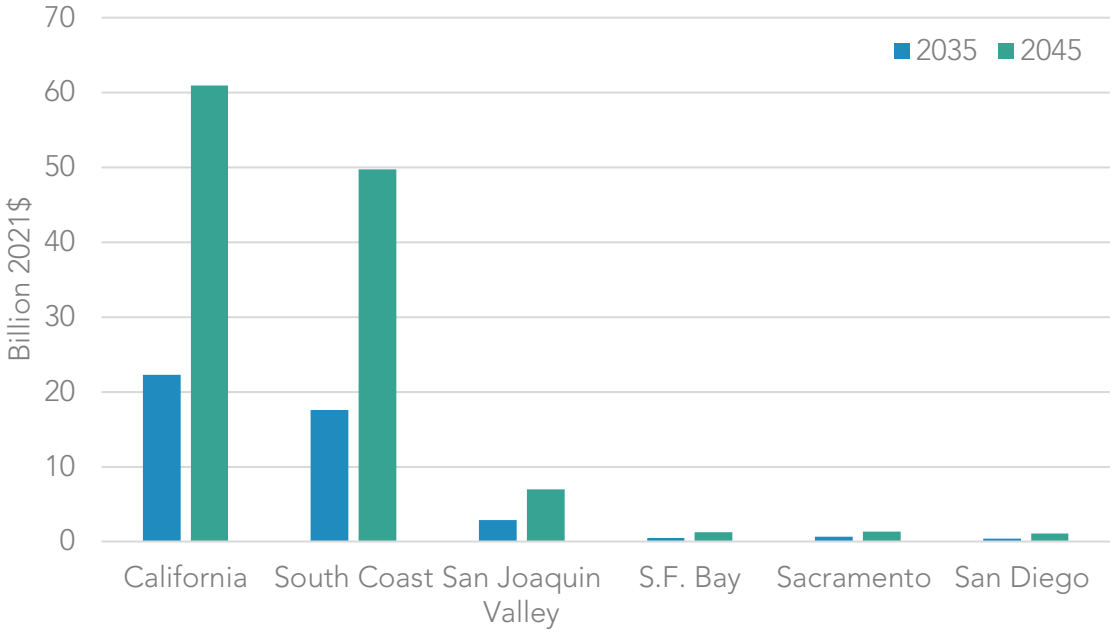
Notable health benefits representing the economic value of the avoided incidence of health effects are associated with the Scoping Plan Scenario. In total, the benefits reach $78 billion in 2035 and $199 billion in 2045, as shown in Figure 3-6. Populations in Southern California benefit the most due to preexisting air quality challenges, significant emission sources and activity, and the presence of a large, dense urban population. Additional details regarding the health impact assessment are provided in Appendix H (AB 32 GHG Inventory Sector Modeling).

Figure 3-6: Total health benefits estimated from air quality improvements in the Scoping Plan Scenario (AB 32 GHG Inventory sectors)



Furthermore, these benefits accrue within socially and economically disadvantaged communities identified by CalEnviroScreen, where they are most needed. Total health benefits within census tracts identified as disadvantaged communities using CalEnviroScreen 4.0 reach $22 billion in 2035 and $61 billion in 2045, as shown in Figure 3-7. Similarly to the statewide health benefits, the largest share of benefits occurs within disadvantaged communities in Southern California. Additional information on the health benefits within disadvantaged communities can be found in Appendix H (AB 32 GHG Inventory Sector Modeling).

Figure 3-7: Disadvantaged community health benefits relative to the Reference Scenario for the Scoping Plan Scenario (AB 32 GHG Inventory sectors)

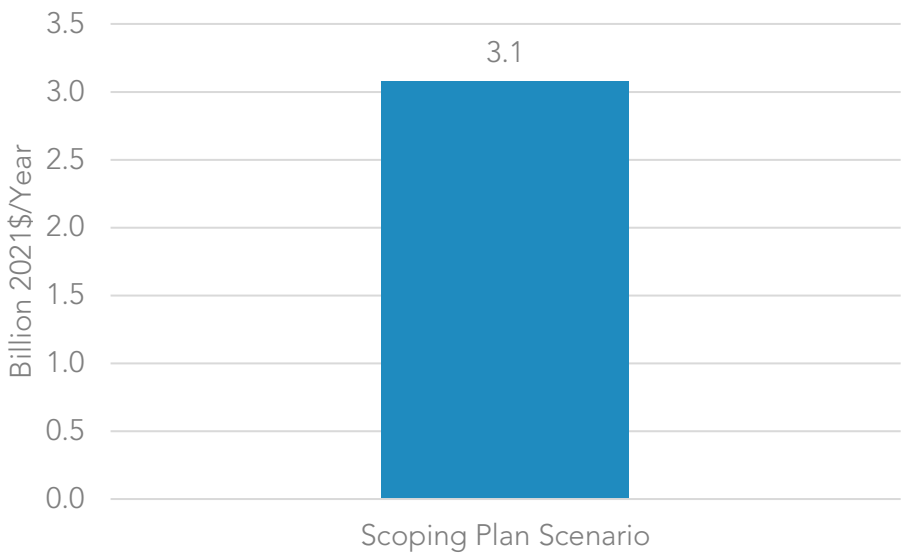


Natural and Working Lands

For NWL, health benefits were evaluated based on projected $PM_{2.5}$ wildfire emissions on forests, shrublands, and grasslands, discussed in the AB 197 Measure Analysis section of the chapter that follows.[220] The health endpoints for the Scoping Plan Scenario and in Appendix I (NWL Technical Support Document) for the alternative scenarios were the basis for the estimated health benefits shown in Figure 3-8. Health benefits were derived from the preliminary University of California, Los Angeles (UCLA) study that estimated annual health impacts and associated costs from California's wildfires from 2008–2018. Additional details are included in Appendix I (NWL Technical Support Document). These costs were applied to the health endpoints discussed in the AB 197 Measure Analysis section of the chapter.

[220] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N11, N14. *finalejacrecs.pdf (arb.ca.gov)*.

Figure 3-8: Total average annual health benefits relative to the Reference Scenario for the Scoping Plan Scenario (NWL)



As health impacts analyzed here are driven by wildfire emissions, the health benefits for the Scoping Plan Scenario are directly related to the amount of forest, shrubland, and grassland management action. These management actions reduce vegetation fuels and, as a result, wildfire activity. The Scoping Plan Scenario increases the amount of these management actions, reducing wildfire emissions and avoiding incidence of emission-related health effects. The health benefits, or economic value of the avoided incidence of health effects, correspondingly increase with an increasing management implementation rate. Additional details are included in Appendix I (NWL Technical Support Document).

Estimated health benefits do not include the direct impact of wildfires on injuries, deaths, or mental health, nor the indirect costs of lost ecosystem benefits to wildfire. Additional direct health costs may result from wildfire that would likely increase the health benefits from increased forest, shrubland, and grassland management to reduce wildfire activity. Nonetheless, the conservative health benefits under the Scoping Plan Scenario are estimated to be $3.1 billion per year relative to the Reference Scenario for all NWL actions identified in the Scoping Plan Scenario.

AB 197 Measure Analysis

This section provides estimates for information associated with GHG emissions reduction measures evaluated in this Scoping Plan.[221] These estimates, which were developed as part of the process for meeting the requirements of AB 197 (E. Garcia, Chapter 250, Statutes of 2016), provide information on the relative impacts of the evaluated measures when compared to each other. To support the design of a suite of policies that result in GHG reductions, air quality co-benefits, and cost-effective measures, it is important to understand if a measure will increase or reduce criteria pollutants or toxic air contaminant emissions, or if increasing stringency at additional costs yields few additional GHG reductions. To this end, AB 197 requires the following for each potential emissions reduction measure evaluated in any Scoping Plan update:

- The range of projected GHG emissions reductions that result from the measure;
- The range of projected criteria pollutant emission reductions that result from the measure; and
- The cost-effectiveness, including avoided social costs, of the measure.

The following sections describe the evaluation of measures for the AB 32 GHG Inventory sectors and NWL. For the purposes of this Scoping Plan, the identified emissions reduction measures for the analysis required by AB 197 are actions grouped by sectors where several policies and programs are expected to overlap. This approach reflects the most granular feasible analysis given the modeling tools available,[222] the overlap and interaction effects among policies and incentive programs, the longer planning horizon used for this Scoping Plan compared to previous efforts, and the scale of transition needed to achieve carbon neutrality. To implement this Scoping Plan, dozens of individual regulations, policies, and incentive programs are anticipated that work together to drive down emissions across all economic sectors and support actions. Every specific policy or incentive program that could contribute to the deployment of clean technology and energy called for in this plan may overlap in ways that make it infeasible to tease out those policies and programs' individual effects with any reasonable degree of certainty. For example, in the transportation sector, deploying ZEVs and reducing driving demand may be achieved through a combination of the implementation of new or existing regulations, fuels programs, incentive programs, and VMT reduction initiatives that can each contribute to reductions in emissions for the sector. It is not feasible to isolate each sub action from each other at this time in terms of the share of contribution to total reductions. The estimated emission

[221] AB 197 calls for the evaluation of "emission reduction measures." This Scoping Plan treats each action and its variants on stringency as emission reduction measures for the purposes of this chapter. Appendix C (AB 197 Measure Analysis) lists the measures and corresponding modeling assumptions for each alternative.
[222] See Appendix H (AB 32 GHG Inventory Sector Modeling and Appendix I (NWL Technical Support Document).

reductions, health endpoints, and costs by measure for the Scoping Plan Scenario are presented in this chapter, and the corresponding estimates for the Proposed Scenario and Alternatives 1, 2, and 4 are included in Appendix C (AB 197 Measure Analysis).

Because many of the measures and underlying assumptions interact with each other, isolating the GHG emission reductions, corresponding changes to fuel combustion, and associated cost of an individual measure is analytically challenging. Each measure is evaluated by examining the change in fuel combustion, cost, and emissions associated with just that measure using the PATHWAYS model. The difference between the Scoping Plan Scenario and the Reference Scenario is estimated for each measure. Starting from the Scoping Plan Scenario, the modeling assumptions for an individual measure are reverted to the Reference Scenario values, resulting in GHG reductions, changes to fuel combustion, and costs (or savings). This approach does not reflect interactions between sectors in PATHWAYS that influence the results for each complete alternative, presented earlier. As such, the values associated with each measure should not be added to obtain an overall scenario estimate.

To arrive at the 2045 target for NWL, CARB modeled the ecological impact that climate smart land-based management strategies (suites of on-the-ground actions, or *treatments,* that are used across the landscape to manipulate an ecosystem) will have on ecosystem carbon; and whenever possible, additional co-benefits from those actions. The Scoping Plan Scenario incorporates a set of land management actions at varying scales of implementation for each land type to achieve the GHG emission reductions. Each land type, and its associated management actions, was considered a measure for this analysis. For modeling individual landscapes and management actions, CARB used a suite of models. The complexity of these models varies by land type, depending on the existing science, data, and availability of existing models to use. Appendix I (NWL Technical Support Document) provides detailed modeling assumptions for each NWL type. The estimated emission reductions, health endpoints, and costs by measure under the Scoping Plan Scenario for each NWL type are presented in this chapter, and the corresponding estimates for the Proposed Scenario and NWL Alternatives 1, 2, and 4 are included in Appendix C (AB 197 Measure Analysis).

Estimated Emissions Reductions

Both GHG emissions reductions and emissions of criteria air pollutants were evaluated for the AB 32 GHG Inventory sectors and for NWL. The methods and results are described in this section.

AB 32 GHG Inventory Sectors

In the absence of having direct modeling results for criteria pollutant estimates from PATHWAYS, CARB estimated criteria pollutant emissions impacts by using changes in fuel combustion in units of exajoules from PATHWAYS and emission factors in units of tons per exajoule to estimate the change in emissions in tons per year. Emission factors from a variety

of sources for each sector were utilized, including but not limited to CARB's mobile source emissions models,[223] U.S. EPA's AP 42 Emissions Factors,[224] and the South Coast Air Quality Management District's (AQMD's) District Rules.[225] These emission factors were applied to fuel burn change by fuel type, sector, equipment type, and process, where applicable. Statewide annual average emissions were estimated for three criteria pollutants: NO_x, $PM_{2.5}$, and ROG.

Table 3-5 provides the estimated GHG and criteria pollutant emission reductions for the measures in the Scoping Plan Scenario in 2035 and 2045. The other alternatives are presented in Appendix C (AB 197 Measure Analysis). Based on the estimates below, these measures are expected to provide air quality benefits. The estimates provided in this chapter and Appendix C (AB 197 Measure Analysis) are appropriate for comparing across alternatives considered for the development of this Scoping Plan, but they are not precise estimates.

[223] CARB. MSEI - Modeling Tools. *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools*.
[224] U.S EPA. AP-42: Compilation of Air Emissions Factors. *https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors*.
[225] South Coast AQMD. South Coast AQMD Rule Book. *https://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book*.

Table 3-5: Estimated GHG and criteria pollutant emission reductions relative to the Reference Scenario for the Scoping Plan Scenario in 2035/2045 (AB 32 GHG Inventory sectors)

Measure	GHG Reductions ($MMTCO_2$)	NOx Reductions (Short Tons/Year)	$PM_{2.5}$ Reductions (Short Tons/ Year)	ROG Reductions (Short Tons/Year)
Deploy ZEVs and reduce driving demand	-46 / -84	-51,620 / -122,806	-2,008 / -6,506	-18,967 / -30,410
Coordinate supply of liquid fossil fuels with declining California fuel demand	-25 / -30	-1,601 / -2,707	-978 / -1,705	-747 / -1,323
Generate clean electricity	-8 / -31	-92 / -1,555	-177 / -1,382	-41 / -425
Measure	**GHG Reductions ($MMTCO_2$)**	**NOx Reductions (Short Tons/Year)**	**$PM_{2.5}$ Reductions (Short Tons/ Year)**	**ROG Reductions (Short Tons/Year)**
Decarbonize industrial energy supply	-9 / -22	-21,172 / -34,876	-1,188 / -2,527	-3,710 / -6,298
Decarbonize buildings	-14 / -35	-8,105 / -94,455	-826 / -6,877	-1,093 / -8,109
Reduce non-combustion emissions[a]	-0.41 / -0.52 ($MMTCH_4$)	N/A	N/A	N/A
Compensate for remaining emissions	-25 / -64	N/A	N/A	N/A

[a] Methane emissions reductions are reported for this measure.

The measures related to reducing non-combustion emissions and compensating for the remaining emissions do not include changes to fuel combustion, and therefore are not

associated with changes to air pollutants. Biomethane combustion is captured in measures that reduce combustion of fossil gas, such as decarbonizing industrial energy supply and buildings.

Natural and Working Lands

NWL ecosystems naturally vary between being a source and a sink for carbon over time. The NWL ecosystem carbon stock changes projected through mid-century by the suite of models were used to estimate net emissions or emissions reductions relative to the Reference Scenario. These changes in carbon stocks were affected by projected climate change, the implementation of management actions under the various scenarios, land conversion, and (for forests, shrublands, grasslands) wildfire. Each NWL type was evaluated, and an overview of all NWL is presented in Table 3-6. More detailed results for each NWL type can be found in Appendix C (AB 197 Measure Analysis).

Table 3-6: Estimated average annual GHG and criteria pollutant emission reductions relative to the Reference Scenario for the Scoping Plan Scenario from 2025–2045 (NWL)

Measure	GHG Reductions ($MMTCO_2e$/year)	$PM_{2.5}$ Reductions (MT/Year)
Forests/Shrublands/Grasslands	-0.12	-17,500
Annual Croplands	-0.25	N/A
Perennial Croplands	-0.01	N/A
Urban Forest	-1.29	N/A
Wildland Urban Interface (WUI)	0.75	N/A
Wetlands	-0.43	N/A
Sparsely Vegetated Lands	<-0.01	N/A

Fine particulate wildfire emissions were evaluated for forests, shrublands, and grasslands only. Wildfire emissions decreased under the Scoping Plan Scenario compared to the Reference Scenario. The Scoping Plan Scenario's higher level of management actions that reduce tree or shrub densities, protect large trees, reintroduce fire to the landscape, and diversify species and structures result in greater reductions in wildfire emissions.

Estimated Health Endpoints

Climate change mitigation will result in both environmental and health benefits. This section provides information about the potential health benefits of the Scoping Plan Scenario. Health benefits are primarily the result of reduced $PM_{2.5}$ pollution, both from stationary and mobile sources, as well as wildfire in forests, shrublands, and chaparral.

AB 32 GHG Inventory Sectors

CARB used the criteria pollutant emissions in Table 3-5 to understand potential health impacts. Similar to the air quality estimates, this information should be used to understand the relative health benefits of the various measures and should not be taken as absolute estimates of health outcomes. CARB used the incidence-per-ton (IPT) methodology to quantify the health benefits of emission reductions. The IPT methodology is based on a methodology developed by the U.S.

EPA.[226,227,228,229] Under the IPT methodology, changes in emissions are approximately proportional to the resulting changes in health outcomes. IPT factors are derived by calculating the number of health outcomes associated with exposure to $PM_{2.5}$ for a baseline scenario using measured ambient concentrations and dividing that number by the emissions of $PM_{2.5}$ or a precursor. To estimate the reduction in health outcomes, the emission reductions are multiplied by the IPT factor. For future years, the number of outcomes is adjusted to account for population growth. IPT factors were computed for the two types of $PM_{2.5}$: primary $PM_{2.5}$ and secondary $PM_{2.5}$ of ammonium nitrate aerosol formed from precursors.

For this AB 197 analysis, CARB calculated the health benefits associated with the five key measures that are represented by changes to fuel combustion. The health benefits associated with emission reductions for the Scoping Plan Scenario were estimated for each air basin and then aggregated for the entire state of California. CARB assumed that the statewide emission reductions distribution among the air basins is proportional to the baseline emissions in that air basin.

Calculated health endpoints include premature mortality, cardiovascular emergency department (ED) visits, acute myocardial infarction, respiratory ED visits, lung cancer incidence, asthma onset, asthma symptoms, work loss days, hospitalizations due to cardiopulmonary illnesses, hospitalizations due to respiratory illnesses, hospital admissions for Alzheimer's disease, and hospital admissions for Parkinson's disease.[230,231,232] These health endpoints were calculated using the IPT method for estimated emission reductions. Table 3-7 compares the health benefits of emission reductions associated with each measure for the Scoping Plan Scenario in the year

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[226] CARB. CARB's Methodology for Estimating the Health Effects of Air Pollution. Retrieved February 9, 2021. *https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution*.

[227] Fann, N., C. M. Fulcher, and B. J. Hubbell. 2019. "The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution." *Air Quality, Atmosphere & Health* 2:169–176. *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2770129/*.

[228] Fann, N., K. R. Baker, and C. M. Fulcher. 2012. "Characterizing the $PM_{2.5}$-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S." *Environ Int*. 49:141–51. November 15. *https://www.sciencedirect.com/science/article/pii/S0160412012001985*.

[229] Fann, N., K. Baker, E. Chan, A. Eyth, A. Macpherson, E. Miller, and J. Snyder. 2018. "Assessing Human Health $PM_{2.5}$ and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025." *Environ. Sci. Technol.* 52 (15), 8095–8103. *https://pubs.acs.org/doi/abs/10.1021/acs.est.8b02050*.

[230] CARB. CARB's Methodology. *https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution*.

[231] CARB. 2022. Updated Health Endpoints in CARB's Health Benefits Methodology. *Evaluating New Health Endpoints for Use in CARB's Health Analyses*.

[232] Cardio-pulmonary mortality, hospitalizations due to cardiopulmonary illnesses, and hospital admissions due to respiratory illnesses endpoints utilize studies documented in CARB's methodology document. For future assessments, CARB will use more recent studies to estimate cardiovascular hospital admissions and respiratory hospital admissions, as documented in CARB's updated health endpoints memo.

specified (2035 or 2045). The other alternatives are presented in Appendix C (AB 197 Measure Analysis).

Table 3-7: Estimated avoided incidence of mortality, cardiovascular and respiratory disease onset, work loss days and hospital admissions relative to the Reference Scenario for the Scoping Plan Scenario (AB 32 GHG Inventory sectors)

Measure	Mortality	Cardiovascular ED Visits	Acute Myocardial Infarction	Respiratory ED Visits	Lung Cancer Incidence	Asthma Onset	Asthma Symptoms	Work Loss Days	Hospital Admissions, Cardiovascular	Hospital Admissions, Respiratory	Hospital Admissions, Alzheimer's Disease	Hospital Admissions, Parkinson's Disease
Deploy ZEVs and reduce driving demand in 2035	635	170	70	400	45	1,475	128,930	92,510	95	115	245	40
Deploy ZEVs and reduce driving demand in 2045	1,820	475	200	1,115	135	3,995	343,095	255,800	295	350	745	125
Coordinate supply of liquid fossil fuels with declining CA fuel demand in 2035	115	30	15	70	10	275	23,530	16,880	20	20	50	10

Measure	Mortality	Cardiovascular ED Visits	Acute Myocardial Infarction	Respiratory ED Visits	Lung Cancer Incidence	Asthma Onset	Asthma Symptoms	Work Loss Days	Hospital Admissions, Cardiovascular	Hospital Admissions, Respiratory	Hospital Admissions, Alzheimer's Disease	Hospital Admissions, Parkinson's Disease
Coordinate supply of liquid fossil fuels with declining CA fuel demand in 2045	215	55	25	130	15	490	40,860	30,445	35	40	95	15
Generate clean electricity in 2035	20	5	0	10	0	45	3,930	2,820	5	5	10	0
Generate clean electricity in 2045	170	45	20	105	15	385	32,065	23,890	25	30	75	10
Decarbonize industrial energy supply in 2035	300	80	35	190	20	695	60,660	43,520	45	55	115	20
Decarbonize industrial energy supply in 2045	595	155	65	365	45	1,310	111,925	83,435	95	115	245	40

Measure	Mortality	Cardiovascular ED Visits	Acute Myocardial Infarction	Respiratory ED Visits	Lung Cancer Incidence	Asthma Onset	Asthma Symptoms	Work Loss Days	Hospital Admissions, Cardiovascular	Hospital Admissions, Respiratory	Hospital Admissions, Alzheimer's Disease	Hospital Admissions, Parkinson's Disease
Decarbonize buildings in 2035	155	40	15	95	10	360	31,130	22,335	25	30	60	10
Decarbonize buildings in 2045	1,610	420	175	985	120	3,550	303,830	226,500	260	310	665	115
Note: All values are rounded to the nearest 0 or 5.												

The measures related to reducing non-combustion emissions and compensating for remaining emissions do not include changes to fuel combustion and therefore are not associated with changes to air pollutants or health endpoints. Biomethane combustion is captured in measures that reduce combustion of fossil gas, such as decarbonizing industrial energy supply and buildings.

Although the estimated health outcomes presented are based on a well-established methodology, they are subject to uncertainty. For instance, future population estimates are subject to increasing uncertainty as they are projected further into the future, and baseline incidence rates can experience year-to-year variation. Also, the relationship between changes in pollutant concentrations and changes in pollutant or precursor emissions is assumed to be approximately proportional.

In addition, emissions are reported at an air basin level and do not capture local variations. These estimates also do not account for impacts from global climate change, such as temperature rise, and are only based on the scenarios in this Scoping Plan.

The fuel changes for each AB 197 measure are estimated based on the impact of each measure compared to the Reference Scenario for the years 2035 and 2045. Therefore, aggregating the effect of each measure would overestimate the impacts of the Scoping Plan Scenario because the implementation of each measure would affect the level of benefits of the other measures. This measure-by-measure analysis uses a different methodology for calculating health endpoints than does the health analysis for the complete Scoping Plan Scenario provided earlier.

Natural and Working Lands

Implementation of NWL management strategies to mitigate and adapt to climate change will result in both environmental and health benefits. This section provides information about the potential health benefits of measures evaluated for the Scoping Plan Scenario. For this analysis, health benefit estimates were focused on increases or decreases to $PM_{2.5}$ resulting from wildfire emissions on forests, shrublands, and grasslands.[233] Other health benefits resulting from NWL management actions in the Scoping Plan Scenario are not quantified here but are important for all Californians. This includes, but is not limited to, reductions in exposure to synthetic pesticides when switching to organic agricultural systems, improvements in shade availability and mental health with increasing urban forest cover, improved mental health from opportunities for recreation in resilient and healthy environments, and protection from floods and rising sea levels.

[233] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N11, N14. *finalejacrecs.pdf (arb.ca.gov)*.

These examples are by no means exhaustive, as our natural and working lands provide immense health benefits to everyone.

For this analysis, CARB used the $PM_{2.5}$ emissions in Table 3-6 to understand potential health impacts. This information should be used to understand the relative health endpoints of the various measures and should not be taken as absolute estimates of health outcomes of this Scoping Plan statewide or within a specific community. The IPT methodology was used to calculate health endpoints, similar to the AB 32 GHG Inventory Sector analysis. CARB calculated the annual health endpoints associated with the wildfire emissions changes resulting from the implementation of management strategies on forests, shrublands, and grasslands under each alternative. The annual health endpoints associated with emission reductions for the Scoping Plan Scenario were estimated for the entire state. Calculated health endpoints include emissions-caused mortality, hospital admittance, and emergency room visits from asthma; hospital admittance from chronic obstructive pulmonary disease; and emergency room visits from respiratory and cardiovascular outcomes. Table 3-8 compares the average annual health endpoints of wildfire emission reductions associated with the Scoping Plan Scenario over the period 2025–2045. The other alternatives are presented in Appendix C (AB 197 Measure Analysis).

Table 3-8: Estimated average annual avoided incidence of hospital admissions, emergency room visits, and mortality relative to the Reference Scenario for the Scoping Plan Scenario resulting from forest, shrubland, and grassland wildfire emissions (NWL)

Health Endpoints from Forest, Shrubland, and Grassland Wildfire Emissions	Average Annual Avoided Incidence
Hospital admissions from asthma	22
Hospital admissions from chronic obstructive pulmonary disease without asthma	19
Hospital admissions from all respiratory outcomes	63
Emergency room visits from asthma	155
Emergency room visits from all respiratory outcomes	419
Emergency room visits from all cardiovascular outcomes	156
All causes of mortality	394

Estimated Social Cost

Social costs are generally defined as the cost of an action on people, the environment, or society and are widely used to understand the impact of regulatory actions. One tool, the social cost of greenhouse gases (SC-GHG), is an estimate of the present value of the costs associated with the emission of GHGs in future years. It combines climate science and economics to help understand the benefits of reducing GHG emissions. The estimates of the social cost of carbon (SC-CO_2) and social cost of methane (SC-CH_4), two types of SC-GHGs presented here, estimate the value of the net harm to society associated with adding GHGs to the atmosphere in a given year; they do not represent the cost of actions taken to reduce GHG emissions (known as the *cost of abatement*) nor the cost of GHG emissions reductions. In principle, the SC-GHG includes the value of climate change impacts, including but not limited to, changes in net agricultural productivity, human health effects, property damage from increased flood risk and other natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. It reflects the societal value of reducing emissions

of the gas in question by one metric ton.[234] Many of these damages from GHG emissions today will affect economic outcomes throughout the next several centuries.

In 2008, federal agencies began incorporating SC-CO_2 estimates into the analysis of their regulatory actions. U.S. EPA has used various models and discount rates to determine the value of future impacts. Generally, these models begin with assumptions to predict economic activity over time, along with projected GHG emissions. The modeled emissions are input into a model of the global climate system, which then translates into estimates of surface temperature, sea level rise, and other impacts. These outputs are used to estimate economic damages per ton of GHG emitted in a given year in the future. Since the models are calculating the present value of future damages, a discount rate is applied. For example, the SC-CO_2 for the year 2045 represents the value of climate change damages from a release of CO_2 in 2045 discounted back to today. The present value is significantly affected by the discount rate used; a higher discount rate results in a lower present value. For example, in 2021 dollars the SC-CO_2 in 2045 is $31 using a 5 percent discount rate, $88 using a 3 percent discount rate, and $122 using a 2.5 percent discount rate. Additional detail is included in Appendix C (AB 197 Measure Analysis).

The 2017 Scoping Plan utilized SC-CO_2 and SC-CH_4 Obama Administration-era values developed by the Council of Economic Advisors and the Office of Management and Budget-convened Interagency Working Group on the Social Cost of Greenhouse Gases (IWG)[235] to consider the social costs of actions to reduce GHG emissions. The Biden Administration reinstated these values in February 2021,[236] after they had been rescinded and significantly revised by the Trump Administration. The reinstatement was considered an interim step, and the Biden Administration also reconvened the IWG to continue its work to evaluate and incorporate the latest climate science and economic research and

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[234] U.S. Government. Interagency Working Group on Social Cost of Greenhouse Gases. February 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide – Interim Estimates under Executive Order 13990. *https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf*

[235] Originally titled the "Interagency Working Group on the Social Cost of Carbon," the IWG was renamed in 2016. 82 Fed. Reg. 16093, 16095-96 (Mar. 28, 2017). *https://www.govinfo.gov/content/pkg/FR-2017-03-31/pdf/2017-06576.pdf*.

[236] Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, Executive Order 13990 (Jan. 20, 2021), 86 Fed. Reg. 7037 (Jan. 25, 2021). *https://www.energy.gov/sites/default/files/2021/02/f83/eo-13990-protecting-public-health-environment-restoring.pdf*. IWG, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990 (February 2021), *https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf* See also, The White House. 2021. A Return to Science: Evidence-Based Estimates of the Benefits of Reducing Climate Pollution. *https://www.whitehouse.gov/cea/written-materials/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/*.

respond to the National Academies' recommendations from 2017 as it develops a more complete revision of the estimates.

It is important to note that the models used to produce SC-GHG estimates do not include all of the important physical, ecological, and economic impacts of climate change recognized in the climate literature. There are additional costs to society, including the costs associated with changes in co-pollutants and costs that cannot be included due to modeling and data limitations. The IWG has stated that the range of the interim SC-GHG estimates likely underestimates societal damages from GHG emissions.[237] The revised estimates were originally slated to be released in early 2022 but were stalled.[238] CARB staff is applying the interim values presented in the IWG February 2021 Technical Support Document (TSD), which reflect the best available science in the estimation of the socioeconomic impacts of GHGs.[239] This Scoping Plan utilizes the TSD standardized range of discount rates, from 2.5 to 5 percent, to represent varying valuation of future damages.

AB 32 GHG Inventory Sectors

Table 3-9 presents the estimated social cost, in terms of avoided economic damages, for each measure of the Scoping Plan Scenario. For each measure, Table 3-9 includes the range of the SC-CO_2 and SC-CH_4 that results from the GHG emissions reductions in 2035 and 2045 at 2.5 and 5 percent discount rates. Additional background on the SC-GHG and methodology for calculating the SC-CO_2 and SC-CH_4 estimates in this Scoping Plan, as well as estimates for the alternatives, are provided in Appendix C (AB 197 Measure Analysis).

[237] Interagency Working Group on Social Cost of Greenhouse Gases. 2021. Technical Support Document. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

[238] See *Louisiana v. Biden* (W.D. La. 2022) 585 F.Supp.3d 840, stayed pending review (5th Cir. Mar. 16, 2022) 2022 WL 866282. A federal district court ruling issued in early February 2022 had granted a preliminary injunction blocking the Biden Administration from using the interim IWG SC-GHG estimates. However, a federal appeals court overturned the lower court's preliminary injunction in March 2022, which allows the Biden Administration to continue using the policy as legal proceedings continue. CARB will continue to monitor the litigation. However, the federal action does not prohibit CARB from using social cost of carbon and CARB will use the best available science regardless of politics. A separate federal appeals court upheld the Biden administration's use of the IWG SC-GHG estimates in October 2022. *Missouri v. Biden* (8th Cir. 2022) ____ F.4th ____.

[239] Interagency Working Group on Social Cost of Greenhouse Gases. 2021. Technical Support Document. https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

Table 3-9: Estimated social cost (avoided economic damages) of measures considered in the Scoping Plan Scenario (AB 32 GHG Inventory sectors)

Measure	Social Cost of Carbon in 2035, 5%–2.5% Discount Rate Billion USD (2021 dollars)	Social Cost of Carbon in 2045, 5%–2.5% Discount Rate Billion USD (2021 dollars)
Deploy ZEVs and reduce driving demand	1.12–4.87	2.64–10.23
Coordinate supply of liquid fossil fuels with declining California fuel demand	0.61–2.63	0.95–3.67
Generate clean electricity	0.20-0.88	0.97–3.75
Decarbonize industrial energy supply	0.23–1.01	0.69–2.67
Decarbonize buildings	0.35–1.52	1.11–4.32
Reduce non-combustion emissions	0.51–1.29 (SC-CH_4)	0.86–2.01 (SC-CH_4)
Compensate for remaining emissions	0.61–2.66	2.03–7.84
Scoping Plan Scenario SC-CO_2	2.4–10.4	5.6–21.9
Scoping Plan Scenario SC-CH_4	0.51–1.3	0.86–2.0
Scoping Plan Scenario (Total)[a]	2.9–11.7	6.5–23.9

[a] CARB staff could not precisely separate some CO_2 and CH_4 from other GHGs from PATHWAYS outputs, but the contribution is believed to be small for purposes of calculating the social cost of carbon. The approach used to estimate GHG emissions reductions for individual measures in PATHWAYS does not reflect cross-sector interactions. Therefore, the GHG values for each measure do not sum to the overall scenario total. The total GHG emissions reduction used in this calculation is 97 $MMTCO_2e$ in 2035 and 180 $MMTCO_2e$ in 2045.

Natural and Working Lands

The SC-CO_2 estimates for the NWL measures shown in Table 3-10, in terms of avoided economic damages, reflect 2021 IWG interim values, updated for inflation, similar to the AB 32 GHG Inventory Sector analysis. This analysis utilizes the 2.5 percent and 5 percent

discount rate and the average annual emissions reductions from each NWL type from 2025–2045. Estimates for all alternatives are included in Appendix C (AB 197 Measure Analysis).

Table 3-10: Estimated social cost (avoided economic damages) of measures considered in the Scoping Plan Scenario (NWL)

Measure	Social Cost of Carbon in 2035, 5%–2.5% Discount Rate Billion USD (2021 dollars)	Social Cost of Carbon in 2045, 5%–2.5% Discount Rate Billion USD (2021 dollars)
Forests/Shrublands/Grasslands	0.003–0.012	0.004–0.014
Annual Croplands	0.006–0.027	0.008–0.031
Perennial Croplands	<0.001–0.001	0.000–0.001
Urban Forest	0.032–0.138	0.041–0.157
Wildland Urban Interface (WUI)	(0.018) – (0.080)[a]	(0.023) – (0.090)
Wetlands	0.011–0.046	0.014–0.053
Sparsely Vegetated Lands	<0.001	<0.001

[a] Parentheses indicate an increase in estimated social cost, i.e., an increase in economic damages. This is only the case for WUI measures where emissions are increased, shown in Table 3-6. The estimated social cost does not account for the decrease in wildfire risk or decrease in wildfire damages resulting from the WUI measures.

Social Costs of GHGs in Relation to Cost-Effectiveness

AB 32 includes a requirement that rules and regulations "achieve the maximum technologically feasible and cost-effective" greenhouse gas emissions reductions.[240] Under AB 32, *cost-effectiveness* means the relative cost per metric ton of various GHG reduction strategies,[241] which is the traditional cost metric associated with emission control. In contrast, the SC-CO_2, SC-CH_4, and social cost of nitrous oxide (SC-N_2O), because they are estimates of the cost to society of additional GHG emissions, can be used to estimate of the economic benefits of reducing emissions, but do not take into account the cost of the actions that must be taken to achieve those GHG emissions reductions.

There may be technologies or policies that do not appear to be cost-effective when compared to the SC-CO_2, SC-CH_4, and SC-N_2O associated with GHG reductions. However, these technologies or policies may result in other benefits that are not reflected in the IWG social costs. Examples include the evaluation of social diversification of the portfolio of transportation fuels (a goal outlined in the Low Carbon Fuel Standard) and reductions in criteria pollutant emissions from power plants (as in the Renewables Portfolio Standard). Additionally, costs for new technology may be higher early on in a technology's development cycle and may drop over time as use of the technology is scaled up.

Estimated Cost per Metric Ton

AB 197 requires an estimation of the cost-effectiveness of the measures evaluated for this Scoping Plan. The cost (or savings)[242] per metric ton of CO_2e reduced for each measure is one metric for comparing the performance of the measures. Additional factors beyond the cost per metric ton that could be considered include continuity with existing laws and policies, implementation feasibility, contribution to fuel diversity and technology transformation goals, and health and other benefits to California. These considerations are not reflected in the cost per metric ton estimates presented below. It is important to understand the relative cost-effectiveness of individual measures as presented in this section. However, the economic analysis presented earlier in this chapter, in Appendix H

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[240] AB 32 Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006. (AB 32, Nuñez, Chapter 488, Statutes of 2006). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.

[241] Health & Saf. Code § 38505(d).

[242] Similarly, to the direct costs reported earlier, the cost per metric ton of a measure reflects the stock costs and any fuel or efficiency savings associated with a measure divided by the GHG emission reduction achieved by the measure. Costs are reported as positive values, and savings are reported as negative values.

(AB 32 GHG Inventory Sector Modeling), and in Appendix I (NWL Technical Support Document) provides a more comprehensive analysis of how the Scoping Plan Scenario and alternative scenarios affect the state's economy and jobs.

AB 32 GHG Inventory Sectors

The cost per metric ton for the AB 32 GHG Inventory sectors was computed for each measure independently relative to the Reference Scenario using the sensitivity calculations based on PATHWAYS and RESOLVE outputs. The difference in the annualized cost between the Scoping Plan Scenario and the Reference Scenario was computed for each measure in 2035 and in 2045. The incremental cost was divided by the incremental GHG emissions impact to calculate the cost per metric ton in each year. To capture the fuel and GHG impacts of investments made from 2022 through 2035, or from 2022 through 2045, CARB computed an average annual cost per metric ton. The incremental cost in each year was averaged over the period. This value is divided by the corresponding annual, incremental GHG impact averaged over the same period.

The cost metric includes the annualized incremental cost of energy infrastructure, such as zero-emission vehicles, electric appliances, and required revenue to support all electric assets. A residual value for equipment such as vehicles or appliances that are retired early is included. The annual fuel cost or avoided fuel cost that results from efficiency improvements or changes to demand for fuels associated with transitioning to alternative fuels is included. Not included in this cost metric are costs that represent transfers within the state, such as incentive payments for early retirement of equipment.

It is important to note that this cost per metric ton does not represent an expected market price value for carbon mitigation associated with these measures. In addition, the values do not capture fuel savings or GHG reductions associated with the full economic lifetime of measures that have been implemented by the target date of 2035 or 2045 but whose impacts extend beyond the target date.

Table 3-11 includes the cost per metric ton and annual average cost per metric ton estimates for the Scoping Plan Scenario. The other alternatives are presented in Appendix C (AB 197 Measure Analysis). Measures that are relatively less costly in 2035 or 2045 are also less costly over the extended period. As noted earlier, incremental costs of new vehicles are generally offset by gains in efficiency and avoided fuel consumption resulting in negative cost per metric ton.

Table 3-11: Estimated cost per metric ton of reduced CO_2e relative to the Reference Scenario for measures considered in the Scoping Plan Scenario (AB 32 GHG Inventory sectors)

Measure	Annual Cost, 2035 ($/ton)	Average Annual Cost, 2022–2035 ($/ton)	Annual Cost, 2045 ($/ton)	Average Annual Cost, 2022–2045 ($/ton)
Deploy ZEVs and reduce driving demand	-171	-99	-103	-122
Coordinate supply of liquid fossil fuels with declining CA fuel demand	60	109	-50	39
Generate clean electricity[a]	101	156	145	161
Decarbonize industrial energy supply	290	217	257	274
Decarbonize buildings	235	230	112	213
Reduce non-combustion emissions	93	94	106	99
Compensate for remaining emissions	745	823	236	485

[a] Note: The denominator of this calculation (2045) does not include GHG reductions occurring outside of California resulting from SB 100. If these reductions were included, this number would be lower.

Natural and Working Lands

The cost per metric ton for NWL measures were computed for the Scoping Plan Scenario relative to the Reference Scenario using the projected carbon stock/sequestration data from the NWL modeling and the direct cost estimates for each management action, described earlier. Direct costs represent the cost of implementing a certain management action. The projected emissions reductions take into account the loss of carbon that results from the management action, such as fuels reduction treatments in forests, as well as climate change effects on growth. The direct cost for each NWL measure was divided by the average annual emission reductions presented in Table 3-6 to produce the cost

per metric ton. The increasing effect of climate change on diminished future growth reduces the ability of the land to sequester or store carbon, driving up the cost per ton.

It is important to note that this cost per metric ton does not represent an expected market price value for carbon mitigation associated with these measures. In addition, emissions benefits of NWL management actions often take longer time periods to accrue, and these values only capture GHG reductions up to 2045.

Table 3-12 includes the average cost per metric ton estimates for the average annual CO_2e reductions from 2025 through 2045 for the Scoping Plan Scenario. The other alternatives are presented in Appendix C (AB 197 Measure Analysis).

Table 3-12: Estimated average cost per metric ton of reduced CO_2e relative to the Reference Scenario for measures considered in the Scoping Plan Scenario (NWL)

Measure	Average Cost per Reduced Ton CO_2e ($/Ton)
Forests/Shrublands/Grasslands	15,500
Annual Croplands	1,100
Perennial Croplands	412
Urban Forest	3,270
Wildland Urban Interface (WUI)	N/A
Wetlands	64
Sparsely Vegetated Lands	451,000

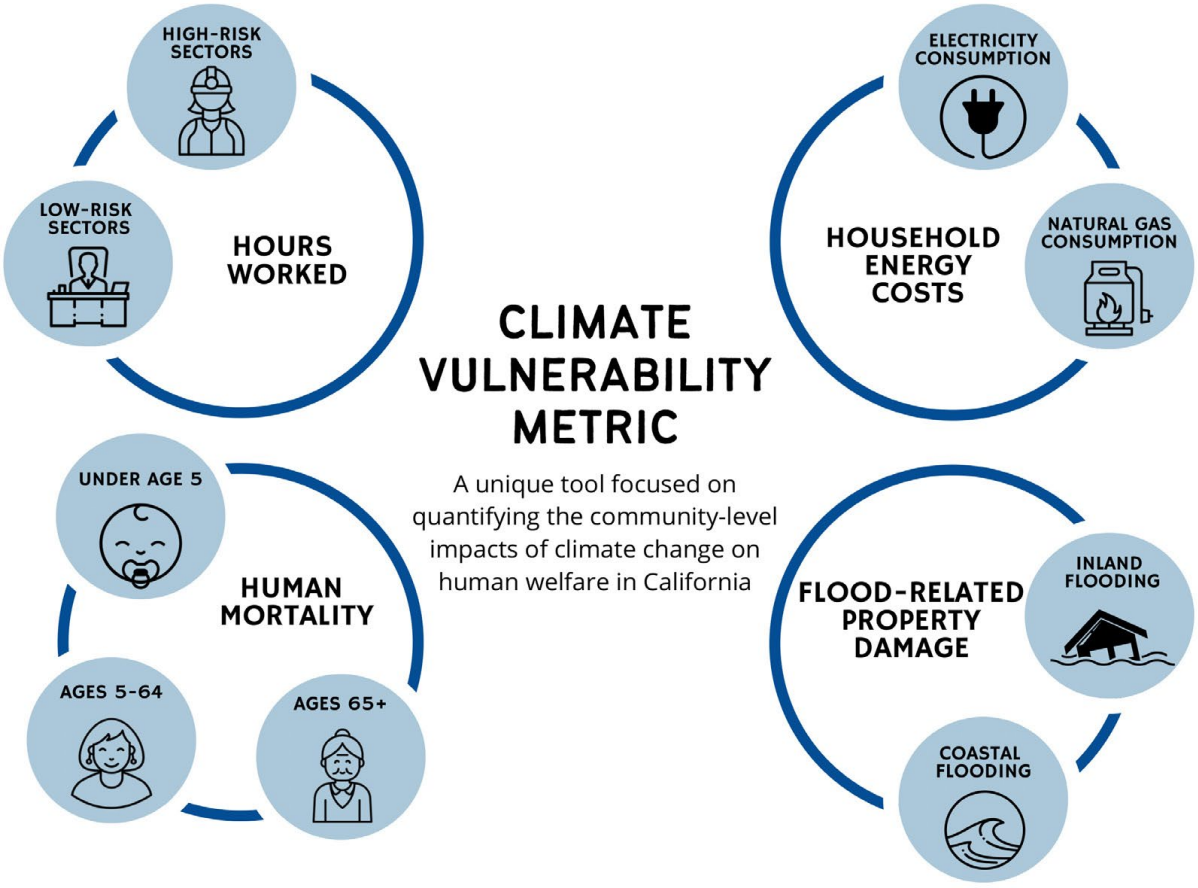
Climate Vulnerability Metric

As California invests in climate mitigation and adaptation, it is essential to understand that the relative impact of climate change will vary across the state's communities. Due to persisting health and opportunity gaps, not all communities are equally resilient in the face of climate impacts. A global metric such as the Social Cost of Carbon cannot adequately capture the incremental additional economic impact faced by overly burdened communities. The Climate Vulnerability Metric (CVM) is specifically focused on quantifying the community-level impacts of a warming climate on human welfare and the additional costs. Additional details and results are included in Appendix K (Climate Vulnerability Metric).

The CVM aggregates the impacts of climate change that can be quantified at the census tract level using robust and currently available research. The CVM includes the projected impacts of climate change on human welfare across four categories (hours worked, household energy costs, human mortality, and flood-related property damage) through midcentury. The CVM identifies nine components of the four climate impacts as shown in Figure 3-9 and aggregates the data to generate a total CVM result for each census tract. To ensure that the CVM represents the diversity of California communities, it is reported as the aggregate monetized impact of climate change as a percentage of census tract-specific incomes.[243] For example, a CVM value of 3 implies that by 2050, a census tract is projected to experience human welfare impacts of climate change that amount to 3% of annual income in that tract.

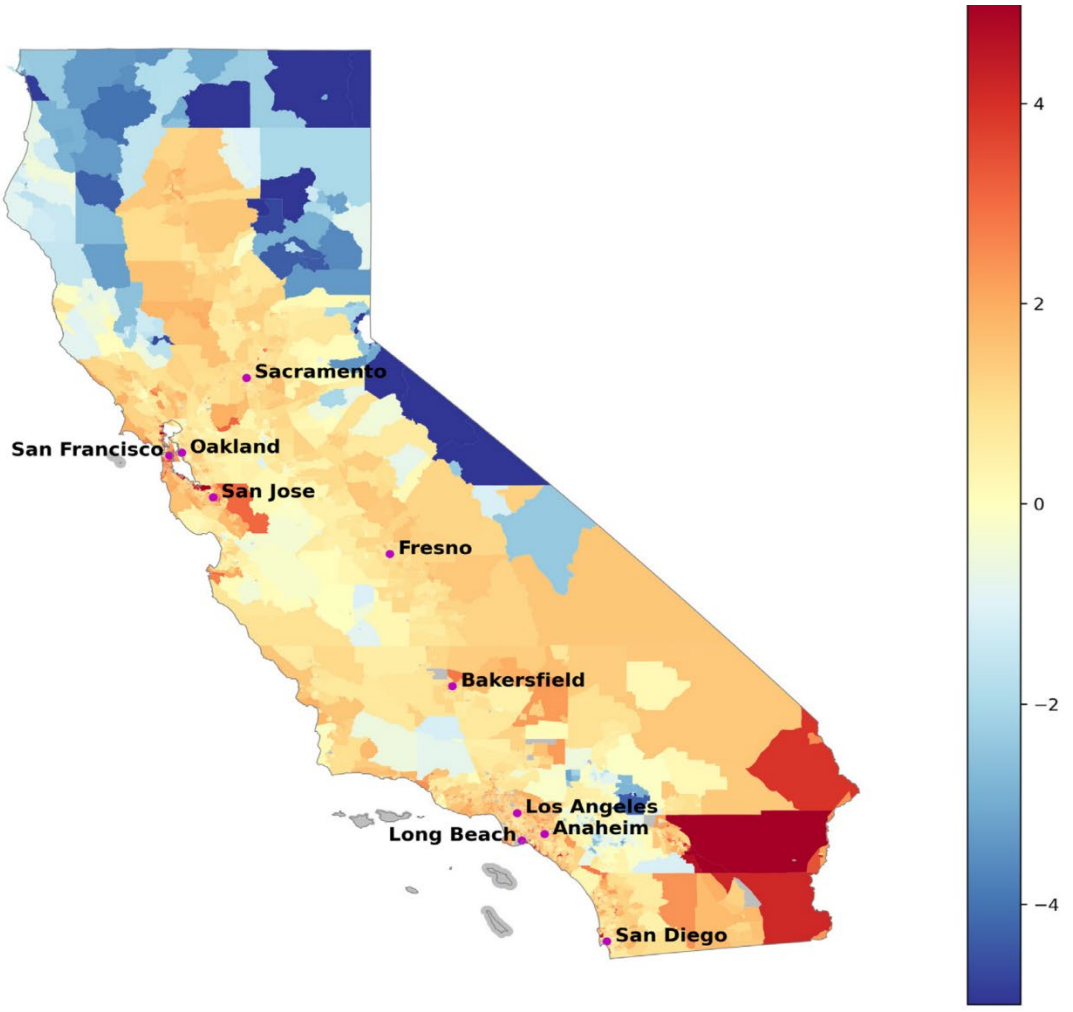
[243] Per capita income in 2019 for census tracts across California ranges from $633 to $176,388, with a median of $32,181 ($2019). Source: American Community Survey.

Figure 3-9: Categories of climate change impacts on human welfare included in the Climate Vulnerability Metric.



The CVM shows that climate change will have highly unequal impacts across California. While some southeastern regions of California are estimated to suffer damages that exceed 5% of annual income, other high-elevation northeastern regions of California are estimated to see benefits of up to 10%. Some low-lying urban areas, such as the San Francisco Bay Area, are estimated to be particularly vulnerable, while much of the Central Valley is estimated to suffer at least moderate economic damages relative to the rest of the state. It is important to note that the CVM does not set a threshold for vulnerability. Instead, it shows relative impacts across census tracts. The CVM is limited to the impacts that can currently be quantified at the census tract level.

Figure 3-10: Combined impacts of climate change in 2050 under a moderate emissions scenario; damages as share of 2019 tract income (%)



The map shows combined impacts of climate change in 2050 under a moderate emissions scenario (RCP 4.5), reported as a share of 2019 census tract income. For example, a CVM value of 3 implies that by 2050, a census tract is projected to experience human welfare impacts of climate change that amount to 3% of annual income. Impacts are combined across the categories shown in Figure 3-9. The higher the CVM for a given census tract, the more damaging the projected impacts of climate change on human welfare. Census tracts with high CVMs are represented by positive percentages in orange and red. A lower CVM is associated with lower projected impacts of climate change, shown in yellow, while a negative CVM value represents a projected beneficial impact of climate change (e.g., through reductions in deaths caused by extremely cold winter weather). Negative CVMs are represented by negative percentages in blue.

By providing information about how climate vulnerability varies across California (Figure 3-10), the CVM results can be used to direct resources to enhance resiliency in the state's

most vulnerable communities based on the specific impacts, such as heat or flooding, they are experiencing. The CVM may be used in combination with existing screening tools, such as CalEnviroScreen 4.0, to identify communities that face environmental and health hazards that contribute to disproportionate economic impacts in addition to climate vulnerability. The CVM can become an essential source of information to implement this Scoping Plan and build a more resilient, just, and equitable future for all communities.

Public Health

Health Analysis Overview

This section focuses on a broader evaluation of public health and climate change. Science demonstrates that taking action to address climate change presents one of the most significant opportunities to improve public health outcomes.[244] Transitioning to clean energy and technology and improving land and ecosystem management will lead to a much healthier future. Many actions to reduce GHG emissions also have health co-benefits that can improve the health and well-being of populations across the state, as well as address climate change. This section and the accompanying Appendix G (Public Health) provide a qualitative analysis of health benefits to accompany the quantitative health analysis included in this chapter, in Appendix C (AB 197 Measure Analysis), and in Appendix H (AB 32 GHG Inventory Sector Modeling). Together the qualitative and quantitative analyses of benefits are demonstrating the many ways that climate action and health improvements go hand in hand.

Climate change can lead to a wide range of direct health impacts such as increased heat-related illnesses (i.e., heat exhaustion and heat stroke), and injuries and deaths from extreme weather events or disasters (e.g., severe storms, flooding, wildfires). Indirect impacts include:

- more air pollution-related exacerbations of cardiovascular and respiratory diseases (e.g., due to increased smog, wildfire smoke)
- increased vector-borne and fungal diseases due to changes in the distribution and geographic range of disease-carrying species (e.g., mosquitoes, ticks, fungi in dust)
- negative nutritional consequences related to decreases in agricultural food yields
- stress and mental trauma due to extreme weather-related catastrophes
- anxiety, depression, and other mental health impacts associated with gradual changes in the climate (e.g., prolonged drought or temperature shifts affecting jobs and industries) that result in unemployment and income loss

[244] Watts, N., W. N. Adger, P. Agnolucci, et al. 2015. “Health and climate change: Policy responses to protect public health.” *Lancet* 386, 1861–1914.

- residential displacement and home loss (e.g., sea level rise impacting coastal communities)

Wildfires and wildfire smoke are one area where we have already seen and expect to see even further drastic impacts on the health of Californians. According to CalFire, since 1932 the top eight largest wildfires in California have occurred in the past five years (2017–2022), with 151 deaths due directly to fires during that period.[245] Researchers estimate that wildfire smoke during fall 2020 may have led to as many as 3,000 excess deaths, with at least 95% of Californians suffering unhealthy levels of particle pollution due to wildfires in 2020.[246] Continued climate change is projected to further increase smoke exposure from wildfires through the end of the century.[247] Wildfires also create a high-risk environment for outdoor workers, including agricultural workers. While the direct medical and physical health impacts are often most noticeable, the psychological impacts can develop and persist well after the event. Estimates indicate that 20%–65% of survivors of extreme weather events have mental health issues following the event.[248]

Extreme heat, drought, and associated worsened air quality impacts are among the most serious climate-related exposures affecting the health of Californians. Numerous studies find a wide range of adverse health effects accompanying extreme heat, including heat stroke and adverse birth outcomes, and find that extreme heat can harm most body systems. Climate change exacerbates air pollution problems that cause difficulty breathing and can lead to serious illness and death in many parts of California. Increasing temperatures cause increases in ozone and other pollution concentrations, including for California's most polluted regions, and heighten health risks for the vulnerable and marginalized populations living in these areas.[249] In 2020, there were 157 ozone polluted days across Los Angeles, Orange, Riverside, and San Bernardino Counties—the most days since 1997. In addition, particulate matter exposure is a heightened problem during

[245] California Department of Forestry and Fire Protection (CAL FIRE). "Stats and Events." *Cal Fire Department of Forestry and Fire Protection*, https://www.fire.ca.gov/stats-events/.
[246] G-FEED. 2020. Indirect mortality from recent wildfires in CA. *http://www.g-feed.com/2020/09/indirect-mortality-from-recent.html*.
[247] M. D. Hurteau, A. L. Westerling, C. Wiedinmyer, and B. P. Bryant. 2014. "Projected effects of climate and development on California wildfire emissions through 2100." *Environ. Sci. Technol.* 48, 2298–2304.
[248] American Public Health Association. 2019. Addressing the Impacts of Climate Change on Mental Health and Well-Being. Policy No: 20196. *https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2020/01/13/addressing-the-impacts-of-climate-change-on-mental-health-and-well-being*.
[249] American Lung Association. State of the Air 2021. *https://www.lung.org/research/sota*.

droughts, which are expected to increase over this century.[250,251] Worse air quality leads to illnesses, emergency room visits, and hospitalizations for chronic health conditions, including chronic obstructive pulmonary disease (COPD), asthma, chronic bronchitis, and other respiratory and cardiovascular conditions, as well as increased risk for respiratory infections, which all result in greater health costs to the state.[252,253,254] These and other climate-related health impacts are discussed in more detail in Appendix G (Public Health).

Health Analysis Components

This Scoping Plan health analysis focuses on the contrast between a California that is still dependent on a fossil fuel-based economy and a California that is transitioned to a carbon-neutral, clean energy future. This qualitative analysis evaluates and demonstrates the broad range of benefits of a dramatic reduction in fossil fuels by 2045 combined with healthier ecosystem management, comparing health outcomes for a "no-action" scenario (Reference) to a "take-action" decarbonization scenario. As this is a qualitative analysis, it looks more broadly at the public health benefits of a drastic reduction in fossil fuel combustion. While this analysis provides scientific evidence for Scoping Plan benefits based on achieving carbon neutrality by 2045, it does not analyze a specific scenario.

The key areas of focus for the analysis are: heat impacts, children's health and development, economic security, food security, mobility and physical activity, urban greening, wildfires and smoke impacts, and housing affordability. For each area of focus, the analysis covers the scientific evidence and compares expected health effects between the Reference and decarbonization scenarios. This analysis looks at the major health outcomes, provides directional effects for each health outcome, and where possible provides information on the strength and scale of health impacts. Some areas include quantitative information where tools are available to measure health outcomes. While the analysis is focused on health outcomes statewide, it also includes discussion

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[250] Cvijanovic, I., B. D. Santer, C. Bonfils, et al. 2017. "Future Loss of Arctic Sea-ice Cover Could Drive a Substantial Decrease in California's Rainfall." 8 *Nat. Commun.* 1947. https://doi.org/10.1038/s41467-017-01907-4.

[251] Williams, A. P., R. Seager, J. T. Abatzoglou, B. I. Cook, J. E. Smerdon, and E. R. Cook. 2015. "Contribution of anthropogenic warming to California drought during 2012–2014." *Geophysical Research Letters* 42(16), 6819–6828.

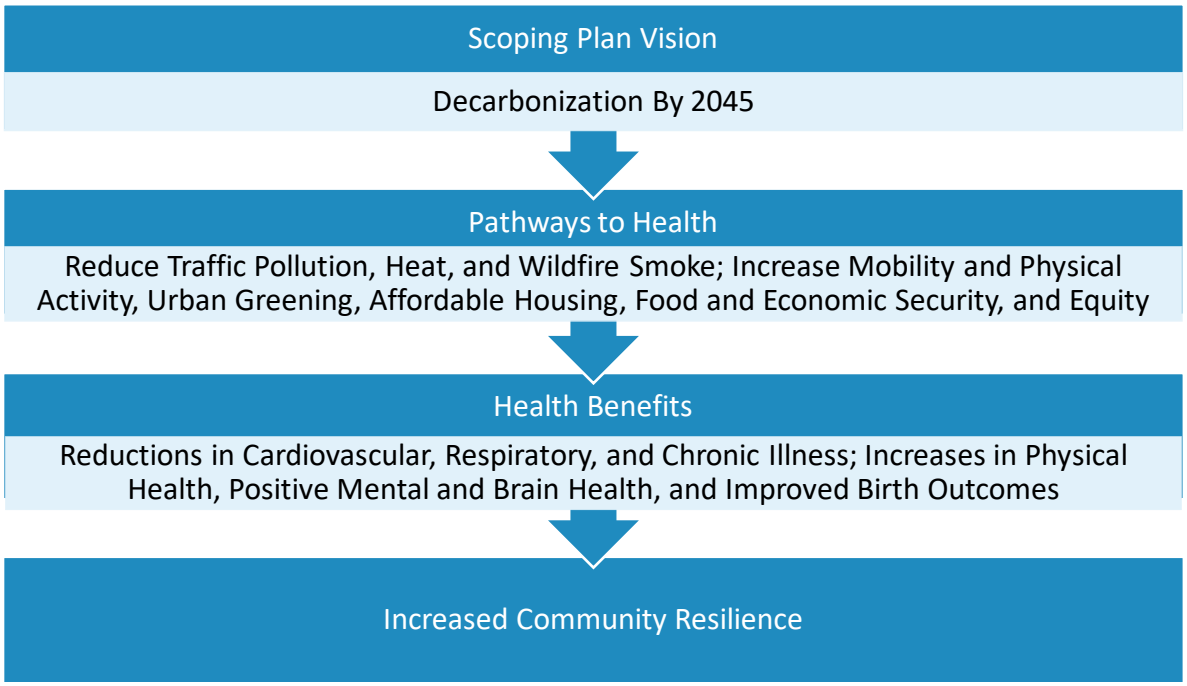
[252] Romley, J. A., A. Hackbarth, and D. P. Goldman. 2010. Cost and Health Consequences of Air Pollution in California. Santa Monica, California. RAND Corp. https://www.rand.org/pubs/research_briefs/RB9501.html.

[253] Wang, M., C. P. Aaron, J. Madrigano, E. A. Hoffman, E. Angelini, J. Yang, A. Laine, et al. 2019. "Association between long-term exposure to ambient air pollution and change in quantitatively assessed emphysema and lung function." *JAMA* 322(6), 546–556.

[254] Inserro, A. 2018. "Air Pollution Linked to Lung Infections, Especially in Young Children." *Am. J. Managed Care* (May 6). https://www.ajmc.com/view/air-pollution-linked-to-lung-infections-especially-in-young-children.

of benefits to community health and climate resilience, as well as potential inequities experienced at a community level. Figure 3-11 shows the co-benefit areas covered in this Scoping Plan and the path to health improvements and increased community resilience.

Figure 3-11: Scoping Plan outcome and the path to health improvements

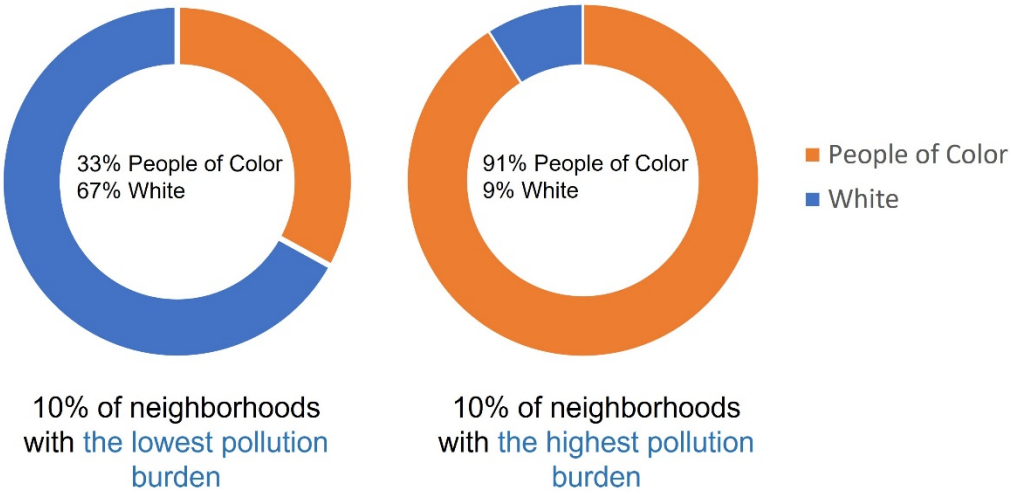


Social and Environmental Determinants of Health Inequities

Communities across the state do not experience exposure to pollution sources and the resulting effects equally. Low-income communities and communities of color (including Black, Latino and Indigenous communities) consistently experience significantly higher rates of pollution and adverse health conditions than others due to factors including historic marginalization rooted in systemic racism. As shown in Figure 3-12, the most impacted neighborhoods according to CalEnviroScreen (CES) are home to very high percentages of people of color while the least impacted neighborhoods are predominantly white. Recent findings show that Black Californians have 19% higher $PM_{2.5}$ exposure from vehicle emissions than the state average, and the census tracts with the highest $PM_{2.5}$ pollution burden from vehicle emissions have a high proportion of people of color.[255] Air pollutant emissions from mobile sources have disproportionate impacts on low-income communities and communities of color due to their proximity.[256] Diesel-fueled vehicles traveling on California's freeways and major roads expose nearby residents to pollution that is linked to lung cancer, hospitalizations and emergency department visits for chronic heart and lung disease, and premature death.[257,258] A combination of historical and social inequities are evident in communities of color disproportionately living close to freeways and other major sources of vehicle pollution. Environmental exposures and contaminants are one component of a broader set of social, economic, and environmental factors that can amplify health conditions, and the combination of all these factors can compound the health effects of individual exposures. This broader set of community factors can be referred to as "cumulative impacts." In addition, specific populations are more sensitive to pollution and face greater susceptibility. This includes young children, older adults, and individuals with existing health conditions.

[255] Reichmuth, D. 2019. *Inequitable exposure to air pollution from vehicles in California.* https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles-california-2019.
[256] CARB. 2017. *California's 2017 climate change scoping plan.* https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
[257] CARB. 2020. Overview: Diesel exhaust & health. https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health.
[258] Kagawa, J. 2002. "Health effects of diesel exhaust emissions—a mixture of air pollutants of worldwide concern." *Toxicology* 181–182:349–353.

Figure 3-12: Least and most impacted neighborhoods from CalEnviroScreen[259]



Social Determinants of Health Inequities

The physical and mental health of individuals and communities is shaped, to a great extent, by the social, economic, and environmental circumstances in which people live, work, play, and learn. According to the World Health Organization, these same circumstances—or social determinants of health—are "mostly responsible for health inequities: the unfair and avoidable differences in health status seen within and between countries." In fact, a strong body of research demonstrates that more than 50 percent of long-term health outcomes are the result of social determinants affecting an individual.[260] Race/ethnicity and socioeconomic status, for example, have been found to amplify impacts from long- and short-term environmental exposures for several health outcomes,

[259] The figure represents the top and bottom decile scoring of CalEnviroScreen census tracts for pollution burden. This chart is modified from Figure 2. Race in the Least and Most Impacted Census Tracts of CalEnviroScreen 4.0 in the Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Analysis of Race/Ethnicity and CalEnviroScreen 4.0 Scores. 2021. *https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40raceanalysisf2021.pdf*.

[260] California Department of Public Health (CDPH). 2015. *The Portrait of Promise: The California Statewide Plan to Promote Health and Mental Health Equity.* A Report to the Legislature and the People of California by the Office of Health Equity. Sacramento, California. California Department of Public Health, Office of Health Equity.

such as mortality and birth outcomes.[261,262,263,264] Social factors combine in low-income communities and communities of color to create levels of toxic chronic stress and limit opportunities for healthy food and healthy lifestyles. Social factors also can cause health disparities through psychosocial pathways such as discrimination and social exclusion.[265] While the importance of social determinants is well known, measuring the specific and cumulative impacts of social determinants is challenging.

There are several important tools to evaluate and map cumulative impacts and factors contributing to the results of historical practices such as redlining, and these tools have been used for air quality and climate planning, community protection, and investments. CalEnviroScreen is a tool that maps cumulative pollution burdens and vulnerabilities on a statewide basis and ranks census tracts based on environmental, exposure, population, and socioeconomic indicators. An analysis using CES shows a direct, persistent relationship between exposure to environmental burdens and socioeconomic and health vulnerabilities affecting communities of color and historical redlining practices. OEHHA has evaluated health impacts of certain climate change policies on disadvantaged communities and communities of color utilizing CES rankings.[266] The Healthy Places Index (HPI) maps indicators that affect life expectancy on a statewide basis. In the future, these and other tools can be helpful to prioritizing investments and informing implementation efforts for GHG emission reductions policies.

Environmental Determinants of Health Inequities

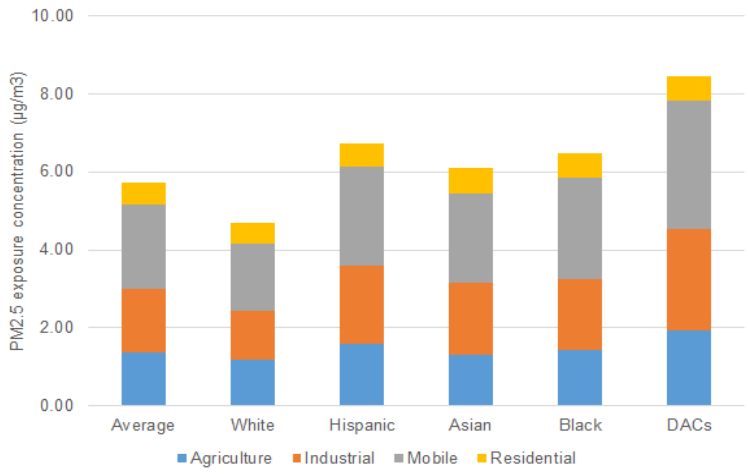
Communities with large percentages of Black and other socially vulnerable and marginalized groups are disproportionately located near pollution sources, such as traffic

[261] O'Neill, M. S., M. Jerrett, I. Kawachi, J. I. Levy, A. J. Cohen, N. Gouveia, et al. 2003. "Health, wealth, and air pollution: Advancing theory and methods." *Environ Health Perspect.* 111 (16): 1861–70.
[262] Ponce, N. A., K. J. Hoggatt, M. Wilhelm, and B. Ritz. 2005. "Preterm birth: The interaction of traffic-related air pollution with economic hardship in Los Angeles neighborhoods." *Am J Epidemiol.* 162 (2): 140–8.
[263] Morello-Frosch, R., B. Jesdale, J. Sadd, and M. Pastor. 2010. "Ambient air pollution exposure and full-term birth weight in California." *Environ Health.* 9: 44.
[264] Finkelstein, M. M., M. Jerrett, P. DeLuca, N. Finkelstein, D. K. Verma, K. Chapman, et al. 2003. "Relation between income, air pollution, and mortality: A cohort study." *CMAJ.* 169 (5): 397–402.
[265] Clougherty, J., and L. Kubzansky. 2009. "A framework for examining social stress and susceptibility in air pollution and respiratory health." *Environ Health Perspect.* 117 (9): 1351–8.
[266] OEHHA. 2022. *Impacts of Greenhouse Gas Emission Limits Within Disadvantaged Communities.* https://oehha.ca.gov/media/downloads/environmental-justice//impactsofghgpoliciesreport020322.pdf.

and freight facilities, industrial facilities, and hazardous waste sites.[267,268,269,270] Research shows large disparities in exposure to pollution between white and non-white populations in California, and between low-income and communities of color (Figure 3-13). The research also shows Black and Latino populations experience significantly greater air pollution impacts than white populations in California.[271] Additionally, Native Americans are disproportionately impacted by air pollution with high rates of exposure to industrial, diesel, and residential pollution sources and higher rates of diseases linked to air pollution.[272, 273]

[267] Mohai. P., P. M. Lanz, J. Morenoff, J. S. House, and R. P. Mero. 2009. "Racial and socioeconomic disparities in residential proximity to polluting industrial facilities: Evidence from the Americans' Changing Lives Study." *Am J Public Health.* 99 (Suppl 3): S649–56.
[268] Mohai, P., and R. Saha. 2007. "Racial inequality in the distribution of hazardous waste: A national-level reassessment." *Soc Probl.* 54 (3): 343–70.
[269] Morello-Frosch, R., M. Pastor, C. Porras, and J. Sadd. 2002. "Environmental justice and regional inequality in southern California: Implications for future research." *Environ Health Perspect.* 110 (Suppl 2): 149–54.
[270] Gunier, R. B., A. Hertz, J. von Behren, and P. Reynolds. 2003. "Traffic density in California: Socioeconomic and ethnic differences among potentially exposed children. *J Expo Anal Environ Epidemiol.* 13 (3): 240–6.
[271] Apte, J. S., S. E. Chambliss, C. W. Tessum, and J. D. Marshall. 2019. *A Method to Prioritize Sources for Reducing High $PM_{2.5}$ Exposures in Environmental Justice Communities in California.* CARB Research Contract Number 17RD006.
[272] Indigenous People and Air Pollution in the United States. A Report from the National Tribal Air Association and Moms Clean Air Force. 2021. *https://7vv611.a2cdn1.secureserver.net/wp-content/uploads/2021/04/indigenousairpollution_041421.pdf*
[273] National Tribal Air Association. 2022. Status of Tribal Air Report. Pg. 66. *https://7vv611.a2cdn1.secureserver.net/wp-content/uploads/2022/10/2022-NTAA-Status-of-Tribal-Air-Report.pdf*.

Figure 3-13: Top sources of $PM_{2.5}$ and their contribution to $PM_{2.5}$ exposures by race and in disadvantaged communities



These disparities in exposure to pollution sources generate health inequities. Communities located near major roadways are at increased risk of asthma attacks and other respiratory and cardiac effects. Studies consistently show that mobile source pollution exposure near major roadways or freight sources contributes to and exacerbates asthma, impairs lung function, and increases cardiovascular mortality.[274] The exposure to mixtures of gaseous and particulate pollutants in mobile sources (including PM, NO_x, and benzene) is associated with higher rates of heart attacks, strokes, lung cancer, autism, and dementia.[275]

Environmental hazards found in communities also can include exposures to toxic substances and emissions, as well as occupational exposures. Due to historical inequities, under-resourced communities and communities of color are often located close to sources of toxic pollution, including chrome platers; metal recycling facilities; oil and gas operations; agricultural burning; railyards; facilities transporting, managing, or disposing of hazardous waste; and areas impacted by pesticides, among others. Some populations may be at increased risk of exposure to pollutants, both at work and home.

Children are more susceptible to environmental pollutants for many reasons, including the ongoing development of their nervous, immune, digestive, and other bodily systems. Moreover, children eat more food, drink more fluids, and breathe more air relative to their

[274] U.S. Environmental Protection Agency website. How Mobile Source Pollution Effects Your Health. https://www.epa.gov/mobile-source-pollution/how-mobile-source-pollution-affects-your-health.
[275] USC Environmental Health Centers. 2018. Living Near Busy Roads or Traffic Pollution. https://envhealthcenters.usc.edu/wp-content/uploads/2016/10/living-near-bus_19696172.pdf.

body weight, as compared to adults.[276] Exposure to high levels of air pollutants, including indoor air pollutants, increases the risk of respiratory infections, heart disease, and asthma.[277] Children living in low-income communities near industrial operations, rail yards, and heavily trafficked freeways and streets in urban areas are at especially high risk of chronic respiratory conditions. Black children are four times more likely to be hospitalized for asthma compared with white children, and urban Black and Latino children are two to six times more likely to die from asthma than white children.[278] Native American children also experience more impacts from asthma and Native American children, along with Black children, have the highest prevalence of asthma.[279]

For older adults, increased vulnerability is linked to respiratory, cardiovascular, and immune systems weakened by aging.[280] Preexisting health conditions interact with environmental pollutants to enhance risks of adverse health outcomes.[281,282] The recent COVID-19 pandemic has highlighted the heightened vulnerability of older adults as well as communities of color to respiratory disease, as hospital admissions and mortality data linked to COVID-19 cases for these groups have been higher than other groups. Research has also underscored the important link between COVID-19 mortality and morbidity and air pollution, demonstrating significantly higher mortality and morbidity for COVID-19 in areas of elevated $PM_{2.5}$ pollution.

Climate Vulnerabilities

Climate change is expected to exacerbate the existing disparities of health conditions and worsen climate vulnerability, which is the degree to which natural systems and people or

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[276] Blaisdell, R. J. Air Toxics Hot Spots Program Risk Assessment Guidelines. 2012. Technical Support Document for Exposure Assessment and Stochastic Analysis. Oakland, California: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. August.
[277] Woodruff, T. J., D. A. Axelrad, A. D. Kyle, O. Nweke, and G. G. Miller. 2003. *America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illness.* 2nd ed. Washington, D.C.: United States Environmental Protection Agency. February.
[278] California Department of Public Health. Asthma Inequities in California Children. 2021. https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHIB/CPE/CDPH%20Document%20Library/CA_Asthma_Inequities_Children_2021-Infographic.pdf.
[279] Meng, Y., S. H. Babey, T. A. Hastert, and E. Brown. 2007. California's Racial and Ethnic Minorities More Adversely Affected by Asthma. UCLA: Center for Health Policy Research. Retrieved from https://escholarship.org/uc/item/4k45v3xt.
[280] Sandström, T., A. J. Frew, M. Svartengren, and G. Viegi. 2003. "The need for a focus on air pollution research in the elderly." *Eur Respir J Suppl.* 40: 92s–5s.
[281] Zanobetti, A., and J. Schwartz. 2001. "Are diabetics more susceptible to the health effects of airborne particles?" *Am J Respir Crit Care Med.* 164 (5): 831–3. https://www.atsjournals.org/doi/pdf/10.1164/ajrccm.164.5.2012039.
[282] Zanobetti, A., J. Schwartz, and D. Gold. 2000. "Are there sensitive subgroups for the effects of airborne particles?" *Environ Health Perspect.* 108 (9): 841–5.

communities are at risk of experiencing the negative impacts of climate change.[283] A report from the California Climate Change Center warned that the impacts of climate change will likely create especially heavy burdens on low-income and other vulnerable populations: "*Without proactive policies to address these equity concerns, climate change will likely reinforce and amplify current as well as future socioeconomic disparities, leaving low-income, minority, and politically marginalized groups with fewer economic opportunities and more environmental and health burdens*."[284]

In the U.S. Environmental Protection Agency's "Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts,"[285] investigators analyzed risks of six primary climate change impacts disproportionately affecting communities across income, educational attainment, race/ethnicity, and age groups. Four socially vulnerable populations—low income, communities of color, no high school diploma, and age 65 and older—were identified as having a higher likelihood of experiencing the greatest impacts of a changing climate (according to the projected 2°C of global warming or 50 centimeters of global sea level rise). Disproportionate impacts were projected for climate events, including air quality, extreme temperature, coastal flooding, and other impacts, leading to increased risk of health and other adverse outcomes. The study projected significant health impacts for low-income communities, certain racial and ethnic subgroups, and those with lower educational attainment.

Several climate vulnerability tools have been developed or are under development to better understand and map areas at higher risk of climate impacts. The Climate Change and Health Vulnerability Indicators (CCHVIs) for California helps state and local health officials prepare for and reduce adverse health impacts due to a changing climate.[286] For example, Los Angeles County shows higher than state average climate vulnerability overall, particularly for those who are linguistically isolated (more than twice the state average).

In summary, there are many environmental, social, individual, and economic factors affecting health and equity in California and contributing to worsening health outcomes from climate change impacts. This section and Appendix G (Public Health) reference a substantial and growing body of research documenting the different social and

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[283] OPR. 2018. Defining Vulnerable Communities in the Context of Climate Adaptation. *https://opr.ca.gov/docs/20180723-Vulnerable_Communities.pdf*.

[284] Shonkoff, S., R. Morello-Frosch, M. Pastor, and J. Sadd. 2011. "The climate gap: environmental health and equity implications of climate change and mitigation policies in California—A review of the literature." *Climatic Change* 109 (Suppl 1): S485–S503.

[285] U.S. EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency. EPA 430-R-21-003.

[286] CDPH. 2022. Climate Change and Health Vulnerability Indicators for California. California Department of Public Health. *https://www.cdph.ca.gov/Programs/OHE/Pages/CC-Health-Vulnerability-Indicators.aspx*.

environmental factors affecting health outcomes and the many groups that are vulnerable to increased effects or that experience health inequities in California (see Table 3-13).

Table 3-13: Examples of vulnerable groups due to socioeconomic, environmental, developmental, and climate change factors

Examples of Vulnerable Groups Due to Socioeconomic, Environmental, Developmental, and Climate Change Factors		
Older People	People with Existing Chronic Illness	People Impacted Due to Working Conditions
Tribal Groups	Infants and Children	Low-Income People
People with Disabilities	People Experiencing Homelessness	Pregnant People
Communities of Color	Marginalized People	Immigrants/Refugees
People with Less Educational Options	Linguistically Isolated Households	People Impacted Due to Poor Housing Conditions

Summary of the Qualitative Health Analysis

CARB has developed a detailed health analysis that covers eight social and environmental co-benefit areas that impact public health (listed below). These co-benefit areas were selected due to ongoing research in these areas as well as discussion in a public workshop on climate change and health impacts held in summer 2018. For each social and environmental area, the analysis includes:

- a discussion of health impacts and disparities,
- key health metrics or epidemiological research on this topic,
- a discussion of how these areas would be affected by "no-action" (i.e., Reference) scenario compared to a "take-action" (i.e., Scoping Plan) scenario
- a discussion of where there are actions to consider for further success, and
- the types of mitigation actions that can help reduce or eliminate disparities and promote greater health equity and resilience.

All co-benefit areas are interconnected, and pursuing benefits in all areas has the potential to multiply positive results and further support building community resilience. *Community resilience* is the ability of a community to reduce harm and maintain an acceptable quality of life in the face of climate-induced stresses, which vary depending on that community's circumstances and location. Below is a brief description of the areas evaluated for public health co-benefits. The specific health outcomes impacted by each

area, as well as the directional health benefits, are included in the Summary of Health Benefits section of the chapter and covered in more detail in Appendix G (Public Health).

Heat Impacts

Globally, increased GHG concentrations in the atmosphere are causing a continuing increase of the planet's average temperature. California temperatures have risen since records began in 1895, and the rate of increase is accelerating. Recent heat waves have broken heat records and caused serious illness across the state, and these events are becoming more frequent. Heat waves have a particularly high impact in Southern California, where they have become more intense and longer lasting. In the past two years, Los Angeles recorded 121°F, and the Coachella Valley had its hottest year ever, with temperatures reaching 123°F. Heat island effects in urbanized areas can elevate heat effects and disproportionately affect low-income communities and communities of color. Heat events exacerbate respiratory and cardiac illness and cause emergency room visits to soar. Strategies that reduce the impacts of heat exposure promote improved health outcomes.

Wildfires and Smoke

California's NWL cover more than 90 percent of California and include rangeland, forests, woodlands, grasslands, and urban green space. They provide biodiversity and ecosystem benefits, including their ability to sequester carbon from the atmosphere. Protecting and managing California's forests and other natural lands and maintaining their ecosystem health are key practices for maximizing GHG benefits and minimizing negative climate change impacts. Vegetation plays an important role in storing carbon; however, it can also release CO_2 back into the atmosphere when it dies or is burned by fires. California's wildfires are getting worse with increased fire risks, higher frequency of occurrence, larger burn areas, more costly damage, and a longer fire season due to climate change. Strategies that promote healthy ecosystem management of natural and working lands and increased urban greening promote improved health outcomes. Healthy ecosystems provide many health and environmental benefits and can maximize carbon sequestration.

Children's Health and Development

There are a wide range of interconnected environmental, social, biological, and community factors associated with climate change that are adversely affecting children's health. This section focuses on air pollution and near-roadway or traffic pollution as environmental impacts that have a profound effect on children's health. Children's bodies and lungs are still developing, and they take in more air per body weight than adults do. Many low-income communities and communities of color in California experience disproportionately high levels of air pollution, as well as high levels of traffic and freight that impact children. This excess exposure harms children's development and

predisposes them to increased risk of illness throughout their lives. Strategies that reduce air pollution and traffic emissions promote improved health outcomes for children.

Economic Security

Climate change is expected to result in serious adverse socioeconomic effects across many sectors. Economic factors, such as income inequality (among geographic regions), poverty, wealth, debt, unemployment rate, and job security are among the strongest determinants of health. Along the entire income spectrum, higher income is associated with increased life expectancy and improved health outcomes in the United States. Additionally, economic insecurity and negative health impacts are more pronounced in low-income communities and communities of color. Economic strategies, such as the promotion of clean energy and other green jobs and investments in low-income communities and communities of color, and promoting a transition to high road jobs in economic sectors tied to the current fossil fuel economy, can promote improved health outcomes.[287]

Food Security

The food system is under pressure from numerous factors, and climate change is a key concern. Climate change can affect food production and agricultural yield, impact culturally significant plants and animals for Native American tribes, and exacerbate factors that limit food availability, such as supply chain disruption. Food security is defined as stable access to affordable, sufficient food for an active, healthy life. Many Californians routinely experience food insecurity, and while that impacts Californians of all races and groups, low-income communities and communities of color and children are disproportionately affected by food insecurity. Many Native Americans depend on resources from the land, such as animals and plants for consumption and cultural practices. Strategies that promote sustainable agriculture, access to healthy foods, and reduced organic food waste promote improved health outcomes.

Mobility and Physical Activity

Physical activity is one of the most important factors for a healthy lifestyle, and lack of activity increases the risk of chronic illness and premature death. Research shows that regular physical activity improves health in people of all ages by improving heart and lung

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[287] According to the California Labor and Workforce Development Agency's High Road Training Partnership program, high road jobs are considered "Quality jobs [that] provide family-sustaining wages, health benefits, a pension, worker advancement opportunities, and collective worker input and are stable, predictable, safe and free of discrimination." *https://cwdb.ca.gov/wp-content/uploads/sites/43/2020/08/OneSheet_Job-Quality_ACCESSIBLE.pdf*.

function, muscle fitness, mental health and brain function, and sleep quality. A sedentary lifestyle contributes to chronic illnesses, including obesity, heart disease, and Type 2 diabetes among other chronic illnesses. Promoting community design that supports sustainable patterns of land use and transportation enables active transportation choices like walking, biking, and public transit over driving, and can significantly increase physical activity, leading to many valuable health benefits.

Affordable Housing

Housing is an important social determinant of health. The stability of housing, housing quality, conditions inside and outside the home, the cost of housing, and the environmental and social characteristics of the places people live all affect health (including energy efficiency and insulation, cooler building material, tree canopy, home size). Housing affordability is a key factor, and this section highlights how housing affordability supports not only improved health but also more sustainable land use and transportation patterns. A lack of affordable housing is increasing commute distances for low-income renters and creating health burdens. Strategies that support sustainable transportation and housing patterns, together with increased housing affordability, promote improved health outcomes.

Urban Greening

Urban Greening is well recognized as an important amenity, but the inherent health benefits are not always well understood. Under-resourced and vulnerable areas consistently show a lack of urban greening and higher percentages of concrete, asphalt, and impervious surfaces. Under-resourced communities have a greater proportion of concrete and heat-trapping surfaces and a lower amount of tree cover in the neighborhoods in which they live. Areas with reduced urban greening have the potential to create areas of higher temperatures as heat is reflected from pavements and buildings. By contrast, increasing urban greening can provide air pollution buffers and promote physical activity. Strategies that preserve and create urban parks, green space, natural infrastructure, and sustainable agricultural practices support improved physical and mental health outcomes.

No Action Scenario (Reference)

In a no-action scenario, California would remain dependent on fossil fuels and other GHG emitting technologies. Fossil-fuel powered mobile sources including cars, trucks, trains, tractors, and a myriad of other on-road and off-road vehicles and equipment are the largest source of criteria pollutants and toxic air contaminants that directly affect

community health and contribute the largest portion of GHG emissions.[288] Other key GHG emission sources include buildings, natural and working lands, and power production and industry. The no-action scenario reflects a continued reliance on fossil fuels in mobile and stationary sectors, including buildings. The continued production and use of fossil fuels; ongoing dependence on gasoline and diesel cars, trucks, buses, and equipment; continued releases of short-lived climate pollutants; and decreased emphasis on forest and ecosystem health will impact communities by reducing climate resilience and health benefits. Green space will likely remain at the same levels or degrade, and urban heat islands will likely increase. With continued growth of vehicle miles traveled, physical activity and the accompanying health benefits will not increase.

Exposure to wildfire smoke will increase, and air quality is expected to worsen as rising temperatures will increase levels of harmful air pollution. Jobs and economic security will be affected by the continuing potential for price spikes in fossil fuels, impacts to the economy from climate change, and fewer job opportunities in green technologies such as solar and electric vehicles. Food security in California will decrease due to the effects of accelerating climate impacts to agriculture; and without increased recovery of organic waste, including food products, food security will continue to decline under a no action scenario. All these impacts can be linked to worse health outcomes. Adverse health impacts are often most felt by Black, Latino, Native American, and other people of color and in low-income communities. These groups are affected more intensely by the physical stress of environmental pollution, social inequities, and the psychological stress of extreme weather events and food and economic insecurity.

Take Action Scenario

In the Take Action scenario, California will drastically reduce reliance on fossil fuels for motor vehicles, freight, buildings, electricity, or other sectors. This scenario is not a specific scenario within this Scoping Plan but examines the broad outcomes of actions to achieve carbon neutrality in 2045. Implementation of this Scoping Plan would achieve a transition to ZEVs, with 100% sales of light-duty ZEVs by 2035 and 100% sales of zero emission trucks by 2040, along with 30% VMT reductions below 2019 levels by 2045. State and local action that supports sustainable land use and transportation patterns and enables more transit and active transportation will lead to substantial health benefits from physical activity, including reduced illness and deaths.

[288] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020.* *https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf*.

The economic benefits of improved health through active transportation can be modeled using the Healthy Mobility Options Tool (HMOT).[289] In order to demonstrate the important health and economic benefits of VMT reduction, CARB and CDPH used the HMOT to analyze an illustrative trip reduction scenario for 2050 from the California Transportation Plan (CTP). The CTP has a goal of increasing active modes of travel and transit from the current level of 13 percent to a level of 23 percent of all travel trips. While the CTP goal of 23 percent for active modes of travel is not a VMT reduction target, the scenario increases active transportation through a mix of changes in land use planning for increased transportation options, including increases in biking, walking, and transit use, and it helps to show the health benefits of increased active transportation. By achieving the CTP 2050 goals, nearly 8,000 deaths would be avoided in 2050 alone (see Figure 3-14), along with significant reductions in chronic diseases. Achieving this would rank among the top public health accomplishments (see Appendix G [Public Health] for additional modeling results and detailed discussion).

The dramatic reduction in fossil fuel combustion, combined with reductions in VMT and freight and traffic emissions projected in this Scoping Plan will significantly reduce air pollution and its associated health impacts on a statewide basis and in communities near freight sources. Coordinated action strategies will emphasize natural and working lands management changes, including healthy forests, increased vegetative cover, and increased organic farming. Wildfire smoke exposure will reduce significantly with healthy ecosystem management strategies. Since many communities in California are disproportionately impacted by high levels of traffic pollution, the reduction in petroleum fueled vehicles will reduce the additional impacts of living or going to school near historically highly polluting sources. Indoor air quality is also likely to improve through a shift to non-fossil fuel appliances. Concerted state and local action to support sustainable land use and transportation patterns can enable more active transportation with health benefits from physical activity.

[289] ITHIM California. 2020. Transportation Planning for Health, Equity, and Climate Change. *https://skylab.cdph.ca.gov/HealthyMobilityOptionTool-ITHIM/*.

Figure 3-14: Quantified health benefits of active transportation from increased physical activity

*Calculated by the Healthy Mobility Options Tool, active transportation (including walking, rolling, cycling, and taking public transit) from the California Transportation Plan 2050 compared to business as usual for 2050.

Overall community resilience is expected to increase as physical activity and green space increases—potentially decreasing urban heat islands. Efforts to support VMT reduction will include coordination across state agencies on affordable housing measures. Reduced fossil fuel dependence will reduce economic pressure from wildfires, droughts, and price spikes in fossil fuels, especially as more jurisdictions implement plans with similar actions. Investment in sustainable agriculture, healthy forests, urban greening, and clean energy technologies will add sustainable jobs and further promote economic security. More sustainable agriculture and food recovery efforts will add to food security. All these impacts can be linked to wide ranging health benefits, including positive respiratory and cardiovascular effects, healthier birth and brain outcomes, improved mental health indicators, improved life expectancy, reductions in chronic illness and cancers, improved children's health and development, reduced depression, and other benefits. The magnitude of the possible co-benefits is extremely large, especially in areas that are currently the most affected.

Summary of Health Benefits

Below, Tables 3-14 and 3-15 show overall summaries of the directional benefits by co-benefit area estimated for this Scoping Plan. The supporting epidemiological studies used for qualitative or quantitative analysis of each co-benefit area are included in Appendix G (Public Health). Another section of Chapter 3, together with Appendix C (AB 197 Measure Analysis) and Appendix H (AB 32 GHG Inventory Sector Modeling), also includes the quantitative analysis of air pollution related health impacts, including recently added health endpoints for CARB's ongoing analysis.

Table 3-14: Scoping Plan directional benefits for health co-benefit areas (heat, affordable housing, food security, economic security, and urban greening)

Health Co-benefit Areas*					
Quantitative vs. Qualitative	**Reduced Heat Impacts**	**Increased Affordable Housing**	**Increased Food Security**	**Increased Economic Security**	**Increased Urban Greening**
Research was used for Qualitative Analysis	↓ Mortality ↓ Emergency Room Visits for cardiovascular and respiratory causes and intestinal infections ↓Hospitalization for cardiovascular, respiratory causes ↓ Preterm Birth ↓ Mental Illness	↓ Infectious Disease ↓ Chronic Illness ↓ Asthma ↓ Injuries ↓ Mental Illness ↑ Children's Performance in Schools ↑ Children's Health ↓ Children's Behavioral Problems	↓ Mental Illness ↓ Iron Deficiency ↓ Chronic Diseases ↑ Life Expectancy ↓ Children's Mental Illness ↓ Children's Cognitive Problems ↓ Children's Behavioral Health Problems ↓ Children's Iron Deficiency ↓ Children's Oral Health Problems	↑ Life Expectancy ↑ Health Status ↑ Mental Health	↓ Mortality ↓ Asthma Prevalence ↓ Depression ↓ Adverse Birth Outcomes including low birth weight and small for gestational age ↑ Life Expectancy

*See Appendix G (Public Health) for a table with references to research for each health outcome listed.

Table 3-15: Scoping Plan directional benefits for health co-benefit areas (traffic pollution, wildfire, and active transportation)

Health Co-benefit Areas*			
Quantitative vs. Qualitative	**Reduced Traffic Pollution**	**Reduced Wildfire Smoke**	**Increased Active Transportation**
Research was used for Quantitative Analysis	↓ Children's Respiratory Outcomes, Hospital Admissions ↓ Children's Respiratory Outcomes, Emergency Room Visits ↓ Children's Asthma Onset ↓ Children's Asthma Symptoms	↓ All-Cause Mortality ↓ Asthma, Hospital Admissions ↓ COPD, Hospital Admissions ↓ All Respiratory Outcomes, Hospital Admissions ↓ Asthma, Emergency Room Visits ↓ All Respiratory Outcomes, Emergency Room Visits ↓ All Cardiac Outcomes, Emergency Room Visits	↓ Cardiovascular Diseases ↓ Colon Cancer ↓ Breast Cancer ↓ Diabetes ↓ Dementia ↓ Lung Cancer ↓ Respiratory Disease ↓ Depression ↑ Traffic Accidents
Research was used for Qualitative Analysis	↑ Children's Lung Function Growth ↓ Children's Bronchitic Symptoms ↓ Children's Impaired Cognitive Development ↓ Children's Adverse Birth Outcomes, including low birth weight and preterm birth		

*See Appendix G (Public Health) for a table with references to research for each health outcome listed.

In summary, the qualitative health analysis of the No-Action versus Take-Action scenarios for this Scoping Plan shows an overwhelming benefit for the state by taking action to move forward to carbon neutrality while continuing efforts to increase health equity and resilience in individual communities. Taking action can improve physical and mental health for adults and children, reduce a range of chronic illnesses, and promote improvements in life expectancy. Development and implementation of actions to achieve the outcomes called for in this Scoping Plan should consider how to engage affected communities in implementation, address the existing health and opportunity gaps, and pursue equitable implementation statewide and locally. This Scoping Plan deployment of clean technology and fuels, together with improved land management, will reduce GHGs and air pollution and create more resilient communities that are better able to prepare for and recover from extreme climate events.

Environmental Analysis

In May 2022, CARB, as the lead agency for the Scoping Plan, released for public review the Draft Environmental Analysis (Draft EA) for this Scoping Plan; it assessed the potential environmental impacts of implementing the Scoping Plan. CARB circulated the Draft EA for public review and comment for a period of 45 days that began on May 10, 2022, and ended on June 24, 2022. CARB held a public hearing on June 23, 2022 to provide the opportunity for public comment. During the review period, written and oral comments were received on the Draft EA. CARB reviewed the comments to identify environmental topics and began preparation of responses to those comments.

After the end of the Draft EA public review period, CARB identified potential revisions to certain aspects of this Scoping Plan that merit revisions to the project description. This new information results from, among other things, revisions to the project description regarding energy sector goals (including offshore wind), revised carbon removal targets, and additional strategies for natural and working lands. CARB released a Recirculated Draft EA for a written public comment period that started September 9, 2022, and ended on October 24, 2022. See Chapter 2 of the Recirculated Draft EA[290] for further information regarding the changes. The Recirculated Draft EA assesses the potential for significant adverse and beneficial environmental impacts associated with all proposed actions in this Scoping Plan, and provides a programmatic environmental analysis of the reasonably foreseeable compliance responses that could result from implementation of the Scoping

[290] CARB. 2022. Recirculated Draft EA. *https://ww2.arb.ca.gov/sites/default/files/2022-09/2022-draft-sp-appendix-b-draft-ea-recirc.pdf*.

Plan.[291] The Recirculated Draft EA concluded implementation of this Scoping Plan could result in the following:

- Beneficial impacts to: air quality (long-term operational-related) and GHG emissions (short-term construction-related and long-term operational-related)
- Less than significant impacts to: energy demand, mineral resources, population and housing, public services, recreation (short-term construction-related), and wildfire (short-term construction-related)
- Potentially significant and unavoidable adverse impacts to: aesthetics, agriculture and forest resources, air quality (construction-related and operational odors), biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, recreation (long-term operational-related), transportation and traffic, tribal cultural resources, utilities and service systems, and wildfire (long-term operational-related

Before the public meeting at which the Board will consider this Scoping Plan Update, CARB will publish the Final EA as Appendix B (Final Environmental Analysis) to this Scoping Plan, along with written responses to timely submitted comments raising significant environmental issues received on the Draft EA and the Recirculated Draft EA, which will be presented to the Board for consideration.

[291] The Recirculated Draft EA is available at *https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents*.

Chapter 4: Key Sectors

Chapter 4 provides an overview of the major energy sources and technology in use today, and of alternative clean technology and fuels to support decarbonization based on the latest information available. Every sector of the economy will need to begin to transition in this decade to meet our GHG reduction goals and achieve carbon neutrality no later than 2045. AB 32 requires climate change mitigation policies to be considered in the context of the sector's contribution to the state's total GHG emissions. The transportation, electricity (in-state and imported), and industrial sectors are the largest contributors of GHGs in the state and present the largest opportunities for GHG reductions. Actions to reduce fossil fuel combustion in these sectors also can provide critical air pollution reductions in low-income communities and communities of color, which are often located adjacent to these sources. A carbon neutrality framework also elevates the role of CO_2 removal through natural and working lands and mechanical capture and storage. Actions that support energy efficiency, reduced VMT, alternative fuels, and renewable power also can provide benefits by reducing both criteria and toxic air pollutants.

What sets this plan apart from previous Scoping Plans is the focus on the accelerated rate of deployment of clean technology and energy within every sector. As a result, specific actions, including accelerated rates of deployment of clean technology and fuels identified within this Scoping Plan, will need to be translated into both new and amended regulations, policies, and incentive programs. State agencies will need to evaluate current authority to align existing policies or develop new ones to achieve outcomes called for in this Scoping Plan. Legislative support may be needed in some cases to ensure authority and funding is sufficient to ensure this Scoping Plan is translatable to action on the ground. Most regulations, or change to existing regulations, ultimately considered by the Board or other state agencies for adoption will be subject to administrative procedure requirements. Accordingly, they must rely on specific subsequent supporting analysis and extensive public processes and consultations with interested tribes to develop and identify appropriate proposals for effective implementation. For example, any proposal to strengthen the LCFS regulations through amendments increasing the stringency of the carbon intensity (CI) targets would be considered on the basis of a public process, including workshops, and focused environmental, economic, and public health analyses.

Policies that ensure economy-wide investment or program decisions that incorporate consideration of GHG emissions are particularly important. As we pursue GHG reduction targets, we must acknowledge the manner in which built and natural environments are connected, how changes in one may impact the other, and how policy choices in one sector can and do impact other sectors. For example, fostering more compact, transportation-efficient development in infill areas and increasing transportation choices with the goal of reducing VMT not only reduces demand for transportation fuel but also requires less energy for buildings and helps to conserve natural and working lands that

sequester carbon. Therefore, the multiple and often interwoven actions that reduce VMT both reduce emissions from the transportation sector and support reductions needed in other sectors.

Legislation, such as SB 350[292] (De León and Leno, Chapter 457, Statutes of 2015), has recognized the need for CARB, the CEC, and the CPUC to work together to ensure the state's energy and climate goals are integrated in procurement decisions by load serving entities as part of Integrated Resource Plans. Moving forward, it is especially critical that similar approaches are adopted to break down silos across state agencies to ensure policies and programs are aligned with multiple state priorities outlined in this plan. Finally, supportive legislative direction, such as SB 905 that requires CARB to create the Carbon Capture, Removal, Utilization, and Storage Program, may also benefit emerging areas of policy to provide express agency authority and roles for these nascent efforts, including streamlining of permitting, while ensuring that protections for communities are in place.

Unlike previous Scoping Plans that separated out individual economic sectors, this Scoping Plan approaches decarbonization from two perspectives: (1) managing a phasedown of existing energy sources and technology and (2) ramping up, developing, and deploying alternative clean energy sources and technology over time. This approach supports a more comprehensive consideration of our energy infrastructure, the ability to repurpose existing assets, and the need to build new assets. It also provides multiple metrics beyond just the annual AB 32 GHG Inventory to better enable tracking progress. For example, it clearly demonstrates the production and distribution rates of specific types of clean energy, such as adding 4.3 GW of utility solar and 2.5 GW of storage year-over-year between now and 2035 to be on track to achieve carbon neutrality no later than 2045, and does the same for technology deployment, such as 11 million ZEVs in 2035.

The sections below include key actions to support success in the necessary transition away from fossil combustion, which is an overriding goal of this plan. The wide array of complementary and supporting actions being contemplated or to be undertaken across state government are detailed here. The broad view of actions described in this chapter thus provides context for the specific deployment of clean technology and fuels identified in the Scoping Plan Scenario described in Chapter 2. Actions identified in this Scoping Plan are based on currently known options and the latest science. As part of future Scoping Plan updates, additional clean technology and fuels may be identified and added to the mix of needed tools to continue to reduce the state's GHG emissions, support air quality co-benefits, and remove carbon from the atmosphere.

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[292] California Air Resources Board. SB 350 Electricity Sector Greenhouse Gas Planning Targets. *https://ww2.arb.ca.gov/our-work/programs/sb350*.

Transportation Sustainability

The transportation sector has long relied on liquid petroleum fuels as the primary energy source for internal combustion engine (ICE) vehicles, including cars, trucks, locomotives, marine equipment, and aircraft. Combustion of fossil fuels in vehicles emits significant amounts of GHGs, criteria pollutants, and toxic air contaminants. In 2019,[293] the transportation sector accounted for approximately 50 percent of statewide GHG emissions[294] and thus was by far the single largest source of carbon pollution in the state. In addition, the transportation sector accounted for over 80 percent of statewide NOx emissions and 30% of fine particulate matter emissions, including toxic diesel particulate matter.[295]

Communities adjacent to congested roadways, including ports and distribution centers, are exposed to the highest concentration of toxic pollutants from vehicles and equipment consuming fossil fuels, leading to a number of demonstrated health impacts such as respiratory illnesses, higher likelihood of cancer development, and premature death. In addition, communities located near oil extraction operations or crude oil refineries often experience higher exposure to poor air quality. While CARB's programs, along with local action, have made substantial progress over the past few decades, it is clear that California must transition away from fossil fuels to zero-emission technologies with all possible speed and pursue policies that result in less driving, in order to meet our GHG and air quality targets.

The transportation sector can be divided into three general categories: Technology, Fuels, and Vehicle Miles Traveled.

- *Technology* refers to the vehicles themselves, as well as the associated refueling infrastructure for those vehicles.
- *Fuels* refers to the energy source used to power vehicles and the facilities that produce them.
- Vehicle travel is measured as *vehicle miles traveled* (VMT), and is a product of development patterns and available transportation options.

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[293] In 2020 the state experienced shelter-in-place orders in response to the COVID-19 pandemic. The orders, and the effects of the pandemic, led to a significant year-over-year decline in transportation emissions in 2020. This means 2019 is likely a more representative year for overall transportation emissions and 2020 a likely outlier in the historical transportation emissions trend data.
[294] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020.* *https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf*. This includes upstream oil extraction and refining emissions.
[295] CARB. California Greenhouse Gas Emission Inventory Program. *https://ww2.arb.ca.gov/our-work/programs/ghg-inventory-program*.

Sector Transition

Technology

Vehicles must transition to zero emission technology to decarbonize the transportation sector. Executive Order N-79-20[296] reflects the urgency of transitioning to zero emission vehicles (ZEVs) by establishing target dates for reaching 100 percent ZEV sales or fleet transitions to ZEV technology. The primary ZEV technologies available today are battery-electric and hydrogen fuel cell electric vehicles (FCEVs), both of which emit zero tailpipe GHGs, criteria pollutants, and toxic air contaminants, as they do not burn fuel. These vehicles are rapidly growing in performance, affordability, and popularity.[297] Plug-in hybrid electric vehicles also offer a limited but increasing range of zero emission operation and will play a role in the transition to ZEVs.

Light-duty passenger vehicles consume the majority of gasoline in the state—12.9 billion gallons in 2019[298]—and are well-suited for transitioning to ZEVs. EO N-79-20 calls for 100 percent ZEV sales of new light-duty vehicles by 2035, and this target is reflected in this Scoping Plan.[299] The Advanced Clean Cars II regulation fulfills the goal in the Executive Order and serves as the primary mechanism to help deploy ZEVs. A number of existing incentive programs also support this transition, including the Clean Cars 4 All Program.[300] Heavy-duty trucks are the largest source of diesel particulate matter, a toxic air contaminant that is directly linked to a number of adverse health impacts, and EO N-79-20 also sets targets for transitioning the medium- and heavy-duty fleet to zero emissions: by 2035 for drayage trucks and by 2045 for buses and heavy-duty long-haul trucks where feasible. Replacing heavy-duty vehicles with ZEV technology will significantly reduce GHG emissions and diesel PM emissions in low-income communities and communities of color adjacent to ports, distribution centers, and highways. The existing Advanced Clean Trucks regulation, paired with the proposed Advanced Clean Fleets regulation, are designed to transition a significant amount of the

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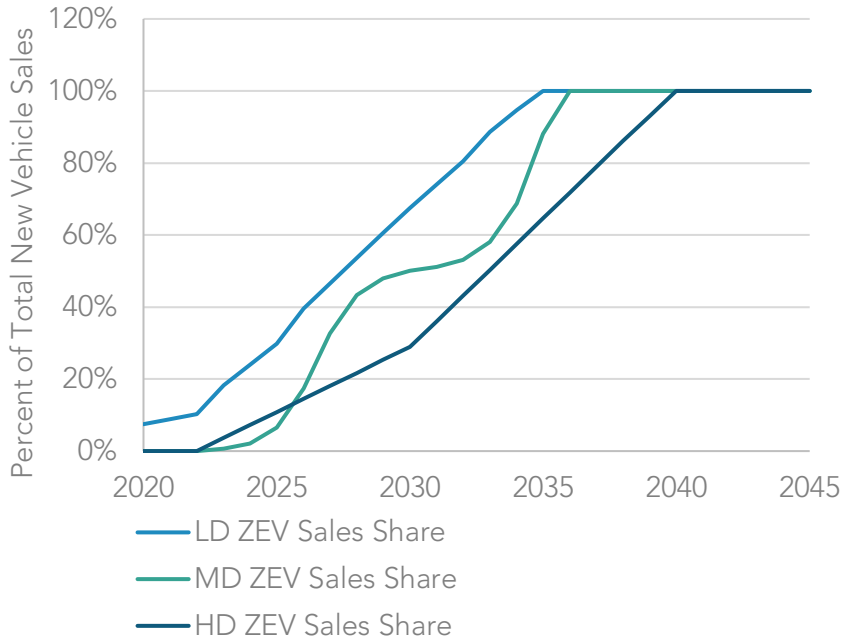
[296] Executive Department. State of California. Executive Order N-79-20. *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf*.
[297] CARB. 2021. Public Workshop for Advanced Clean Cars II. May 6. *https://ww2.arb.ca.gov/sites/default/files/2021-05/acc2_workshop_slides_may062021_ac.pdf*.
[298] CARB. 2022. *Fuel Activity for California's Greenhouse Gas Inventory by Sector and Activity. https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/fuel_activity_inventory_by_sector_all_00-20.xlsx*.
[299] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1A, with reference to the date at which all new vehicle sales are ZEVs. *finalejacrecs.pdf (arb.ca.gov)*.
[300] CARB. Clean Cars 4 All. *https://ww2.arb.ca.gov/our-work/programs/clean-cars-4-all*. The Clean Vehicle Rebate Project (CVRP) also supports the transition to ZEVs. *https://cleanvehiclerebate.org/en*.

California truck fleet to ZEV technology. As with the LDV sector, a number of incentive programs support this transition, such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).[301]

Figure 4-1 below illustrates the pace of transition in vehicle technology needed to drastically reduce GHG emissions from vehicles. All vehicle classes reach 100 percent ZEV sales before 2045, with some achieving this well before. The ZEV technology across the vehicle classes is assumed to be primarily battery electric and hydrogen fuel cell (reflecting the primary ZEV technologies available today).[302]

Figure 4-1: Transition of on-road vehicle sales to ZEV technology in the Scoping Plan Scenario



Today, off-road vehicles also rely heavily on ICE technology. Executive Order N-79-20 sets an off-road equipment target of transitioning the entire fleet to ZEV technology by 2035, where feasible. There is a great need for both investment and innovation in the off-road space in order to develop and commercialize zero emission equipment types that meet or exceed the performance of existing equipment. A number of funding sources currently support this transition, including programs such as FARMER, Carl Moyer, and

[301] California HVIP. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project. https://californiahvip.org/?msclkid=efaf65f2c26f11eca6bdd08ecc323864.

[302] The light-duty fleet includes more than 11 million battery electric and hydrogen fuel cell vehicles in 2035 and over 23 million battery electric and hydrogen fuel cell vehicles in 2045.

the Community Air Protection Incentives—as well as Low Carbon Transportation Incentives, including the Clean Off-Road Equipment (CORE) program. In addition, the 2021–22 California budget provided record-high allocations for funding ZEVs, including off-road equipment, and the 2022–23 budget is similarly ambitious.[303] Several regulations focused on transitioning to zero emission off-road equipment have recently been adopted or are in the works, and apply to locomotives,[304] forklifts, ocean-going vessels at berth,[305] commercial harbor craft,[306] small off-road engines,[307] and more.

Intrastate aviation relies on ICE technology today, but battery-electric and hydrogen fuel cell aviation applications are in development, along with sustainable aviation fuel. The Scoping Plan Scenario includes a transition of 20% of aviation fuel demand to ZEV technologies by 2045 and sustainable aviation fuel for the rest.

Refueling infrastructure is a crucial component of transforming transportation technology. Electric vehicle chargers and hydrogen refueling stations must become easily accessible for all drivers to support a wholesale transition to ZEV technology. Deployment of ZEV refueling infrastructure is currently supported by a number of existing local and state public funding mechanisms, the new National Electric Vehicle Infrastructure (NEVI) federal funding mechanism, California's electric utilities, the Electrify America initiative that was established in response the Volkswagen ZEV commitment, and by numerous companies, such as EVgo, ChargePoint, Tesla, Ford, FirstElement Fuel, Chevron, Shell, and Iwatani, who are investing substantial private resources into developing these networks. Private investment in reliable, affordable and ubiquitous refueling infrastructure must drive the transition as the business case for ZEVs continues to strengthen.

Strategies for Achieving Success

- Achieve 100 percent ZEV sales of light-duty vehicles by 2035[308] and medium-heavy-duty vehicles by 2040.
- Achieve a 20% zero emission target for the aviation sector.

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[303] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1C. CARB and the Administration are committed to increasing focus on transportation equity investment as was reflected in the governor's 2022–23 budget. *finalejacrecs.pdf (arb.ca.gov)*.
[304] CARB. Reducing Rail Emissions in California. *https://ww2.arb.ca.gov/our-work/programs/reducing-rail-emissions-california*.
[305] CARB. Ocean-Going Vessels At Berth Regulation. *https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessels-berth-regulation*.
[306] CARB. CARB passes amendments to commercial harbor craft regulation. *https://ww2.arb.ca.gov/news/carb-passes-amendments-commercial-harbor-craft-regulation*.
[307] CARB. Small Off-Road Engines (SORE). *https://ww2.arb.ca.gov/our-work/programs/small-off-road-engines-sore*.
[308] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1A. *finalejacrecs.pdf (arb.ca.gov)*.

- Develop a rapid and robust network of ZEV refueling infrastructure to support the needed transition to ZEVs.
- Ensure that the transition to ZEV technology is affordable for low-income households and communities of color, and meets the needs of communities and small businesses.[309]
- Prioritize incentive funding for heavy-duty ZEV technology deployment in regions of the state with the highest concentrations of harmful criteria and toxic air contaminant emissions.[310]
- Promote private investment in the transition to ZEV technology, undergirded by regulatory certainty such as infrastructure credits in the Low Carbon Fuel Standard for hydrogen and electricity[311] and hydrogen station grants from the CEC's Clean Transportation Program[312] pursuant to Executive Order B-48-18.[313]
- Evaluate and continue to offer incentives similar to those through FARMER,[314] Carl Moyer,[315] the Clean Fuel Reward Program,[316] the Community Air Protection Program,[317] and Low Carbon Transportation,[318] including CORE.[319] Where feasible, prioritize and increase funding for clean transportation equity programs.[320]
- Continue and accelerate funding support for zero emission vehicles and refueling infrastructure through 2030 to ensure the rapid transformation of the transportation sector.

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[309] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF6, in the context of communities. *finalejacrecs.pdf (arb.ca.gov)*.
[310] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF7. *finalejacrecs.pdf (arb.ca.gov)*.
[311] CARB. LCFS ZEV Infrastructure Crediting. *https://ww2.arb.ca.gov/resources/documents/lcfs-zev-infrastructure-crediting*.
[312] CEC. Clean Transportation Program. *https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program*.
[313] EO B-48-18 calls for 200 hydrogen refueling stations by 2025. *https://www.library.ca.gov/wp-content/uploads/GovernmentPublications/executive-order-proclamation/39-B-48-18.pdf*.
[314] CARB. FARMER program. *https://ww2.arb.ca.gov/our-work/programs/farmer-program*.
[315] CARB. Carl Moyer program. *https://ww2.arb.ca.gov/our-work/programs/carl-moyer-memorial-air-quality-standards-attainment-program*.
[316] California Clean Fuel Reward Program. *https://cleanfuelreward.com/*.
[317] CARB. Community Air Protection Program. *https://ww2.arb.ca.gov/capp*.
[318] CARB. Low Carbon Transportation Investments and Air Quality Improvement Program. *https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-quality-improvement-program*.
[319] Clean Off-Road Equipment (CORE) Voucher Incentive Program. *https://californiacore.org/*.
[320] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1C. *finalejacrecs.pdf (arb.ca.gov)*.

- Evaluate and align with this Scoping Plan relevant CARB policies such as Advanced Clean Cars II,[321] Innovative Clean Transit,[322] Zero Emission Airport Shuttle,[323] California Phase 2 GHG Standards,[324] Advanced Clean Trucks, Advanced Clean Fleets, Zero Emission Forklifts,[325] In-use Locomotives,[326] the Off-Road Zero-Emission Targeted Manufacturer rule, Clean Off-Road Fleet Recognition Program, In-use Off-Road Diesel-Fueled Fleets Regulation,[327] Commercial Harbor Craft,[328] Off-Road Zero-Emission Targeted Manufacturer rule, Clean Off-Road Fleet Recognition Program, Amendments to the In-use Off-Road Diesel-Fueled Fleets Regulation,[329] carbon pricing through the Cap-and-Trade Program,[330] and the Low Carbon Fuel Standard.[331]
- Identify and address permitting and market barriers to successful rapid ZEV technology deployment while protecting public health and the environment.

Fuels

Transitioning away from conventional ICE vehicles is part of the solution, but we must ensure that an adequate supply of zero-carbon alternative fuel and distribution is available to power these vehicles. Electricity and hydrogen are currently the primary fuels for ZEVs,

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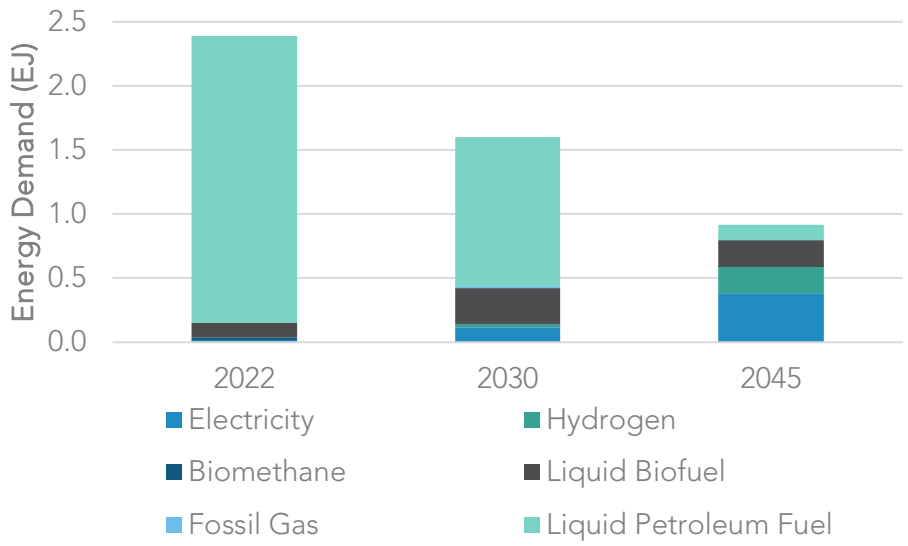
[321] CARB. Advanced Clean Cars Program. *https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program*. Cal. Code Regs., tit. 13, §§ 1900, 1961.2, 1961.3, 1961.4, 1962.2, 1962.3, 1962.4, 1962.5, 1962.6, 1962.7, 1962.8, 1965, 1968.2, 1969, 1976, 1978, 2037, 2038, 2112, 2139, 2140, 2147, 2317, 2903.
[322] CARB. Innovative Clean Transit. *https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit*. Cal. Code Regs., tit. 13, §§ 2023—2023.11.
[323] CARB. Zero-Emission Airport Shuttle. *https://ww2.arb.ca.gov/our-work/programs/zero-emission-airport-shuttle*. Cal. Code Regs., tit. 17, §§ 95690.1—95690.8.
[324] CARB. California Phase 2 Greenhouse Gas Standards. *https://ww2.arb.ca.gov/our-work/programs/greenhouse-gas-standards-medium-and-heavy-duty-engines-and-vehicles/phase2*. Cal. Code Regs., tit. 13, §§ 1956.8 and 2036; and Cal. Code Regs., tit. 17, §§ 95301, 95302, 95303, and 95663.
[325] CARB. Zero-Emission Forklifts. *https://ww2.arb.ca.gov/our-work/programs/zero-emission-forklifts*. Cal. Code Regs., tit. 17, §§ 95690.1—95690.8.
[326] CARB. Reducing Rail Emissions. *https://ww2.arb.ca.gov/our-work/programs/reducing-rail-emissions-california*. Proposed Cal. Code Regs., tit. 13, §§ 2478—2478.16.
[327] CARB. In-use Off-Road Diesel-Fueled Fleets Regulation. *https://ww2.arb.ca.gov/our-work/programs/use-road-diesel-fueled-fleets-regulation*. Cal. Code Regs., tit. 13, §§ 2449, 2449.1, 2449.2.
[328] CARB. Commercial Harbor Craft. *https://ww2.arb.ca.gov/our-work/programs/commercial-harbor-craft*. Cal. Code Regs., tit. 13, § 2299.5.
[329] CARB. In-use Off-Road Diesel-Fueled Fleets Regulation. *https://ww2.arb.ca.gov/our-work/programs/use-road-diesel-fueled-fleets-regulation*.
[330] CARB. Cap-and-Trade Program. *https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program*. Cal. Code Regs., tit. 17, §§ 95801 et seq.
[331] CARB. Low Carbon Fuel Standard. *https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard*. Cal. Code Regs., tit. 17, §§ 95480 et seq.

and both fuels must be produced using low-carbon technology and feedstocks to minimize upstream emissions.

The transition to complete ZEV technology will not happen overnight. Conventional ICE vehicles from legacy fleets will remain on the road for some time, even after all new vehicle sales have transitioned to ZEV technology. In addition, some equipment types are only now in the initial stages of development of ZEV technology for propulsion, such as commercial aircraft or ocean-going vessels. In addition to building the production and distribution infrastructure for zero-carbon fuels, the state must continue to support low-carbon liquid fuels during this period of transition and for much harder sectors for ZEV technology such as aviation, locomotives, and marine applications. Biomethane currently displaces fossil fuels in transportation and will largely be needed for hard-to-decarbonize sectors but will likely continue to play a targeted role in some fleets while the transportation sector transitions to ZEVs. Figure 4-2 provides the detail on fuels used in 2020 and the fuel mix under the Scoping Plan Scenario for 2035 and 2045.

Figure 4-2: Transportation fuel mix in 2022, 2030, and 2045 in the Scoping Plan Scenario[332]



Private investment in alternative fuels will play a key role in diversifying the transportation fuel supply away from fossil fuels. The Low Carbon Fuel Standard is the primary mechanism for transforming California's transportation fuel pool with low-carbon

[332] See https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx for transportation fuels by year.

alternatives and has fostered a growing alternative fuel market. Partially as a result of the powerful market signals from the LCFS, fuels like renewable diesel, sustainable aviation fuel, biomethane, and electricity have all gained significant market shares and continue to displace gasoline and diesel in both on- and off-road vehicles. In addition, Executive Order N-79-20 calls on state agencies to support the transition of existing fuel production facilities away from fossil fuels and directs that this transition also protect and support workers, public health, safety, and the environment. In line with this direction, existing refineries could be repurposed to produce sustainable aviation fuel, renewable diesel, and hydrogen. This trend has already begun, and continuing to develop fuel production capacity in-state to support the energy transition while making the most efficient use of existing assets is critical to avoiding emissions leakage. If fuel demand persists after fuel production facilities have ceased operations, fuel demand will have to be met through imports.

As we transition or build new energy production facilities and infrastructure, it will be important to ensure low-income communities, tribes, and communities of color do not experience increases in existing air pollution disparities and continue to experience a reduction in the air pollution disparities that exist today. California must use the best available science to ensure that raw materials used to produce transportation fuels do not incentivize feedstocks with little to no GHG reductions from a life cycle perspective. A dramatic increase in alternative fuel production must not come at the expense of global deforestation, unsustainable land conversion, or adverse food supply impacts, to name a few examples. CARB will continue to monitor scientific findings on these topics to ensure that California policies, such as the LCFS, send the appropriate market signals and do not result in unintended consequences.[333]

Strategies for Achieving Success

- Accelerate the reduction and replacement of fossil fuel production and consumption in California.[334]
- Incentivize private investment in new zero-carbon fuel production in California.
- Incentivize the transition of existing fuel production and distribution assets to support deployment of low- and zero-carbon fuels while protecting public health and the environment.
- Invest in the infrastructure to support reliable refueling for transportation such as electricity and hydrogen refueling.

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[333] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1E. *finalejacrecs.pdf (arb.ca.gov)*.
[334] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F3. *finalejacrecs.pdf (arb.ca.gov)*.

- Evaluate and propose, as needed, changes to strengthen the Cap-and-Trade Program.
- Initiate a public process focused on options to increase the stringency and scope of the LCFS:
    - Evaluate and propose accelerated carbon intensity targets pre-2030 for LCFS.
    - Evaluate and propose further declines in LCFS post-2030 carbon intensity targets to align with this 2022 Scoping Plan.
    - Consider integrating opt-in sectors into the program.
    - Provide capacity credits for hydrogen and electricity for heavy-duty fueling.
- Monitor for and ensure that raw materials used to produce low-carbon fuels or technologies do not result in unintended consequences.[335]

Vehicle Miles Traveled

Transforming the transportation sector goes beyond phasing out combustion technology and producing cleaner fuels. Managing total demand for transportation energy by reducing the miles people need to drive on a daily basis is also critical as the state aims for a sustainable transportation sector in a carbon neutral economy. Though GHG emissions are declining due to cleaner vehicles and fuels, rising VMT can offset the effective benefits of adopted regulations.

Even under full implementation of Executive Order N-79-20 and CARB's Advanced Clean Cars II Regulations, with 100 percent ZEV sales in the light-duty vehicle sector by 2035, a significant portion of passenger vehicles will still rely on ICE technology, as demonstrated in Figure 4-2 above. Accordingly, VMT reductions will play an indispensable role in reducing overall transportation energy demand and achieving the state's climate, air quality, and equity goals. After a significant pandemic-induced reduction in VMT during 2020, passenger VMT has steadily climbed back up and is now closing in on pre-pandemic levels.[336] Driving alone with no passengers remains the primary mode of travel in California, amounting to 75 percent of the mode share for daily commute trips. Conversely, the transit industry, which was significantly impacted during

[335] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1E. *finalejacrecs.pdf (arb.ca.gov)*.
[336] U.S. Department of Transportation. 2021. December 2021 Traffic Volume Trends. Figure 3 - Seasonally Adjusted Vehicle Miles Traveled by Month. *https://www.fhwa.dot.gov/policyinformation/travel_monitoring/21dectvt/figure3.cfm*.

the lockdown months, and has struggled to recover; ridership only averages two-thirds of pre-pandemic levels,[337] [338] and service levels also lag behind.

Sustained VMT reductions have been difficult to achieve for much of the past decade, in large part due to entrenched transportation, land use, and housing policies and practices. Specifically, historic decision-making favoring single-occupancy vehicle travel has shaped development patterns and transportation policy, generating further growth in driving (and making transit, biking and walking less viable alternatives). These policies have also reinforced long-standing racial and economic injustices that leave people with little choice but to spend significant time and money commuting long distances, placing a disproportionate burden on low-income Californians, who pay the highest proportion of their wages on housing and transportation. While CARB has included VMT reduction targets and strategies in the Scoping Plan and appendices, these targets are not regulatory requirements, but would inform future planning processes. CARB is not setting regulatory limits on VMT in the 2022 Scoping Plan; the authority to reduce VMT largely lies with state, regional, and local transportation, land use, and housing agencies, along with the Legislature and its budgeting choices.

Appendix E (Sustainable and Equitable Communities) elaborates on reasons for reducing VMT and identifies a series of policies that, if implemented by various responsible authorities, could help to achieve the recommended VMT reduction trajectory included in this Scoping Plan (and related mode share increases for transit and active transportation). These policies aim to advance four strategic objectives:

1. Align current and future funding for transportation infrastructure with the state's climate goals, preventing new state-funded projects from inducing significant VMT growth and supporting an ambitious expansion of transit service and other multimodal alternatives.
2. Move funding for transportation beyond the gasoline and diesel taxes and implement fuel-agnostic pricing strategies that accomplish more productive uses of the roadway network and generate revenues to further improve transit and other multimodal alternatives.
3. Deploy autonomous vehicles, ride-hailing services, and other new mobility options toward high passenger-occupancy and low VMT-impact service models that complement transit and ensure equitable access for priority populations.
4. Encourage future housing production and multi-use development in infill locations and other areas in ways that make future trip origins and destinations

[337] U.S. Government Accountability Office. January 25, 2022. During COVID-19, Road Fatalities Increased and Transit Ridership Dipped. *https://www.gao.gov/blog/during-covid-19-road-fatalities-increased-and-transit-ridership-dipped*.
[338] American Public Transportation Association. APTA - Ridership Trends. *https://transitapp.com/APTA*.

closer together and create more viable environments for transit, walking, and biking.

The pace of change to reduce VMT must be accelerated. Certainly, structural reform will be challenging, but California has demonstrated time and again that it possesses the collective leadership and commitment to break away from ideas that no longer represent Californians' values and their aspirations for the many generations to come.

Strategies for Achieving Success

- Achieve a per capita VMT reduction of at least 25 percent below 2019 levels by 2030 and 30 percent below 2019 levels by 2045. [339]
- Reimagine new roadway projects that decrease VMT in a way that meets community needs and reduces the need to drive.
- Invest in making public transit a viable alternative to driving by increasing affordability, reliability, coverage, service frequency, and consumer experience.[340]
- Implement equitable roadway pricing strategies based on local context and need, reallocating revenues to improve transit, bicycling, and other sustainable transportation choices.[341]
- Expand and complete planned networks of high-quality active transportation infrastructure.[342]
- Channel the deployment of autonomous vehicles, ride-hailing services, and other new mobility options toward high passenger-occupancy and low VMT-impact service models that complement transit and ensure equitable access for priority populations.
- Streamline access to public transportation through programs such as the California Integrated Travel Project.
- Ensure alignment of land use, housing, transportation, and conservation planning in adopted regional plans, such as regional transportation plans (RTP)/ sustainable communities strategies (SCS), regional housing needs assessments (RHNA), and local plans (e.g., general plans, zoning, and local transportation plans), and develop tools to support implementation of these plans.

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[339] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1D. finalejacrecs.pdf (arb.ca.gov).
[340] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1D. finalejacrecs.pdf (arb.ca.gov).
[341] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1D. finalejacrecs.pdf (arb.ca.gov).
[342] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1F. finalejacrecs.pdf (arb.ca.gov).

- Accelerate infill development and housing production at all affordability levels in transportation-efficient places, with a focus on housing for lower-income residents.

Clean Electricity Grid

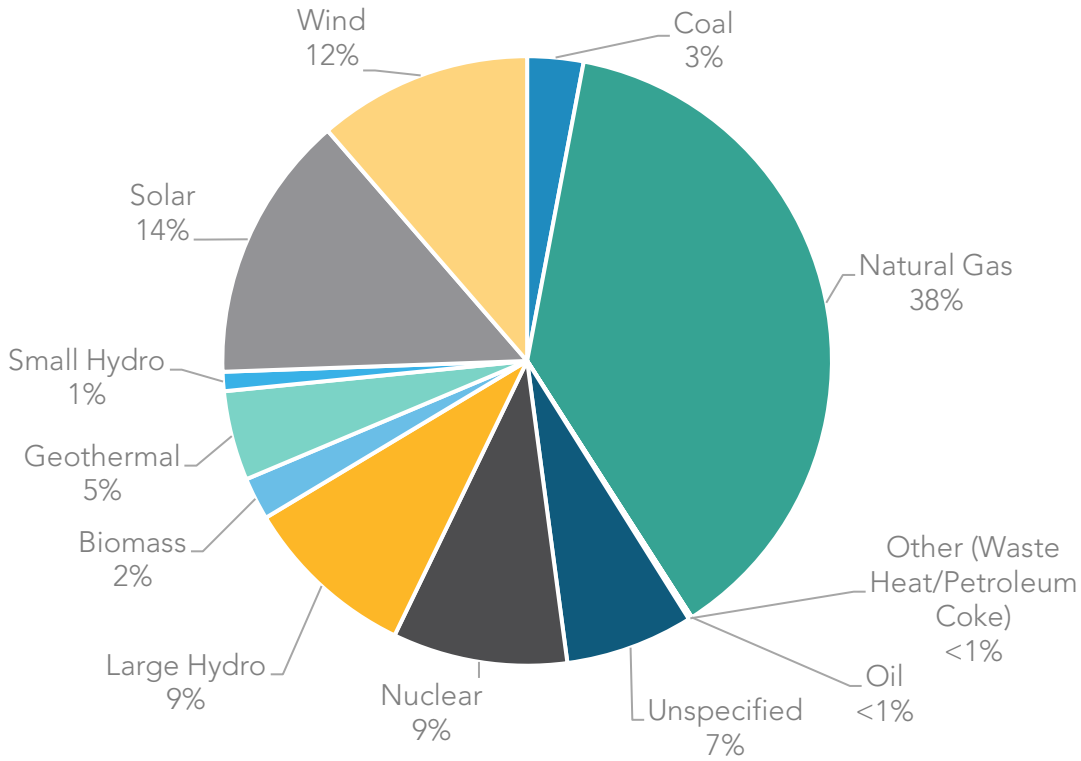
Much of the state's success to date in reducing GHGs is due to decarbonization of the electricity sector as a result of the RPS, SB 100 implementation, and the Cap-and-Trade Program. Moving forward, a clean, affordable, and reliable electricity grid will serve as a backbone to support deep decarbonization across California's economy. Under this Scoping Plan, the role of electricity in powering the economy will grow in almost every sector.

In 2021, 70 percent of California electricity demand was served by in-state power plants totaling about 82 GW, with the rest coming from out-of-state imports.[343] Additionally, approximately 8 GW of customer solar photovoltaic capacity has been installed to date to help with in-state demand.[344] Figure 4-3 shows the breakdown of in-state and imported sources of electricity.

[343] CEC. 2021. Electric Generation Capacity and Energy. Data available at: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy and CEC. 2021. Total System Electric Generation. Data available at: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation. Capacity values are nameplate capacity from sources 1 MW and larger.

[344] CEC. 2021. *SB 100 Joint Agency Report Summary: Achieving 100% Clean Electricity in California, An Initial Assessment.* 10. https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity.

Figure 4-3: 2021 total system electric generation (based on GWh)[345]



Note: Imports contributing to total system generation are comprised of 58% zero-carbon energy and 42% non-renewable and unspecified energy. Percentages do not add to exactly 100 due to rounding.

In 2021, about 48 percent of electricity generation serving California came from non-renewable and unspecified[346] resources, while 52 percent came from renewable and zero-carbon resources. The state's Strategic Reliability Reserve, established in AB 205 to provide additional reliability insurance during extreme events, may make three of the fossil gas-fired OTC plants planned for retirement available to support the grid on a limited basis after 2023. The state also adopted legislation to facilitate extension of the Diablo Canyon Nuclear Power Plant for five years beyond its 2025 planned closure.[347] At the

[345] *Total system generation* is the sum of all utility-scale, in-state generation, plus net electricity imports. CEC. 2021 Total System Electricity Generation. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation.

[346] *Unspecified power* refers to electricity that is not traceable to a specific generating facility, such as electricity traded through open market transactions. It typically consists of a mix of resources and may include renewables.

[347] In accordance with SB 846 (Dodd, Chapter 239, Statutes of 2022).

same time, the state continues to rapidly expand deployment of clean energy generation and storage resources and plan for increased electrification.[348] This is critical to reducing GHG emissions and addressing the long-term impacts of climate change.

Climate change is causing unprecedented stress on California's energy system—driving high demand and constraining supply. Heat, drought, and wildfires can both reduce electricity supply from reductions in hydropower generation and impacts on generation and transmission performance, and increase demand, especially in the evening hours when solar generation is declining.

California has experienced three straight years of energy reliability challenges, including a multi-day extreme heat event across the western United States with temperatures up to 20 degrees above normal in California, resulting in rotating outages in August 2020. In 2021, heat waves in June prompted a Grid Warning and the onset of emergency conditions, and the Bootleg Fire caused the loss of one transmission line, reducing import capability by 3,000 megawatts into the California Independent System Operator (CAISO) balancing authority area. And from August 31–September 9, 2022, a 10-day extreme heat event resulted in an unprecedented, sustained period of high peak loads in the CAISO system, averaging 47,000 MW and maxing at an all-time record of over 52,000 MW on September 6. The Western region also hit its record peak load on September 6, at 167.5 GW.

Reliable electricity service was maintained throughout the 10-day September 2022 heat wave in spite of the record breaking load levels. Factors that contributed to this outcome include the installation of over 3,500 MW of lithium-ion battery storage since summer 2020, enhanced coordination and communication within and outside of California, engagement with customer groups and other stakeholders, state actions to reduce load during critical times, and the additional capacity provided through the Strategic Reliability Reserve and other new state programs authorized in the 2022 Budget to provide load reduction and support the grid in extreme events. CEC, CPUC, CAISO, and the California Department of Water Resources will continue to build out strategies to enhance reliability in light of the increasing and compounding impacts of climate change on the electricity system.

[348] In June 2021, the CPUC adopted D.21-06-035 directing procurement of 11,500 MW of new capacity between 2023 and 2026 to ensure systemwide electric reliability as Diablo Canyon and several OTC facilities retire. It requires that, out of the 11,500 MW, 2,500 MW must be from zero-emission resources. Additionally, 2,000 MW must be long lead-time resources, with at least 1,000 MW of long-duration storage and 1,000 MW of firm capacity with zero on-site emissions or that qualifies under the RPS eligibility requirements.

While the electricity sector is using less fossil fuel due to increasing amounts of renewables,[349] existing fossil gas generation will continue to play a critical role in grid reliability until other clean, dispatchable alternatives can be deployed at scale. The integration of greater amounts of variable renewable generation resources[350] is changing power system planning and operations, and system operators need resources with flexible attributes to balance shifting supply and demand.

High levels of solar generation can lead to instances of oversupply during the middle of the day, when the sun is brightest.[351] In the evening hours, as the sun is setting, solar generation declines to zero and customers with solar generation shift back to the electric grid. In hot weather, customer demand remains high well into the summer evening period to power air conditioning, which can lead to reliability challenges.[352]

Figure 4-4 shows the energy sources used throughout one summer day in July. Renewable energy is consistent during the middle of the day, but it cannot meet all of the evening demand in the gray area. As illustrated in the figure, fossil gas generation is currently a resource that is typically ramped up to meet this evening demand as solar production begins to drop and electrical loads increase To help address this challenge, resource installations that pair solar with batteries, as well as a greater amount of battery build-out, are coming online currently and over the next five years. Nevertheless, the state's electricity grid is expected to be stressed further in the coming years by heat waves, drought, wildfires, and the growing intermittent power supply from renewables. California must accelerate deployment of diverse clean energy resources to maintain reliability and affordability in the face of climate change.

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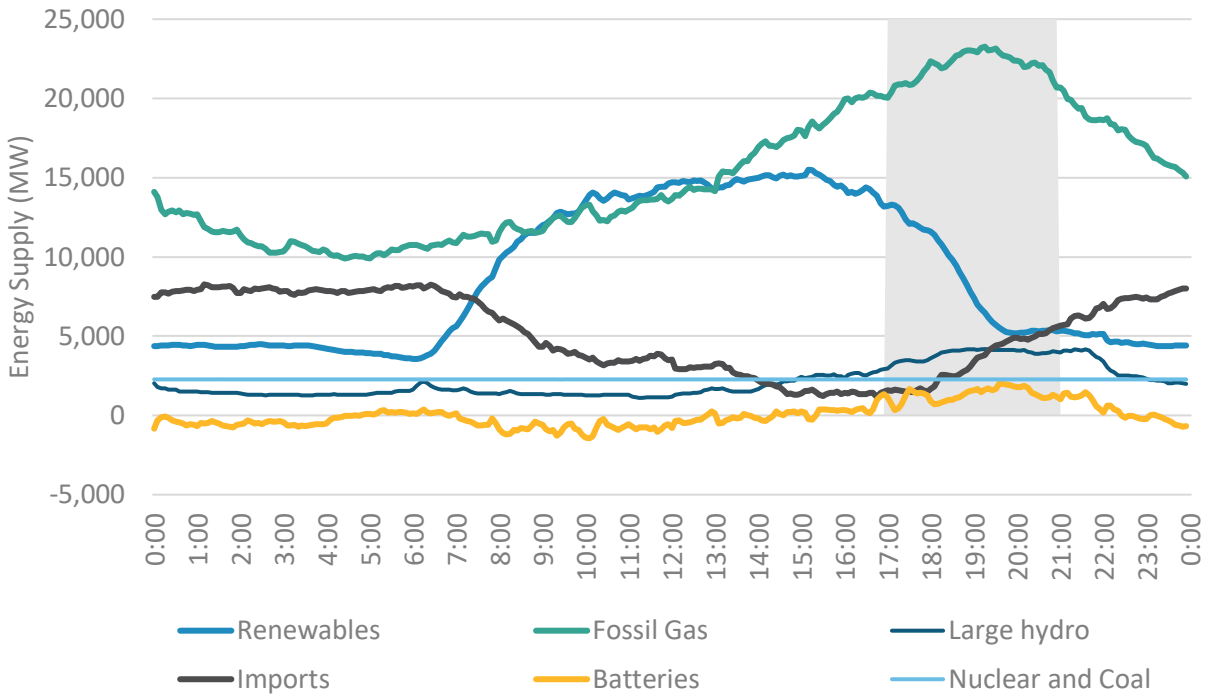
[349] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf.

[350] A *variable renewable generation resource* is a renewable source of electricity that is non-dispatchable due to its fluctuating nature and only produces electricity when weather conditions are right, such as when the sun is shining or the wind is blowing. Renewable resources that can be controlled and are dispatchable include geothermal, biomass, and dam-based hydroelectric power.

[351] *Brightness* is used colloquially here; solar energy depends on insolation (e.g., sun-hours), which is the measurement of cumulative solar energy that reaches an area over a period of time.

[352] CAISO, CPUC, and CEC. 2021. *Final Root Cause Analysis: Mid-August 2020 Extreme Heat Wave.* http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf.

Figure 4-4: Electricity supply trend by resource for a California summer day, July 2022



Sector Transition

Decarbonizing the electricity sector is a crucial pillar of this Scoping Plan. It depends on both using energy more efficiently and replacing fossil-fueled generation with renewable and zero carbon resources, including solar, wind, energy storage,[353] geothermal, biomass, and hydroelectric power. The RPS Program[354] and the Cap-and-Trade Program continue to incentivize dispatch of renewables over fossil generation to serve state demand. SB 100 increased RPS stringency to require 60 percent renewables by 2030 and for California to provide 100 percent of its retail sales[355] of electricity from renewable and zero-carbon resources by 2045. Furthermore, SB 1020 has added interim targets to

[353] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF1, NF2. *finalejacrecs.pdf (arb.ca.gov)*.

[354] The CEC estimates that 36 percent of California's 2019 retail electricity sales was served by RPS-eligible renewable resources (see CPUC. 2021. CPUC Perspectives on Electric Sector Decarbonization. *https://ww2.arb.ca.gov/sites/default/files/2021-11/CPUC-sp22-electricity-ws-11-02-21.pdf*).

[355] SB 100 speaks only to retail sales and state agency procurement of electricity. The *2021 SB 100 Joint Agency Report* interprets this to mean that other loads—wholesale or non-retail sales and losses from storage and transmission and distribution lines—are not subject to the law.

SB 100's policy framework to require renewable and zero-carbon resources to supply 90 percent of all retail electricity sales by 2035 and 95 percent of all electricity retail sales by 2040; the governor has asked the CEC to establish a planning goal of at least 20 GW of offshore wind by 2045; and the governor directed that state agencies plan for an energy transition that avoids the need for new fossil gas capacity to meet California's long-term energy goals.[356] In addition to grid-level resources, state efforts have supported rapid growth of the distributed solar industry through key actions like the California Solar Initiative (SB 1, Murray, Chapter 132, Statues of 2006).[357] Steps to commercialize microgrids powered by clean resources[358] are also being examined as part of SB 1339 (Stern, Chapter 566, Statutes of 2018).[359]

California also continues to advance its appliance and building energy efficiency standards to reduce growth in electricity consumption and meet the SB 350 goal to double statewide energy efficiency savings in electricity and fossil gas end uses[360] by 2030. In 2018, the CEC adopted a building energy efficiency code requiring most new homes to have solar photovoltaic systems[361] (or be powered by a solar array nearby) starting January 1, 2020. In 2019, California reached the milestone of 1 million solar rooftop installations.

Increased transportation and building electrification and continued policy commitment to behind-the-meter solar and storage will continue to drive growth of microgrids and other distributed energy resources (DER).[362] The CPUC's High-DER proceeding is examining how to prepare the electric grid for a high DER future by determining how to integrate

[356] Newsom, Gavin. July 22, 2022. Letter from Governor Newsom to CARB Chair Liane Randolph. *https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf*.
[357] More information on the program, which closed in 2016, can be found on the CPUC website, including annual program assessment reports, at: *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/california-solar-initiative*.
[358] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, In part (NF2, NF13). *finalejacrecs.pdf (arb.ca.gov)*.
[359] CPUC. Resiliency and Microgrids. *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/resiliency-and-microgrids*.
[360] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF1, ES1. *finalejacrecs.pdf (arb.ca.gov)*.
[361] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF2. *finalejacrecs.pdf (arb.ca.gov)*.
[362] Distributed energy resources include rooftop solar and other distributed renewable generation resources, energy storage, electric vehicles, time variant and dynamic electric rates, flexible load management, demand response, and energy efficiency technologies.

millions of DERs within the distribution grid to maximize societal and ratepayer benefits from DERs while ensuring grid reliability and affordable rates.[363]

SB 350 also aims to connect long-term planning for electricity needs with the state's climate targets. This is primarily accomplished through CARB's establishment of 2030 GHG emissions targets for the electricity sector in general and for each electricity provider, which inform the CPUC and publicly owned utilities' integrated resource planning. A GHG planning target range of 30 to 53 MMTCO_2e—informed by the 2017 Scoping Plan—was originally developed and adopted by CARB in 2018. In its 2021 IRP planning cycle, the CPUC adopted a 38 MMT GHG target for the electricity sector in 2030, which drops to 35 MMT in 2032.[364]

The Scoping Plan Scenario incorporates SB 350's energy efficiency doubling goal, aligns with the CPUC's IRP 2030 GHG target and latest GHG emissions benchmarks through 2035,[365] the governor's 20 GW offshore wind and no new gas generation[366] goals, and SB 100's 2030 RPS and 2045 zero-carbon retail sales targets to reduce dependence on fossil fuels in the electricity sector by transitioning substantial energy demand to renewable and zero-carbon resources.[367] As described in Chapter 2, CCS is applied in limited sectors, including on 16.7 MMT of CO_2 from existing fossil gas electricity generation in 2045, to ensure the state achieves the 85 percent reduction in anthropogenic emissions required by AB 1279. Continued transition to renewable and

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[363] The High-DER proceeding is one of four "anchor" proceedings in the CPUC's DER Action Plan 2.0 and is within the Action Plan's infrastructure track. Information on the High-DER proceeding is available at: *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/distribution-planning*. The Action Plan can be accessed at: *https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/der-action-plan*.

[364] The February 10, 2022, Decision 22-02-004 by the CPUC adopts the 2021 Preferred System Plan, completing the 2019–21 IRP cycle. *https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M451/K412/451412947.PDF*. The Decision requires load serving entities to submit plans in the next IRP cycle detailing how they will meet their proportionate share of a 30 MMT electric sector target, as well as a 38 MMT GHG target.

[365] June 15, 2022, Administrative Law Judge's Ruling for 2022 integrated resource plan filings specifies the need for GHG targets to plan for in 2035 to continue progress toward the 2045 goal. The ruling proposes a straight-line projection from the GHG planning target for 2030. Corresponding to the adopted Preferred System Plan in D.22-02-004, 38 MMT in 2030 leads to a target of 30 MMT in 2035. *https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M485/K625/485625915.PDF*.

[366] The governor's July 22, 2022, letter specifies no new gas generation but does not place any constraints on existing gas resources. Therefore, for purposes of RESOLVE electricity sector modeling, existing gas capacity is an available resource that is able to be reduced over time based on announced retirements or if selected for retirement by the model.

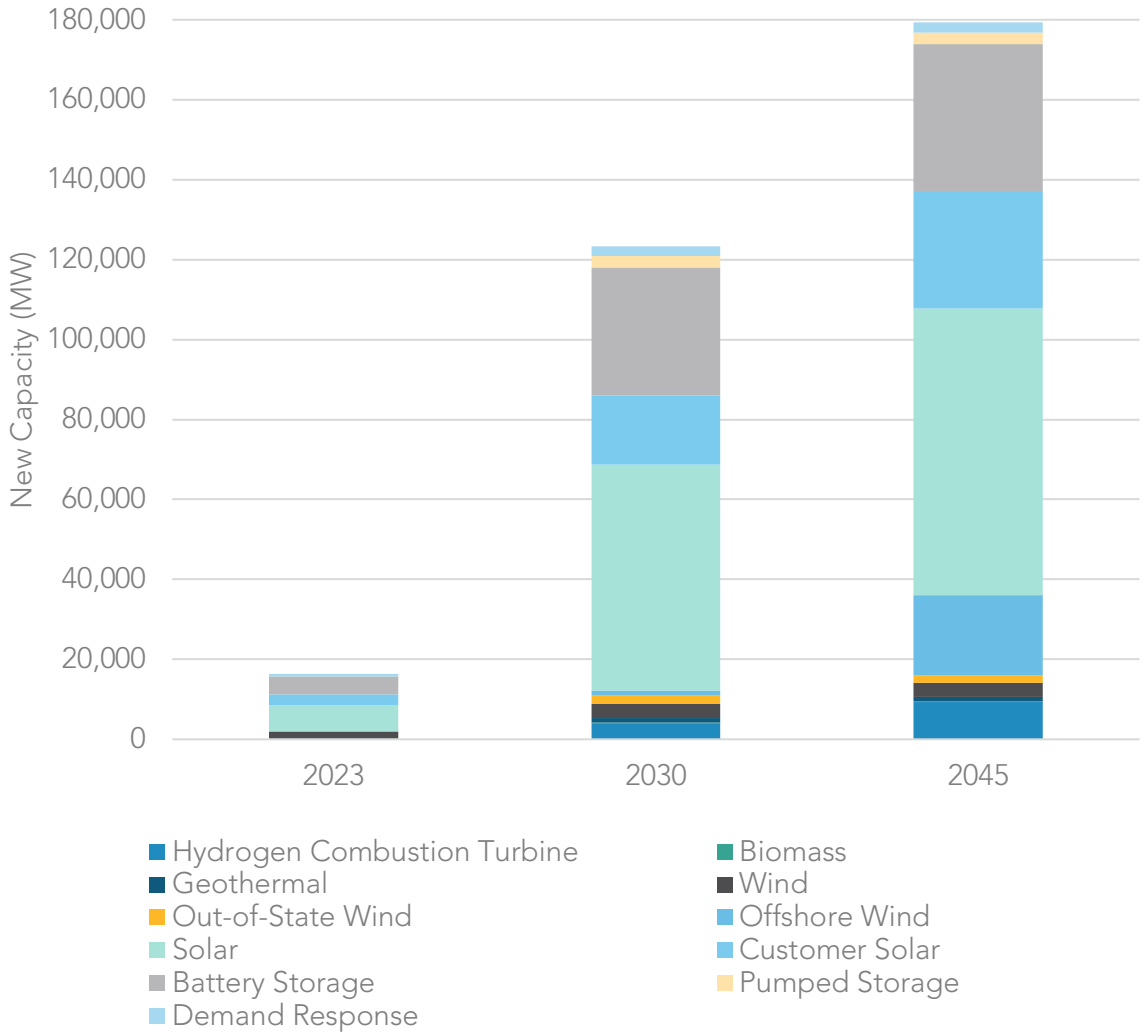
[367] CARB. 2021. PATHWAYS Scenario Modeling: 2022 Scoping Plan Update – Attachment B: Generation Technologies to be included in Modeling. *https://ww2.arb.ca.gov/sites/default/files/2021-12/Revised_2022SP_ScenarioAssumptions_15Dec.pdf*.

zero-carbon electricity resources will enable electricity to become a zero-carbon substitute for fossil fuels across the economy.

Figure 4-5 shows the modeled resource capacity to meet the SB 100 retail sales target.[368] Energy efficiency moderates some of the need for additional electricity generation. However, that is quickly surpassed by growing electricity demand of 26 percent by 2030 and 76 percent by 2045 compared to today (2022) from increased population and electrification of other sectors, as shown in Figure 4-6. The estimated resource build needed to meet this level of demand amounts to approximately 72 GW of utility solar[369] and 37 GW of battery storage by 2045. Annual build rates (over the 2022–2035 period) for the Scoping Plan Scenario will need to increase by about 60 percent and over 700 percent for utility solar and battery storage, respectively, compared to historic maximum rates.[370] To reach the 2045 target, the state will need to quadruple its current level of wind and solar capacity. This does not include capacity associated with hydrogen production nor mechanical CDR, which was modeled off-grid; assuming hydrogen production via electrolysis, this would roughly be equivalent to an additional 10 GW[371] of solar generation needed in 2045, and an additional 64 GW of solar generation for direct air capture in 2045. The scale of solar and battery build rates needed could be reduced through the commercialization of new zero-carbon technologies.

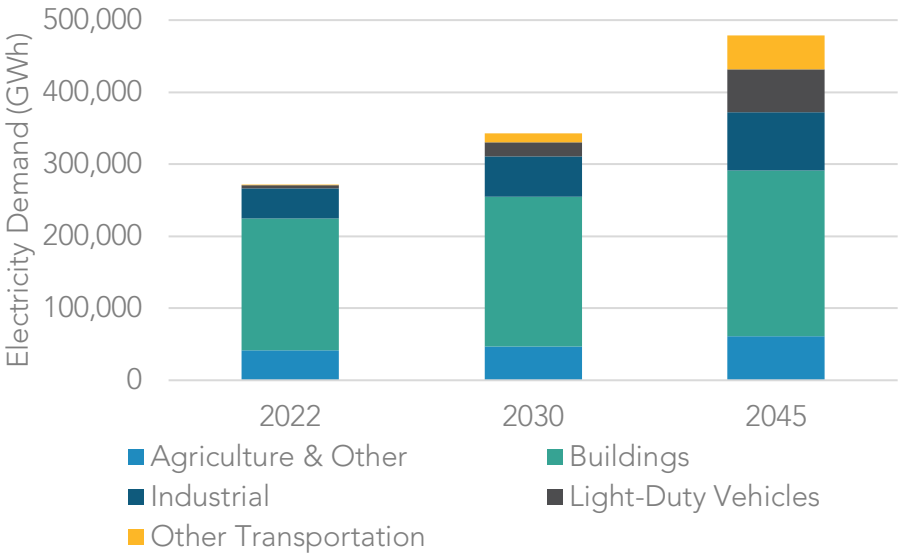
[368] SB 846 requires that load-serving entities exclude energy, capacity, or any attribute from the Diablo Canyon power plant in their resource plans. The Scoping Plan Scenario excludes energy, capacity, or any attribute from the Diablo Canyon power plant after the prior planned retirement date of 2025.
[369] The amount of additional customer solar included in the Scoping Plan Scenario is 29,208 MW by 2045.
[370] E3. 2022. CARB Scoping Plan: AB32 Source Emissions Final Modeling Results. PowerPoint. *https://ww2.arb.ca.gov/sites/default/files/2022-11/SP22-MODELING-RESULTS-E3-PPT.pdf*. Build rates are from EIA data historical builds in the 2011–2021 time frame.
[371] The estimate does not include hydrogen production assumed to be produced with bioenergy with carbon capture and storage (BECCS) and steam methane reforming (SMR).

Figure 4-5: Projected new electricity resources needed by 2045 in the Scoping Plan Scenario[372]



[372] See https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-PATHWAYS-data-E3.xlsx for the capacity build-out by resource type.

Figure 4-6: Electric loads in 2022, 2030 and 2045 for the Scoping Plan Scenario[373]



This transformation will drive investments in a large fleet of generation and storage resources but will also require significant transmission to accommodate these new capacity additions. Transmission needs include high-voltage lines to access out-of-state resources and major in-state generation pockets. In consideration of typical 8- to 10-year lead times for many projects, the CAISO published its first 20-Year Transmission Outlook to inform transmission planning focused on meeting the needs identified through the 2021 SB 100 Joint Agency Report process. The outlook calls for significant transmission development to access offshore wind and out-of-state wind and reinforce the existing CAISO footprint at an estimated cost of $30.5 billion.[374]

Presently, fossil gas power plants provide about 75 percent of the flexible capacity for grid reliability as more renewable power enters the system. Moving forward, other resources such as storage and demand-side management are essential to maintain reliability with high concentrations of renewables. Hydrogen produced from renewable resources and renewable feedstocks can serve a dual role as a low-carbon fuel for existing combustion turbines or fuel cells, and as energy storage for later use. Reliability

[373] *Other Transportation* includes all non-light-duty vehicles and reflects electrification of modes like passenger and freight rail, aviation, and ocean-going vessels.
[374] CAISO. 2022. *20 Year Transmission Outlook.* http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf.

also can be supported through increased coordination and markets in the interconnected western power grid; this is already helping to better integrate renewables.[375]

Strategies for Achieving Success

- Use long-term planning processes (Integrated Energy Policy Report, IRP, CAISO Transmission Planning Process, AB 32 Climate Change Scoping Plan) to support grid reliability and expansion of renewable and zero-carbon resource and infrastructure deployment.
- Complete systemwide and local reliability assessments across CAISO and other balancing authority areas, using realistic assumptions for land use, build rates, statewide and distribution system level constraints, and energy needs. Such assessments should be completed before state agencies update their electricity sector GHG targets.
- Prioritize actions to mitigate impacts to electricity reliability and affordability and provide sufficient flexibility in the state's decarbonization roadmap for adjustments as may be needed.
- Facilitate long lead-time resource development through the IRP and the SB 100 interagency process and through technology development and demonstration funding[376] that includes resources such as long-duration energy storage and hydrogen production.
- Continue coordination between energy agencies and energy proceedings to maximize opportunities for demand response.
- Continue to explore the benefits of regional markets to enhance decarbonization, reliability, and affordability.
- Address resource build-out challenges, including permitting, interconnection, and transmission network upgrades.
- Explore new financing mechanisms and rate designs to address affordability.[377]
- Per SB 350, double statewide energy efficiency savings in electricity and fossil gas end uses by 2030, through a combination of energy efficiency and fuel substitution actions.[378]
- Per SB 100 and SB 1020, achieve 90 percent, 95 percent, and 100 percent

[375] CEC. 2021. *2021 SB 100 Joint Agency Report – Achieving 100 Percent Clean Electricity in California: An Initial Assessment.* Publication Number: CEC-200-2021-001.
[376] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, ES2. The committee recommendation speaks specifically to offshore wind production. *finalejacrecs.pdf (arb.ca.gov)*.
[377] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF30. *finalejacrecs.pdf (arb.ca.gov)*.
[378] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF1, NF2. *finalejacrecs.pdf (arb.ca.gov)*.

renewable and zero-carbon retail sales by 2035, 2040, and 2045, respectively.

- Evaluate and propose, as needed, changes to strengthen the Cap-and-Trade Program.
- Target programs and incentives to support and improve access to renewable and zero-carbon energy projects (e.g., rooftop solar, community owned or controlled solar or wind, battery storage, and microgrids) for communities most at need, including frontline, low-income, rural, and indigenous communities.[379]
- Prioritize public investments in zero-carbon energy projects to first benefit the most overly burdened communities affected by pollution, climate impacts, and poverty.[380]

Sustainable Manufacturing and Buildings

Fossil gas is the primary gaseous fossil fuel used to produce heat at industrial facilities, as well as in residential and commercial buildings. In buildings, space and water heating, cooking, and clothes drying all rely on gaseous fuels today. Industrial processes that require heat for conventional boilers and other processes also rely on gaseous fuels. Refineries rely on fossil gas and other gaseous fossil fuels, like liquefied petroleum gas and refinery fuel gas, and fossil gas is also used to generate electricity, as discussed earlier.

Gaseous fossil fuel use can be displaced by four primary alternatives: zero-carbon electricity, solar thermal heat, hydrogen, and biogas/biomethane. Displacing gaseous fossil fuel use can yield indoor air quality benefits, protect public health and property from unexpected fossil gas leaks, and reduce short-lived climate pollutants, which are many times more potent in affecting climate change than CO_2. The Scoping Plan Scenario reduces dependence on fossil gas in the industrial and building sectors by transitioning substantial energy demand to alternative fuels. Reducing fossil gas combustion also will help toward achieving our air quality and equity goals by reducing pollution in neighboring areas and communities. In addition, reduced dependence on gasoline and diesel in the transportation sector diminishes the need for gaseous fossil fuels to support oil and gas production and petroleum refining operations as those are phased down relative to the demand.

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[379] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF2, NF9, NF11, NF12, NF13. finalejacrecs.pdf (arb.ca.gov).

[380] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF14. finalejacrecs.pdf (arb.ca.gov).

Sector Transition

Industry

California's industrial sector contributes significantly to the state's economy, with a total output from manufacturing in 2019 of $324 billion (10.4 percent of the state total)[381] and employment of 1,222,000 manufacturing jobs (7.6 percent of the total state workforce).[382] California industry includes a diverse range of facilities, including cement plants, refineries, glass manufacturers, oil and gas producers, paper manufacturers, mining operations, metal processors, and food processors. Combustion of fossil gas, other gaseous fossil fuels, and solid fossil fuels provide energy to meet three broad industry needs: electricity, steam, and process heat. Non-combustion emissions result from fugitive emissions and from the chemical transformations inherent to some manufacturing processes. About 20 percent of the GHG emissions from the industrial sector are non-combustion emissions.

Decarbonizing industrial facilities depends upon displacing fossil fuel use with a mix of electrification, solar thermal heat, biomethane, low- or zero-carbon hydrogen, and other low-carbon fuels to provide energy for heat and reduce combustion emissions. Emissions also can be reduced by implementing energy efficiency measures and using substitute raw materials that can reduce energy demand and some process emissions. Some remaining combustion emissions and some non-combustion CO_2 emissions can be captured and sequestered. The strategy employed will depend on the industrial subsector and the specific processes utilized in production. The left side of Figure 4-7 illustrates the fuels used to meet industrial manufacturing energy demand in 2020. Industrial manufacturing energy demand needs to transition to the fuel mix shown for 2035 and 2045. The right side of Figure 4-7 illustrates the fuel mix needed to meet the energy demand of oil and gas extraction and petroleum refining operations for the same years. Energy demand in this portion of the industrial sector declines along with decreased demand for gasoline and diesel in the transportation sector. In both figures there is a continuing demand for fossil gas due to lack of non-combustion technologically feasible or cost-effective alternatives for certain industrial sectors. Policies that support decarbonization strategies like electrification, use of renewable energy, and transition to alternative fuels are needed.

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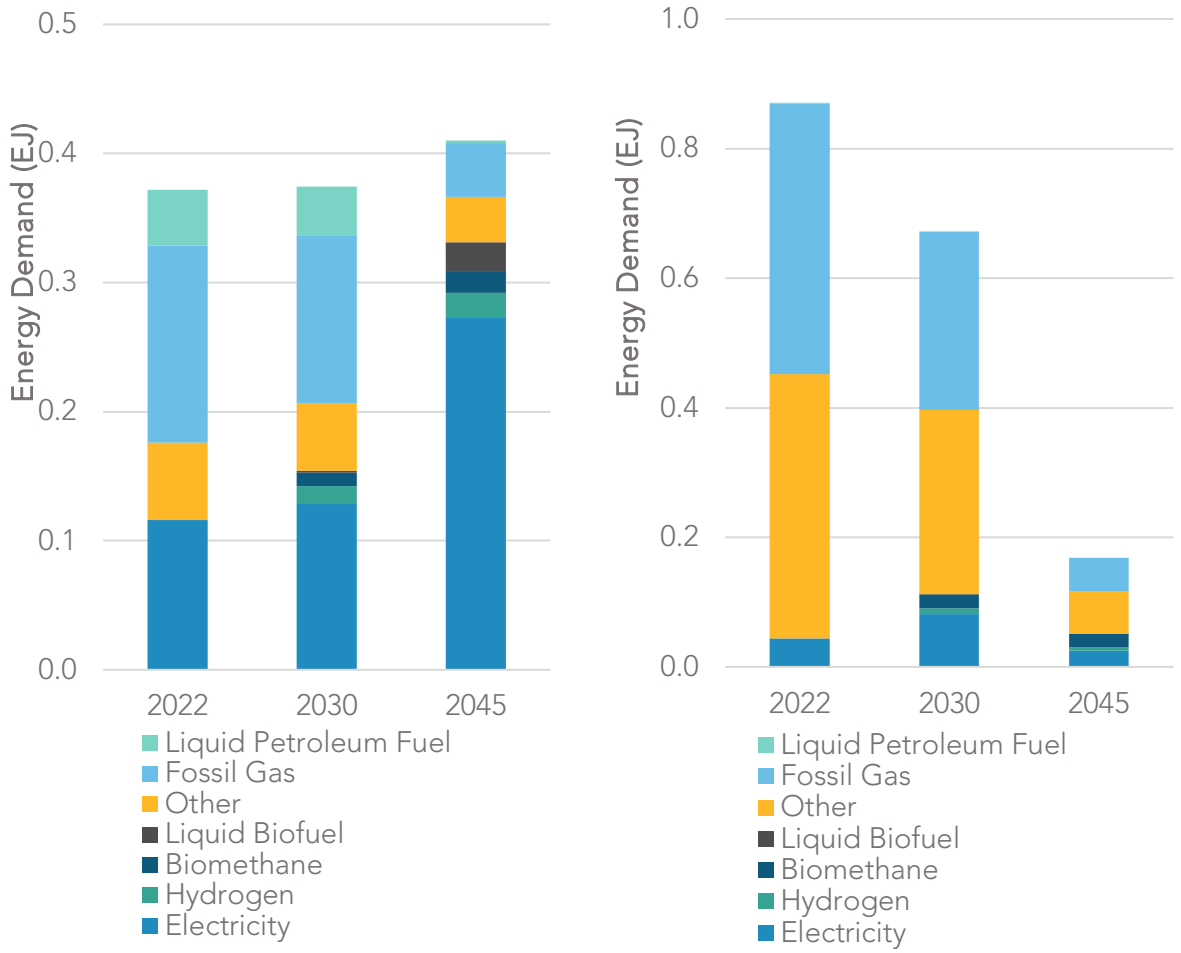
[381] National Association of Manufacturers (NAM). 2021 California Manufacturing Facts. https://www.nam.org/state-manufacturing-data/2021-california-manufacturing-facts/.
[382] NAM. 2021 California Manufacturing Facts. https://www.nam.org/state-manufacturing-data/2021-california-manufacturing-facts/.

Figure 4-7: Final energy demand in industrial manufacturing (left) and in oil and gas extraction and petroleum refining (right) in 2022, 2030, and 2045 in the Scoping Plan Scenario[383]



Electrification and solar thermal heat are best-suited to industrial processes that have relatively low heat requirements, such as food processors, paper mills, and industries that use low-pressure steam in their processes. Approaches could include replacing fossil gas boilers with electric boilers, process heaters with industrial electric heat pumps, steel forging furnaces with induction heaters, and implementing other sector-specific process electrification. Under current rate structures for industrial electricity and fossil gas in

[383] *Other* fuel in the industrial manufacturing sector is primarily coke and coal for cement production. *Other* fuel in the petroleum refining sector is primarily fossil gas associated with refining petroleum products.

California, most projects to electrify a fossil gas-powered industrial process will face operating cost barriers and potential reliability concerns. Microgrids powered by renewable resources and with battery storage are emerging as a key enabler of electrification and decarbonization at industrial facilities.

There are fewer commercially available and economically viable electrification options to replace industrial processes that require higher-temperature heat. For these processes, onsite combustion may continue to be needed, and decarbonization will require fuel substitution to hydrogen,[384] biomethane, or other low-carbon fuels. Fuel substitution and continued combustion will require monitoring and mitigation of any potential air quality impacts, especially in low-income and communities of color which already face disproportionate air pollution burdens. Industries in California with high heat needs include steel forging, glass manufacturing, and industries with calcination processes, such as manufacturing lime and cement.

Onsite emissions from cement manufacturing derive from two main sources: (1) fuel combustion to heat the kiln to a very high temperature and (2) process CO_2 emissions from the chemical transformation of limestone. Over 60 percent of emissions from the sector are process emissions unrelated to fuel use, and most emissions related to fuel use are from coal and petroleum coke combustion. Process emissions from cement manufacturing are significant and will continue even if the sector were to operate using only zero-carbon fuels; thus carbon capture and use/sequestration will be a likely component of any strategy to fully decarbonize cement manufacturing. There are additional opportunities to reduce GHG emissions from cement manufacturing via the combination of fuel-switching to low-carbon fuels (e.g., biomethane, municipal solid waste, biochar), increased blending of non-clinker materials, and efficiency improvements. High technological and economic barriers exist to electrifying kiln process heat at cement plants, as clinker production requires temperatures in excess of 1,500°C. There are potential decarbonization opportunities throughout the value chain of cement use, including in cement manufacturing, concrete mixing, and construction practices.[385] SB 596 (Becker, Chapter 246, Statutes of 2021), which was signed by Governor Newsom in September 2021, requires CARB to develop a comprehensive strategy for cement use in California to achieve a GHG intensity 40 percent below 2019 levels by 2035, and net-zero emissions by 2045.

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[384] Griffiths, Steve, Benjamin K. Sovacool, Jinsoo Kim, Morgan Bazilian, and Joao M. Uratani. 2021. "Industrial decarbonization via hydrogen: A critical and systematic review of developments, socio-technical systems and policy options." *Energy Research & Social Science* 80. 102208, ISSN 2214-6296. *https://doi.org/10.1016/j.erss.2021.102208*.

[385] California Nevada Cement Association. Achieving Carbon Neutrality in the California Cement Industry. *https://cncement.org/attaining-carbon-neutrality*.

Oil and gas extraction and refining make up over half of California's industrial GHG emissions. Reduced demand for transportation fossil fuels corresponds to reduced supply of fossil gas and other gaseous fossil fuels for refineries to produce these fuels. Some refining operations will continue to operate to produce fossil fuel for the remaining transportation energy demands, along with renewable diesel and sustainable aviation fuel, as discussed in the Transportation Sustainability section of this chapter.

Across industrial subsectors and processes, California facilities also could realize significant reductions in GHG emissions and energy-related costs by implementing advanced energy efficiency projects and tools.[386] While enhanced operation and maintenance practices are typical at industrial facilities, additional strategic energy management practices offer greater efficiency gains by focusing on setting goals, tracking progress, and reporting results.

Strategies for Achieving Success

- Maximize air quality benefits using the best available control technologies for stationary sources in communities most in need, including frontline, low-income, disadvantaged, rural, and tribal communities.[387]
- Prioritize alternative fuel transitions first in communities most in need, including frontline, low-income, disadvantaged, rural, and tribal communities.[388]
- Invest in research and development and pilot projects to identify options to reduce materials and process emissions along with energy emissions in California's industrial manufacturing facilities, leveraging programs like the CEC's Electric Program Investment Charge (EPIC).[389]
- Evaluate and propose, as needed, changes to strengthen the Cap-and-Trade Program.
- Support electrification with changes to industrial rate structures.
- Develop infrastructure for CCS and hydrogen production to reduce GHG emissions where cost-effective and technologically feasible non-combustion alternatives are not available.
- Implement SB 905.

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[386] Therkelsen, Peter, Aimee McKane, Ridah Sabouini, and Tracy Evans. 2013. *Assessing the Costs and Benefits of the Superior Energy Performance Program.* U.S Department of Energy. https://www.osti.gov/servlets/purl/1165470.

[387] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, JT14. finalejacrecs.pdf (arb.ca.gov).

[388] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, JT15. finalejacrecs.pdf (arb.ca.gov).

[389] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, M20. finalejacrecs.pdf (arb.ca.gov).

- Establish markets for low-carbon products and recycled materials using Buy Clean California Act and other mechanisms relying on robust data
- Develop a net-zero cement strategy to meet SB 596 targets for the GHG intensity of cement use in California.
- Continue to leverage energy-efficiency programs, including the U.S. DOE's ENERGY STAR program,[390] U.S. DOE's Superior Energy Performance program,[391] and ISO 50001.[392]
- Evaluate and continue to offer incentives to install energy efficiency and renewable energy technologies through programs such as CPUC decisions as part of rulemaking R.19-09-009[393] and the CEC's Food Production Investment Program (FPIP) and EPIC programs.[394]
- Leverage low-carbon hydrogen programs, including the Bipartisan Infrastructure Law, for regional hydrogen hubs, hydrogen electrolysis, and hydrogen manufacturing and recycling.
- Evaluate the role of hydrogen in meeting GHG emission reductions, including policy recommendations regarding the use of hydrogen in California as required by SB 1075.
- Address cost barriers to promote low-carbon fuels for hard-to-electrify industrial applications.

Buildings

Buildings have cross-sector interactions that influence our public health and well-being and affect land use and transportation patterns, energy use, water use, and indoor and outdoor environments.[395] There are about 14 million existing homes and over 7.5 billion square feet of existing commercial buildings[396] in California. Fossil gas supplies about half of the energy consumed by end uses in these buildings. In addition to GHG emissions, fossil gas usage in buildings also produces CO_2, NOx, $PM_{2.5}$, and

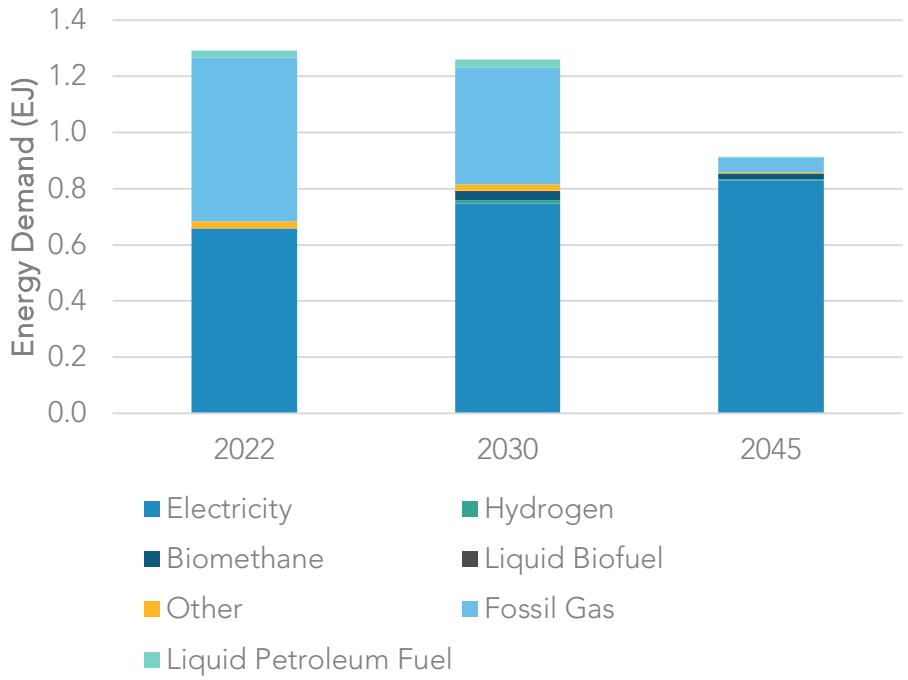
[390] ENERGY STAR. ENERGY STAR Guidelines for Energy Management. https://www.energystar.gov/buildings/tools-and-resources/energy-star-guidelines-energy-management.
[391] Energy.gov. Superior Energy Performance 50001. https://www.energy.gov/eere/amo/superior-energy-performance.
[392] ISO. ISO 50001 Energy Management. https://www.iso.org/iso-50001-energy-management.html.
[393] CPUC. January 14, 2021. CPUC Adopts Strategies to Help Facilitate Commercialization of Microgrids Statewide. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M360/K370/360370887.PDF.
[394] Bailey, Stephanie, David Erne, and Michael Gravely. 2021. *Final 2020 Integrated Energy Policy Report Update, Volume II: The Role of Microgrids in California's Clean and Resilient Energy Future, Lessons Learned From the California Energy Commission's Research.* California Energy Commission. Publication Number: CEC-100-2020-001-V2-CMF.
[395] See Appendix F (Building Decarbonization).
[396] CEC. 2021. California Building Decarbonization Assessment. https://efiling.energy.ca.gov/GetDocument.aspx?tn=239311&DocumentContentId=72767.

formaldehyde.[397] Each year, about 120,000 new homes[398] and more than 100 million-square feet[399] of commercial buildings are newly constructed across California. These new buildings will represent between a third to half of the total building stock by mid-century.

Achieving carbon neutrality must include transitioning away from fossil gas in residential and commercial buildings, and will rely primarily on advancing energy efficiency while replacing gas appliances with non-combustion alternatives. This transition must include the goal of trimming back the existing gas infrastructure so pockets of gas-fueled residential and commercial buildings do not require ongoing maintenance of the entire limb for gas delivery. Blending low-carbon fuels such as hydrogen and biomethane into the pipeline further displaces fossil gas. Pipeline safety and reliability must be evaluated to accommodate low-carbon fuels. Figure 4-8 illustrates the energy Californians use in buildings at present compared with the Scoping Plan Scenario, which introduces alternatives to fossil gas. In that scenario almost 90 percent of energy demand is electrified by 2045, and the remaining energy demand is met with combustion of hydrogen, biomethane, and fossil gas.

[397] Zhu, Yifang, et al. 2020. *Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California.* UCLA Fielding School of Public Health Department of Environmental Health Sciences.
[398] Construction Industry Research Board. 2018. Annual Building Permit Summary. *http://www.cirbreport.org*.
[399] Delforge, Pierre. August 11, 2021. California Forging Ahead on Zero Emission Buildings. Blog. NRDC. *https://www.nrdc.org/experts/pierre-delforge/california-forging-ahead-zero-emission-buildings*.

Figure 4-8: Final energy demand in buildings in 2022, 2030, and 2045 in the Scoping Plan Scenario[400]

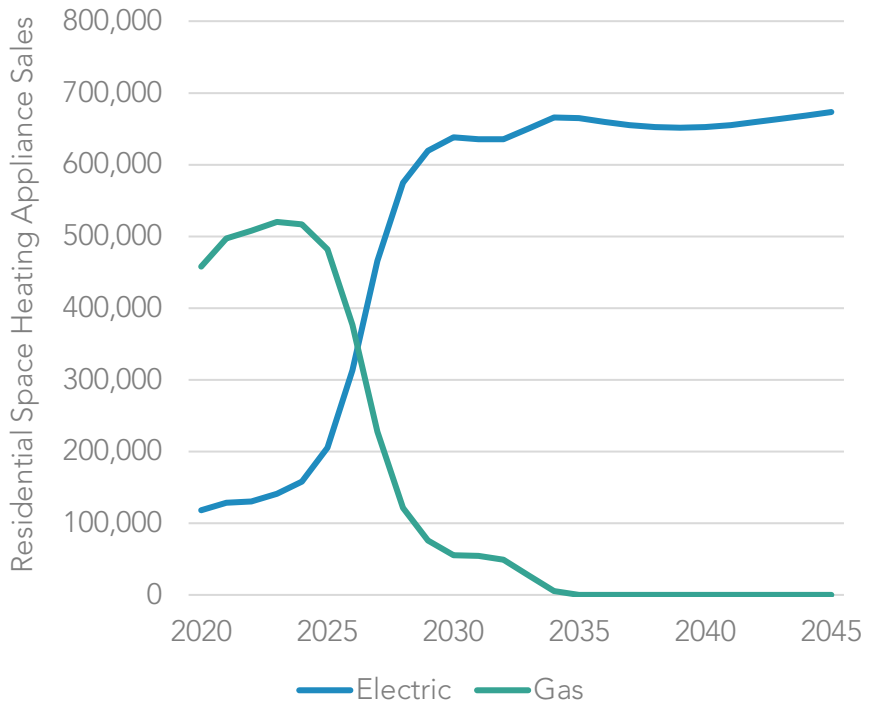


This transition is achieved when all new buildings constructed include non-combustion appliances, and appliances in existing buildings are replaced at the end of their useful life with non-combustion alternatives. Currently, electric alternatives, combined with the decarbonizing of California's grid, are the most effective alternatives, and the Scoping Plan Scenario modeled these alternatives. The Scoping Plan Scenario assumes three million all-electric and electric-ready homes by 2030 and seven million by 2035. Figure 4-9 illustrates the pace at which electric space heating appliance sales increase and gas space heating appliance sales decrease in residences in the Scoping Plan Scenario, such that by 2035 100 percent of residential home appliance sales are electric. By 2030 over six million electric heat pumps are installed statewide. The residential electric space heating appliance sales increases rapidly in the near term as new all-electric buildings are constructed and as existing buildings are renovated to utilize electric appliances. A similar transition is envisioned for other home appliances. Commercial buildings also will undergo a transition away from gas appliances to electric appliances, achieving 80 percent sales of all-electric appliances by 2035 and 100 percent by 2045. Appendix F (Building Decarbonization) describes a holistic policy approach to rapidly grow the

[400] *Other* fuel in the buildings sector is primarily liquid petroleum gas and waste heat.

number of zero emission appliances and buildings, to surmount the market barriers, and to prioritize an equitable transition for vulnerable communities.

Figure 4-9: Residential space heating appliance sales in the Scoping Plan Scenario



Strategies for Achieving Success

- Prioritize California's most vulnerable residents with the majority of funds in the new $922 million Equitable Building Decarbonization program, created through the 2022–2023 state budget. This would include residents in frontline, low-income, disadvantaged, rural, and tribal communities. This program is dedicated to a statewide direct-install building retrofit program for low-income households to replace fossil fuel appliances with electric appliances, energy-efficient lighting, and building insulation and sealing while also coordinating reductions in gas infrastructure in specific geographic areas.
- Achieve three million all-electric and electric-ready homes by 2030 and seven million by 2035 with six million heat pumps installed statewide by 2030.
- Expand incentive programs to support the holistic retrofit of existing buildings, especially for vulnerable communities.
- Ensure that incentive programs prioritize energy affordability and tenant protections, promote affordable and low-income household retrofits that improve habitability and reduce expenses, protect and empower small landlords and homeowners, address overlooked consumer groups, and pair decarbonization

with other critically needed renovation efforts to ensure that buildings support human health and are climate- and weather-resistant.[401]

- End fossil gas infrastructure expansion for newly constructed buildings.[402]
- Evaluate and propose, as needed, changes to strengthen the Cap-and-Trade Program.
- Strengthen California's building standards to support zero-emission new construction.
- Develop building performance standards for existing buildings.
- Adopt a zero-emission standard for new space and water heaters sold in California beginning in 2030, as specified in the 2022 State Strategy for the State Implementation Plan.
- Expand use of low-GWP refrigerants within buildings.
- Support electrification with changes to utility rate structures and by promoting load management programs.
- Increase funding for incentive programs and expand financing assistance programs focused on existing buildings and appliance replacements.
- Expand consumer education efforts to raise awareness and stimulate the adoption of decarbonized buildings and appliances, especially in vulnerable communities.
- Implement biomethane procurement targets for investor-owned utilities as specified in SB 1440 (Hueso, Chapter 739, Statutes of 2018) to reduce GHG emissions in remaining pipeline gas and reduce methane emissions from organic waste.

[401] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF23, NF24, NF25, NF26, NF28. *finalejacrecs.pdf (arb.ca.gov)*.
[402] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF22. *finalejacrecs.pdf (arb.ca.gov)*.

Carbon Dioxide Removal and Capture

Climate Change 2022: Mitigation of Climate Change,[403] a report by the IPCC released in early 2022, states "The deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO_2 or GHG emissions are to be achieved. The scale and timing of deployment will depend on the trajectories of gross emission reductions in different sectors. Upscaling the deployment of CDR depends on developing effective approaches to address feasibility and sustainability constraints especially at large scales." In line with that report, this Scoping Plan considers CDR as a complement to technologically feasible and cost-effective GHG emissions mitigation, and the size of its role will depend on the degree of success in reducing GHG emissions at the source across the economy. [404] The modeling shows that emissions from the AB 32 GHG Inventory sources will continue to persist even if all fossil related combustion emissions are phased out. These residual emissions must be compensated for to achieve carbon neutrality. Options for CDR include both sequestration in natural and working lands and mechanical approaches like direct air capture. Chapter 2 provides estimates on how much CO_2 removal is possible by our natural and working lands and how much must be removed by mechanical CDR.

CCS, which is carbon capture from anthropogenic point sources, is described in Chapter 2 and involves capturing carbon from a smokestack of an emitting facility. Direct air capture, on the other hand, captures carbon directly from the atmosphere. Direct air capture technologies, unlike CCS, are not associated with any particular point source.

For this section, *carbon management* refers to the capture, movement, and sequestration of CO_2 through mechanical solutions for both capture at point sources and direct removal from the atmosphere through direct air capture.[405] Enabling policies and regulations across each of these steps are necessary for individual projects, and on a broader scale, for delivering reductions in support of the state's carbon neutrality and long-term carbon-negative goals. Figure 4-10 provides a graphic of the typical carbon management infrastructure.

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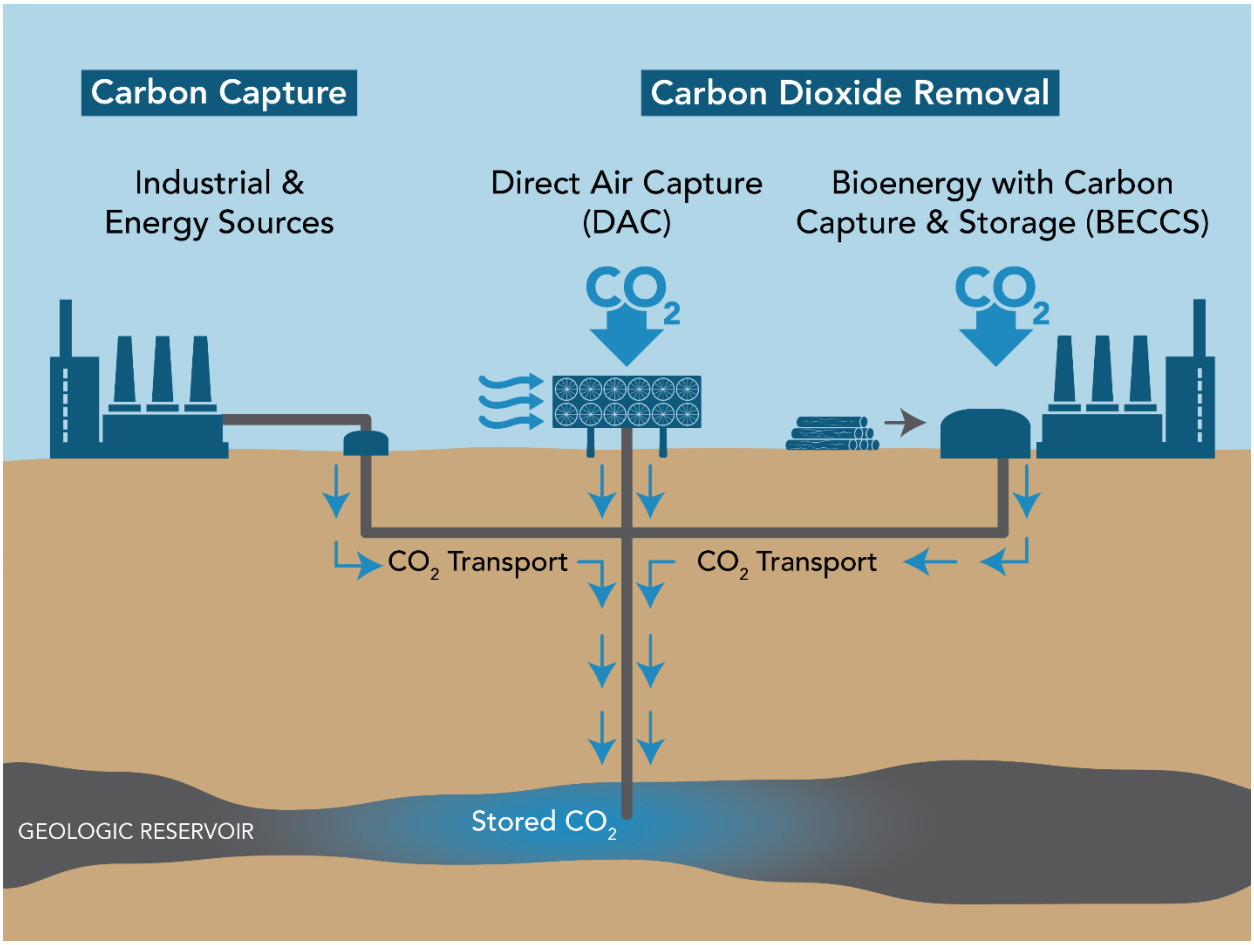
[403] IPCC. 2022. *Climate Change 2022: Mitigation of Climate Change.* https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/.
[404] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F4.7. finalejacrecs.pdf (arb.ca.gov).
[405] CDR through natural and working lands is discussed in Chapter 2 and later in this chapter.

Figure 4-10: Carbon management infrastructure



Carbon dioxide removal directly from the atmosphere itself refers to a suite of carbon negative technologies that can be used to draw down ongoing and historical carbon emissions already in the atmosphere. Some CO_2 removal technologies leverage the abilities of both natural photosynthesis and mechanical removal by using biomass wastes as inputs to make low- or zero-carbon energy or fuels, all while capturing and storing produced CO_2.

Captured CO_2 from point sources or from the atmosphere is permanently stored in specialized geologic formations, typically half a mile or more underground. A recent Stanford University study estimated the state's commercial storage potential is nearly 70,000 million metric tons of CO_2, even when excluding oil and gas reservoirs.[406] California is well-positioned because few other places on the West Coast are suitable for

[406] Stanford Center for Carbon Storage. Opportunities and Challenges for CCS in California. https://sccs.stanford.edu/california-projects/opportunities-and-challenges-for-CCS-in-California.

geologic storage at scale. To inform discussion around CO_2 removal, CARB held two full-day workshops exploring the types of options for carbon capture and geologic storage and utilization in products.[407,408,409]

The modeling results provided in Chapter 2 demonstrate the targeted need for CCS on large facilities such as refineries and cement. The CCS numbers do not include the potential additional applications for producing hydrogen with biomethane, other manufacturing, electricity, or other bioenergy. If CCS is not deployed, those emissions would be released directly into the atmosphere and instead need to be addressed through CDR to achieve carbon neutrality. Although a study finds California has 76 existing electricity and industrial facilities that are suitable candidates for CCS retrofit,[410] this Scoping Plan proposes a targeted role for this technology such that it would only be used to address sectors where non-combustion options are not technologically feasible or cost-effective at this time, to the extent needed to achieve the 85 percent reduction in anthropogenic emissions as called for in AB 1279. In future updates to the Scoping Plan, there may be additional options for technologically feasible or cost-effective technologies that may be deployed, which would further reduce the need for CCS and CDR except in situations to address historical GHG emissions.

Recognizing the need for carbon capture and utilization sequestration and removal, the Legislature passed, and the governor signed, SB 905. It includes several key requirements in the development of the state's Carbon Capture Removal, Utilization, and Storage Program. The following is a summary of the work to be completed to establish and administer this program. Many of these steps will address the need to evaluate the safety and efficacy of actions to support carbon removal, sequestration, and transfer via pipelines. Note that not all of these actions are under CARB's authority.

- Review technology to evaluate efficacy, safety, viability of CCUS/CDR methodologies.
- Develop monitoring and reporting requirements and schedules.
- Develop a unified permit application.
- Develop financial responsibility requirements.
- Develop a centralized public database for project status.

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[407] CARB. December 11, 2019. Carbon Neutrality Meetings & Workshops. *https://ww2.arb.ca.gov/our-work/programs/carbon-neutrality/carbon-neutrality-meetings-workshops*.
[408] CARB. August 2, 2021 Scoping Plan Meetings & Workshops. *https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/scoping-plan-meetings-workshops*.
[409] *Carbon utilization* refers to the use of captured carbon to produce products such as plastics and concrete.
[410] Glenwright, Kara. 2020. *Roadmap for carbon capture and storage in California.* Precourt Institute for Energy. *https://earth.stanford.edu/news/roadmap-carbon-capture-and-storage-california#gs.ysj78q.*

- Consult with CNRA on pore space requirements as CNRA develops a framework for pore space governing agreements.
- Establish a Geologic Carbon Sequestration Group to identify suitable injection well locations, subsurface monitoring, and potential hazards that may require suspension of injection.

SB 905 also has requirements for project developers such as to develop monitoring plans and to avoid any adverse health and environmental impacts at the carbon capture location—or mitigation of unavoidable impacts as required under existing requirements. For the site of injection, there are requirements for site stability, monitoring, and reporting plans. SB 905 also bans CCS with enhanced oil recovery in California and prohibits the transfer of CO_2 via pipeline until the U.S. Department of Transportation's Pipelines and Hazardous Materials Safety Administration (PHMSA) completes its current rulemaking to update existing CO_2 pipeline safety requirements.

An often-cited example of pipeline concerns involves a CO_2 pipeline in Mississippi. On February 22, 2020, a CO_2 pipeline operated by Denbury Gulf Coast Pipelines LLC (Denbury) ruptured in proximity to the community of Satartia, Mississippi. The rupture followed heavy rains that resulted in a landslide, creating excessive axial strain on a pipeline weld (DOT 2022). The combination of weather and topography resulted in a slower dissipation of the gas. The pipeline was also carrying hydrogen sulfide, a flammable and toxic gas. The pipeline failed on a steep embankment, which had recently subsided. Heavy rains are believed to have led to a landslide, which created axial strain on the pipeline and resulted in a full circumferential girth weld failure. The PHMSA investigation also revealed several contributing factors to the accident, including but not limited to: Denbury not addressing the risks of geohazards in its plans and procedures, underestimating the potential affected areas that could be impacted by a release in its CO_2 dispersion model, and not notifying local responders to advise them of a potential failure.

As the Satartia example highlights, appropriate pipeline safety and environmental standards in California are critical to minimize any risks from CO_2 transport in the future. As such, SB 905 also tasks CNRA, in consultation with the Public Utilities Commission, to, no later than February 1, 2023, provide a proposal to the Legislature to establish a state framework and standards for the design, operation, siting, and maintenance of intrastate pipelines carrying CO_2 fluids of varying composition and phase to minimize the risk posed to public and environmental health and safety. The recommended framework shall be designed to minimize risk to public health and environmental health and safety, to the extent feasible. Because SB 905 prohibits the transfer of CO_2 via pipeline until the PHMSA completes its current rulemaking to update existing CO_2 pipeline safety requirements, CCS or CDR projects that would require a pipeline to transfer CO_2 are not feasible at this time within California.

Ultimately, and in accordance with SB 905, the merits of each CCS or CDR project must be evaluated on a case-by-case basis.[411] Deployment of CCS and CDR could support skilled jobs and workforces, including those in traditional fossil energy communities. Other co-benefits could include criteria air pollutant reductions and water production. It will be important to design projects that do not exacerbate community health impacts, include early and ongoing community engagement, and are in compliance with local, state, and federal public health and environmental protection laws. It also should be noted that, as these types of projects are an emerging area of governance, additional coordination and discussion will be needed among the various levels of authorities involved. SB 905 has already initiated this process by assigning specific agencies with tasks related to their expertise and authority.

Chapter 2 includes a more detailed discussion about the proposed role of CO_2 removal in this Scoping Plan.

Sector Transition

State,[412] national,[413,414] and global decarbonization analyses[415] indicate a significant role for carbon management infrastructure, yet relatively few projects are operational. Around the world, about two dozen large CCS projects are capturing tens of millions of metric tons of CO_2 each year, with about a dozen operating in the United States.[416] The vast majority of capacity is at industrial facilities, such as ethanol and fertilizer plants, that would otherwise vent nearly pure CO_2 into the atmosphere as a by-product of normal, non-combustion processes. Future research, development, and demonstration projects must refine and commercialize capture systems for more complex applications, especially

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[411] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F4.5. *finalejacrecs.pdf (arb.ca.gov)*.
[412] E3. October 2020. Achieving Carbon Neutrality in California Report: Final Presentation. *https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_presentation_oct2020_2.pdf*.
[413] World Resources Institute. January 31, 2020. CarbonShot: Federal Policy Options for Carbon Removal in the United States. Working paper. *https://www.wri.org/research/carbonshot-federal-policy-options-carbon-removal-united-states*.
[414] C2ES. No date. Getting to Zero: A U.S. Climate Agenda — Center for Climate and Energy Solutions. *https://www.c2es.org/getting-to-zero-a-u-s-climate-agenda-report/*.
[415] IPCC. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. Chapter 2. *https://www.ipcc.ch/sr15/chapter/chapter-2/*. All analyzed pathways limiting warming to 1.5°C with no or limited overshoot use CDR to some extent to neutralize emissions from sources for which no mitigation measures have been identified and, in most cases, also to achieve net negative emissions to return global warming to 1.5°C following a peak (high confidence). The longer the delay in reducing CO_2 emissions toward zero, the larger the likelihood of exceeding 1.5°C, and the heavier the implied reliance on net negative emissions after mid-century to return warming to 1.5°C (high confidence).
[416] Congressional Research Service. 2021. Carbon Capture and Sequestration (CCS) in the United States. R44902. *https://crsreports.congress.gov/product/pdf/R/R44902?msclkid=e45e0012c25911ec8085ca575cb61e82*.

for those with limited decarbonization options. It has only been in the last few years that attention has seriously turned to mechanical CDR. As new information and modeling on climate change have been made available, the science has become clearer that avoiding the most catastrophic impacts of climate change requires both reducing emissions and deploying mechanical CDR.

California is paving a path forward on a science-based carbon management infrastructure policy that can serve as an example for other jurisdictions. The LCFS, which reduces the carbon intensity of transportation fuels, includes a protocol for select carbon management projects to become certified and generate LCFS credits.[417] CCS is not a new concept or technology. Twenty years of CCS testing show it is a safe and reliable tool.[418] As mentioned in Chapter 2, while no new CCS projects have been implemented or generated any credits under the CARB CCS protocol, CCS projects have been implemented elsewhere since the 1970s. Moreover, there has been a U.S. Department of Energy CCS research program underway for more than two decades. These all form a foundation of information for future efforts. Certified projects must successfully demonstrate adherence to rigorous pre-construction, operational, and site closure standards designed to strengthen environmental performance, as described in CARB's CCS Protocol. The protocol is designed to layer on top of existing federal carbon sequestration regulations designed to protect the environment. The protocol would need to be reevaluated if CCS were to be more broadly applied across sectors beyond transportation fuel production.

Direct air capture and carbon mineralization have high potential capacity for removing carbon, but direct air capture is currently limited by high cost. Carbon mineralization may also have high potential for removing carbon from the atmosphere, but understanding of the technology is still limited.[419] Direct air capture could also be deployed at higher rates to remove legacy GHG emissions from the atmosphere. Chapter 2 contains additional information on the current status of CCS and mechanical CDR projects globally, as well as federal support of such technologies.

Strategies for Achieving Success

- Implement SB 905.

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[417] CARB. 2018. Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard. August 13. *https://ww2.arb.ca.gov/sites/default/files/2020-03/CCS_Protocol_Under_LCFS_8-13-18_ada.pdf*.

[418] National Energy Technology Laboratory. Permanence and Safety of CCS. *https://netl.doe.gov/coal/carbon-storage/faqs/permanence-safety*.

[419] Aines, Roger. No date. Options for Removing CO_2 from California's Air. Lawrence Livermore National Laboratory. *https://ww2.arb.ca.gov/sites/default/files/2021-08/llnl_presentation_sp_engineeredcarbonremoval_august2021.pdf*.

- Convene a multi-agency Carbon Capture and Sequestration Group comprised of federal, state, and local agencies to engage with environmental justice advocates, tribes, academics, researchers, and community representatives to identify the current status, concerns, and outstanding questions concerning CCS, and develop a process to engage with communities to understand specific concerns and consider guardrails to ensure safe and effective deployment of CCS.[420]
- Iteratively update the CARB CCS Protocol with the best available science and implementation experience.
- Incorporate CCS into other sectors and programs beyond transportation where cost-effective and technologically feasible options are not currently available and to achieve the 85 percent reduction in anthropogenic sources below 1990 levels as called for in AB 1279.
- Evaluate and propose, as appropriate, financing mechanisms and incentives to address market barriers for CCS and CDR.
- Evaluate and propose, as appropriate, the role for CCS in cement decarbonization (SB 596) and as part of hydrogen production pathways (SB 1075).
- Support carbon management infrastructure projects through core CEC research, development, and demonstration (RD&D) programs.
- Continue to explore carbon capture applications for producing or leveraging zero-carbon power for reliability needs as part of SB 100.
- Consider carbon capture infrastructure when developing hydrogen roadmaps and strategy, especially for non-electrolysis hydrogen production.
- Evaluate and streamline permitting barriers to project implementation while protecting public health and the environment.
- Explore options for how local air quality benefits can be achieved when CCS is deployed.
- Explore opportunities for CCS and CDR developers to leverage existing infrastructure, including subsurface infrastructure.
- Explore permitting options to allow for scaling the number of sources at carbon sequestration hubs.

Short-Lived Climate Pollutants (Non-Combustion Gases)

Short-lived climate pollutants (SLCPs) include black carbon (soot), methane (CH_4), and fluorinated gases (F-gases, including hydrofluorocarbons [HFCs]). They are powerful climate forcers and harmful air pollutants that have an outsized impact on climate change

[420] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F4.9. finalejacrecs.pdf (arb.ca.gov).

in the near term, compared to longer-lived GHGs, such as CO_2. According to the IPCC's *Climate Change 2021: The Physical Science Basis,* in the near-term (i.e., 10- to 20-year time scale) the warming influence of all SLCPs combined will be at least as large as that of CO_2.[421] The United Nations Environment Programme's Global Methane Assessment[422] advises that achieving the least-cost pathways to limit warming to 1.5°C requires global methane emission reductions of 40–45 percent by 2030 alongside substantial simultaneous reductions of all climate forcers, including CO_2 and SLCPs. Action to reduce these powerful emissions sources today will provide immediate benefits—both to human health locally and to reduce warming globally—as the effects of our policies to transition to low carbon energy systems and achieve carbon neutrality further unfold.

In 2017, the Board approved the comprehensive Short-Lived Climate Pollutant Reduction Strategy (Strategy).[423] This strategy explained how the state would meet the following SB 1383-established targets:

- 40 percent reduction in total methane emissions[424] (including a separate 40 percent reduction in dairy and livestock emissions)
- 40 percent reduction in hydrofluorocarbon gas emissions
- 50 percent reduction in anthropogenic black carbon emissions
- 50 percent reduction of organic waste disposal from 2014 levels by 2020, and 75 percent by 2025, including recovery of at least 20 percent of edible food for human consumption

The state is expected to achieve roughly half of the SB 1383 targeted emissions reductions by 2030 through strategies currently in place (See Figure 4-11). As directed by the Legislature under SB 1383, state agencies focused on voluntary, incentive-based mechanisms to reduce SLCP emissions in the early years of implementation to overcome technical and market barriers. Under this "carrot-then-stick" strategy, incentives are replaced with requirements as the solutions become increasingly feasible and cost-effective. To meet legislated targets, more aggressive action is needed.

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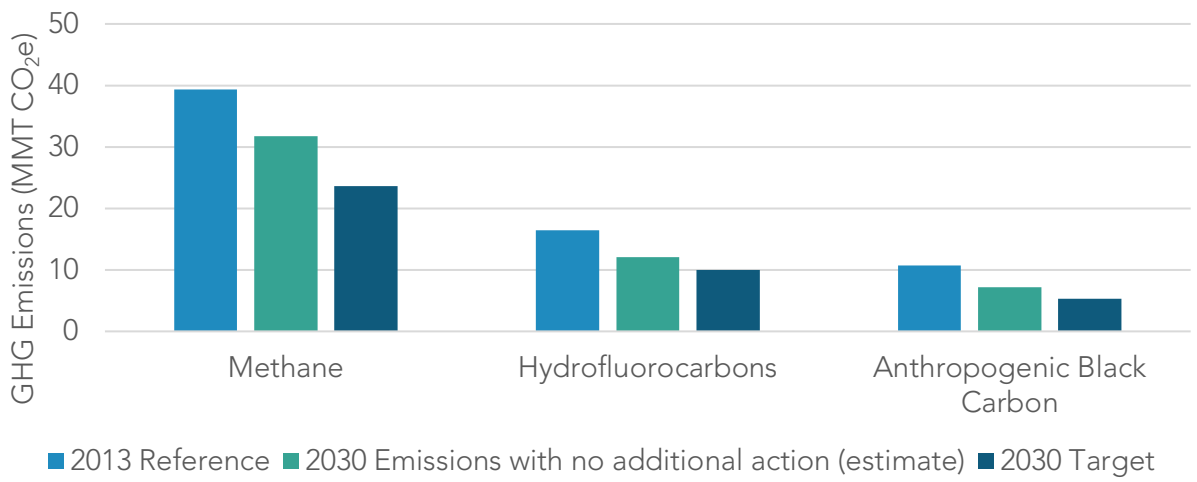
[421] IPCC. 2021. *Climate Change 2021:The Physical Science Basis.* https://www.ipcc.ch/report/ar6/wg1/.
[422] United Nations. Global Methane Assessment. Summary for Policymakers. https://wedocs.unep.org/bitstream/handle/20.500.11822/35917/GMA_ES.pdf.
[423] CARB. 2017. Short-Lived Climate Pollution Reduction Strategy. https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf.
[424] All SB 1383 emissions reductions are mandated to be realized by 2030 and are relative to 2013 levels.

Figure 4-11: Expected progress toward SB 1383 targeted emissions reductions by 2030 through strategies currently in place



While the state's overall GHG emissions have declined by 9 percent over the past decade, SLCP emissions reductions have not kept pace with broader progress toward decarbonization. After growing steadily in the preceding decade, methane emissions have remained relatively flat since 2013.

HFCs are the fastest growing source of GHG emissions, primarily driven by their use to replace ozone-depleting substances and an increased demand for cooling and refrigeration.[425] Since 2005, statewide HFC emissions have more than doubled. While the rate of increase has slowed in recent years due to the state's measures, HFC emissions are still on the rise in California, and have grown by over 50 percent since 2010.[426] Globally, as temperatures rise, adoption of cooling technologies (and refrigerants) is increasing rapidly. If no measures are taken, it is estimated that HFCs will account for 9 to 19 percent of the total global GHG emissions by 2050.[427]

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[425] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020: Trends of Emissions and Other Indicators.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf.

[426] CARB. 2022. *California Greenhouse Gas Emissions for 2000 to 2020.* https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/2000-2020_ghg_inventory_trends.pdf.

[427] Velders, G. J., D. W. Fahey, J. S. Daniel, M. McFarland, and S. O. Andersen. 2009. "The large contribution of projected HFC emissions to future climate forcing." *Proceedings of the National Academy of Sciences* 106(27), 10949–10954.

Methane

Human sources of methane emissions are estimated to be responsible for up to 25 percent of current warming.[428] Fortunately, methane's short atmospheric lifetime of ~12 years[429] means that emissions reductions will rapidly reduce concentrations in the atmosphere, slowing the pace of temperature rise in this decade. Further, a substantial portion of the targeted reductions can be achieved at low cost and will provide significant human health benefits. For example, the UN's *Global Methane Assessment* (2021)[430] found that over half of the available targeted measures have mitigation costs below $21/MTCO$_2$e, and that each million metric tons of methane reduced would prevent 1,430 premature deaths annually due to ozone pollution caused by methane.

Following the Twenty Sixth Conference of Parties (COP26) (the United Nations Convention on Climate Change in 2021), over 110 nations have signed onto the Global Methane Pledge (Pledge)[431] to limit methane emissions by 30 percent relative to 2020 levels. The Pledge covers countries that emit nearly half of all methane and make up 70 percent of global GDP. The UN's Global Methane Assessment[432] shows that human-caused methane emissions can be reduced by up to 45 percent this decade, which would avoid nearly 0.3°C of global warming by 2045.

As shown in Figure 4-12, the three largest sources of California's methane emissions are the dairy and livestock industry, landfills, and oil and gas systems.

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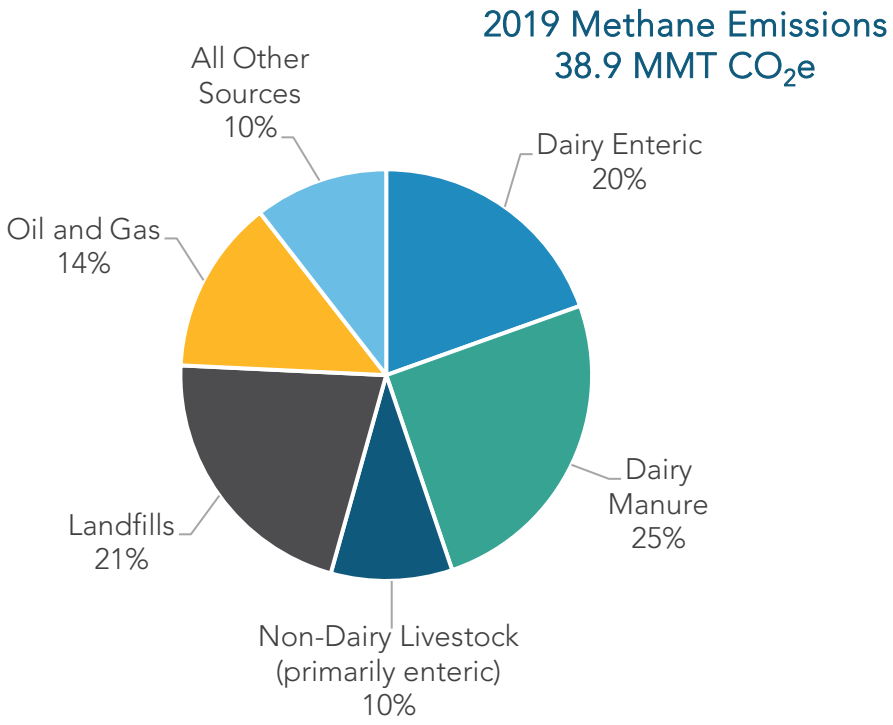
[428] IPCC. 2021. *Climate Change 2021:The Physical Science Basis.* https://www.ipcc.ch/report/ar6/wg1/.
[429] In contrast, the lifetime of CO_2 is hundreds of years. The IPCC Third Assessment Report concluded that no single lifetime can be defined for CO_2 because of the different rates of uptake by different removal processes. According to IPCC Fourth Assessment Report, the majority of an increase in CO_2 will be removed from the atmosphere within decades to a few centuries, while the remaining 20 percent may stay in the atmosphere for many thousands of years.
[430] United Nations. 2021. Global Methane Assessment. https://wedocs.unep.org/bitstream/handle/20.500.11822/35917/GMA_ES.pdf.
[431] Global Methane Pledge. https://www.globalmethanepledge.org/.
[432] United Nations Environment Programme. 2021. Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions. https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions?msclkid=00661370c85811eca078eb8fdbd603d1.

Figure 4-12: Sources of California methane emissions (2019)



Emissions from dairy and livestock operations come from two main sources: (1) enteric fermentation and (2) manure management operations, especially at dairies that employ open anaerobic lagoons that allow methane to escape into the atmosphere. Landfills, the second largest source of methane emissions, produce methane from the decomposition of organic waste. Although approximately 95 percent of all the waste that has been disposed of in the state has been deposited in a landfill that is equipped with a gas collection and control system, as required by California's Landfill Methane Regulation,[433] a portion of the methane still escapes into the atmosphere. Fugitive methane emissions can be intermittent and highly variable, both seasonally and spatially, particularly at landfills. Research has shown that landfills are complex systems and a wide range of conditions (e.g., atmospheric, operational, biological, chemical, and physical) may contribute to variability in rates of organic waste degradation, methane generation, and capture efficiency, so reducing the amount of organics deposited in landfills is critical to reducing overall landfill methane emissions. And despite the variability in individual landfill emissions, landfill gas collection and control systems remain the most effective strategy

[433] CARB. Landfill Methane Regulation. https://ww2.arb.ca.gov/our-work/programs/landfill-methane-regulation.

for reducing methane emissions from waste once it is placed in a landfill. Non-combustion methane emissions from the oil and gas sector are the third largest source of methane emissions in California. Almost three-quarters of the methane emissions from this sector come from leaks and venting from fossil gas transmission and distribution pipelines and equipment.

Hydrofluorocarbons

HFCs are synthetic GHGs that are powerful climate forcers. They are used mainly as refrigerants or heat transfer fluids in refrigeration, space conditioning, and heat pump equipment. Refrigerants are ubiquitous and are used everywhere from supermarkets, convenience stores, cold storage warehouses and wineries, to vending machines and residential and motor vehicle air-conditioners. Additionally, HFCs are also used as foam-blowing agents, solvents, aerosol-propellants, and fire suppressants. While HFCs remain in the atmosphere for a much shorter time than CO_2, the relative global warming potential (GWP) values of HFCs can be hundreds to thousands of times greater than CO_2. The mix of HFCs currently in use in California, weighted by usage (tonnage), have an average 100-year GWP of 1,700.[434] The average atmospheric lifetime of the mix of HFCs in use is 15 years.[435] Given the short average lifetimes, rapid reductions in HFC emissions can translate into near-term reductions in climate change effects.

As the global temperatures increase, the demand for cooling and refrigerants will continue to grow, as will the use of electric heat pumps to replace conventional fossil gas heating options. Unless addressed, continued use of high-GWP HFCs will perpetuate a feedback loop, where the cooling agents themselves cause additional warming.

In 2016, representatives from 197 nations signed the Kigali Amendment, which amended the existing Montreal Protocol (to reduce ozone-depleting substance production and consumption) to include a global phasedown in the production and consumption of HFCs beginning in 2019.[436] As of September 2022, 137 nations have either accepted, approved, or ratified the Kigali Amendment. On September 21, 2022, the U.S. Senate approved ratification of the Kigali Amendment, and it is expected that the United States

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[434] CARB. 2020. *Initial Statement of Reasons: Public Hearing to Consider the Proposed Amendments to the Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols-Propellants, and Foam End-Uses Regulation.* October 20. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hfc2020/isor.pdf?_ga=2.164659835.592460318.1646664679-912670513.1542398285.

[435] Zhongming, Z., et al. 2011. *HFCs: A Critical Link in Protecting Climate and the Ozone Layer: A UNEP Synthesis Report.*

[436] United Nations Treaty Collection. Chapter XXVII, Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-2-f&chapter=27&clang=_en.

will soon join the 137 nations that have already ratified.[437] In the United States, Congress enacted the federal *American Innovation and Manufacturing (AIM) Act* in December 2020.[438] The AIM Act authorizes the U.S. EPA to address HFCs in several ways, including a national HFC phasedown that nearly mirrors the schedule of the global phasedown under the Kigali amendment.[439]

Nearly 90 percent of HFC emissions in California come from their use as refrigerants in the commercial, industrial, residential, and transportation sectors. The timescales over which the HFC emissions occur vary, depending on the type of application. Thus, strategies to reduce HFC emissions must be tailored by equipment type. CARB has several measures in place to tackle HFC emissions from the various sources shown in Figure 4-13 below. This includes the Refrigerant Management Program[440] that tracks and manages emissions from large commercial, industrial, and cold storage refrigeration facilities in the state. CARB has adopted regulations to reduce HFC emissions from consumer product aerosol propellants, semiconductor manufacturing, and small cans of automotive refrigerant.[441]

In 2018, California adopted HFC prohibitions via regulation and legislation for several sectors, including stationary refrigeration and foam end uses to backstop the partially vacated federal Significant New Alternatives Policy (SNAP) program.[442] Most recently, in 2020, CARB adopted additional measures that place GWP limits on refrigerants used in refrigeration and air conditioning equipment, which are the largest sources of HFC emissions, and are commonly used in residential, commercial, and industrial buildings. Additionally, CARB adopted a unique pilot program requiring the use of reclaimed refrigerant: the Refrigerant Recovery, Reclaim, and Reuse (R4) Program. The newly adopted HFC rules for the refrigeration and air conditioning sectors are the first of their kind in the nation.

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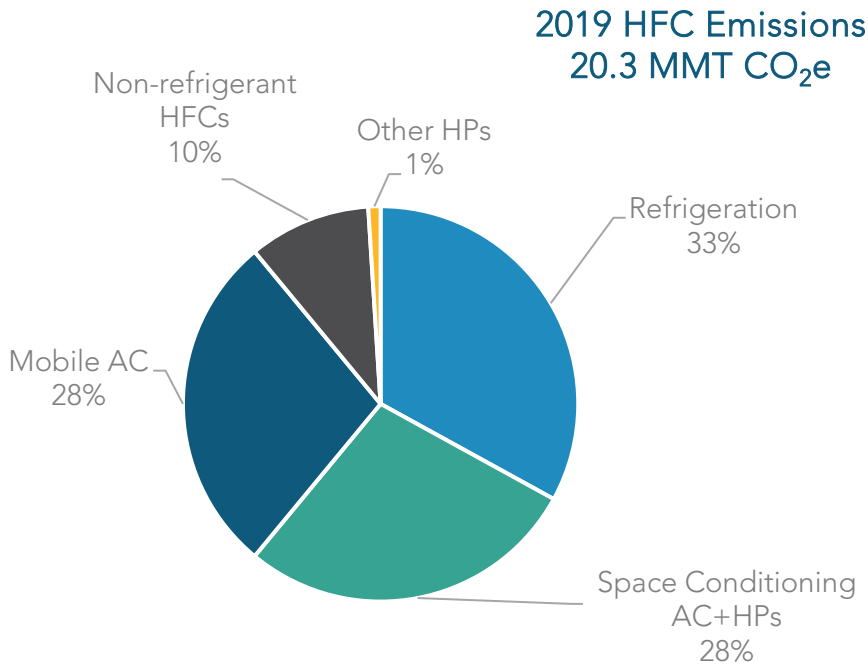
[437] U.S. Ratification of the Kigali Amendment - United States Department of State. *https://www.state.gov/u-s-ratification-of-the-kigali-amendment/*.
[438] 42 U.S.C § 7675, Pub. L. 116-260, § 103. *https://www.epa.gov/sites/default/files/2021-03/documents/aim_act_section_103_of_h.r._133_consolidated_appropriations_act_2021.pdf*.
[439] 42 U.S.C § 7675, Pub. L. 116-260, § 103.
[440] Cal. Code of Regs., tit. 17, §§ 95380, et seq.
[441] Contained in various sections, commencing with Cal. Code of Regs., tit. 13, §§ 1900 et seq.
[442] Cal. Code of Regs., tit. 17, §§ 95371, et seq.; California Cooling Act, Senate Bill 1013 (Lara, Stats. of 2018, Ch. 375, Health & Saf. Code § 39764).

Figure 4-13: Sources of hydrofluorocarbon (HFC) emissions (2019)

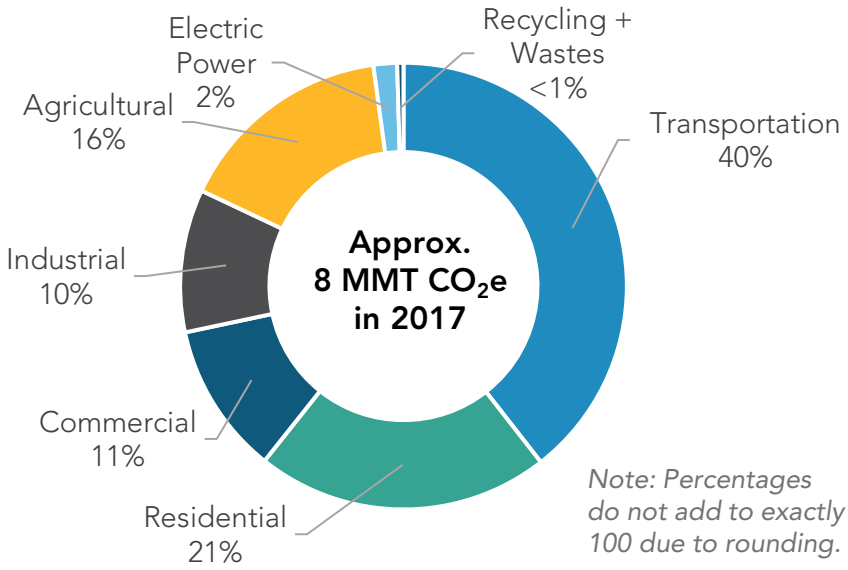


Anthropogenic Black Carbon

Black carbon is not included in AB 32 or the state's AB 32 GHG inventory that tracks progress toward the state's climate targets; however, it has been identified as a powerful climate forcer and is included California's Short-Lived Climate Pollutant Reduction Strategy. The majority of anthropogenic black carbon emissions come from transportation, specifically heavy-duty vehicles, and they have decreased since 2013 due to engine certification standards and in-use rules for on-road and off-road fleets, along with clean fuel requirements and incentives, including California Climate Investments and LCFS credits. Additionally, fuel combustion for residential, commercial, and industrial applications contribute significantly to overall black carbon emissions. Approximately 95 percent of residential black carbon emissions are due to wood combustion; these emissions are being reduced through programs like the Woodsmoke Reduction Program established by SB 563 (Lara, Chapter 671, Statutes of 2017). Alternatives to agricultural burning and policies that phase out agricultural burning will also result in agricultural black carbon emissions reductions. In 2021 CARB provided a preliminary estimate of 2017

black carbon emissions (Figure 4-14).[443] This estimate will be finalized as part of a future update to the Short-Lived Climate Pollutant Inventory.

Figure 4-14: Sources of anthropogenic black carbon (preliminary 2017 estimates; AR5 100-yr GWP 900)



Sector Transition

California has long recognized the importance of mitigating non-combustion SLCPs and took several early action measures as part of a comprehensive, ongoing program to reduce in-state GHG emissions under AB 32. The early action measures included CARB's Landfill Methane Regulation,[444] Refrigerant Management Program,[445] and Oil and Gas Methane Regulation.[446]

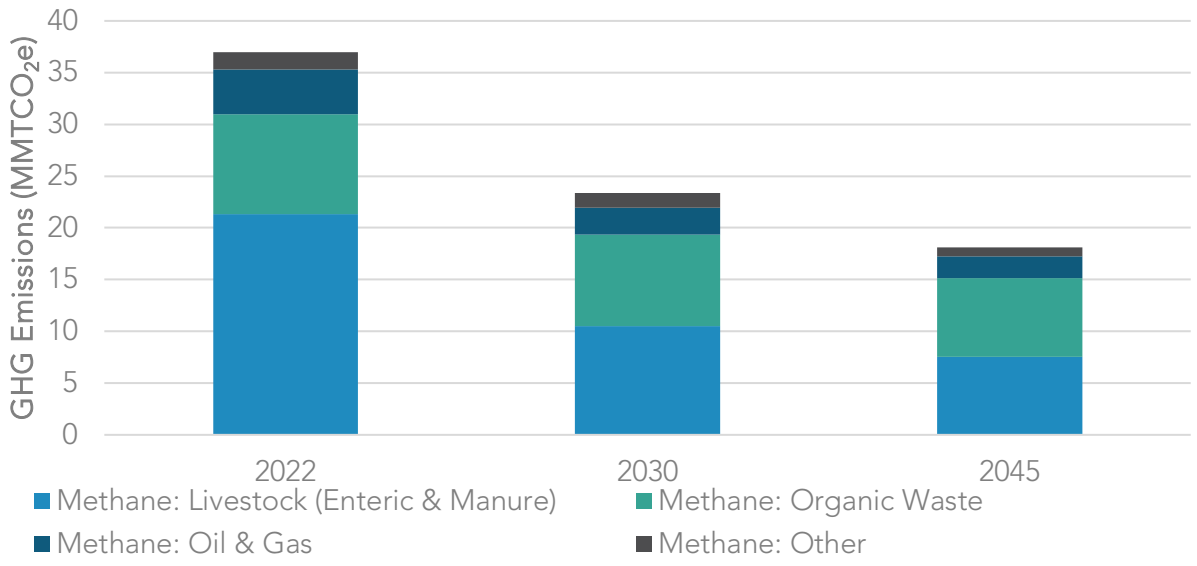
Methane

The methane abatement strategies currently in place are projected to achieve half of the methane emissions needed to meet the overall methane reduction target of SB 1383 (40 percent reduction by 2030). The reduction target translates to a limit of less than 24 MMTCO_2e in 2030 (Figure 4-15). It is anticipated that, since some sectors have fewer

[443] CARB. 2021. 2022 Scoping Plan Update – Short-Lived Climate Pollutants Workshop Presentation, September 8. https://ww2.arb.ca.gov/sites/default/files/2021-09/carb_presentation_sp_slcp_september2021_1.pdf.
[444] Cal. Code of Regs., tit. 17, §§ 95460, et seq.
[445] Cal. Code of Regs., tit. 17, §§ 95380, et seq.
[446] Cal. Code of Regs., tit. 17, §§ 95665–77.

strategies that can be implemented to reduce methane in the near-term, other sectors will need to go beyond the 40 percent reduction to meet the target.

Figure 4-15: Methane emissions in 2022, 2030, and 2045 in the Scoping Plan Scenario[447]



Dairy and Livestock Methane

California is the largest dairy-producing state, home to one in five U.S. dairy cows. To date, methane emissions reductions from the dairy and livestock sector have mainly been driven by a decreasing animal population and the growing adoption of manure management strategies, including anaerobic digesters and conversion to dry manure systems and pasture systems. CARB recently completed a detailed analysis of the emission reductions expected by 2030 and the estimated additional investment needed to reach the dairy and livestock sector methane reduction target. [448]

Assuming no adoption of additional manure management and enteric mitigations strategies beyond the projects that have committed funding, and a continued annual animal population decrease of 0.5 percent per year through 2030, further reductions of approximately 4.4 $MMTCO_2e$ will be needed to achieve the 2030 methane emissions reduction target for the sector set by SB 1383. If the remaining reductions are met through

[447] The *Organic Waste* category includes methane from landfills, wastewater treatment, and compost facilities.
[448] CARB. 2021. Analysis of Progress toward Achieving the 2030 Dairy and Livestock Sector Methane Emissions Target. June. *https://ww2.arb.ca.gov/sites/default/files/2021-06/draft-2030-dairy-livestock-ch4-analysis.pdf*.

a mix of dairy projects in which half are dairy digesters and half are alternative manure management projects, then it is estimated that at least 420 additional projects will be necessary. Additional emissions reductions beyond this level will likely be necessary to ensure that the overall state methane emissions reduction targets are met.

Despite the considerable methane emissions mitigation potential of enteric strategies like feed additives, little progress has been made, as few products with proven mitigation potential have become commercially available, and unlike manure management strategies, there is a lack of financial incentives for their adoption.

Market conditions favoring farm consolidation and improved production efficiencies have driven reductions in the California and U.S. dairy population over the past decade. [449] These efficiency gains have allowed California to maintain production levels despite the decreasing population. If demand for dairy and beef products remains steady or increases, continued improvements in production efficiency and adoption of effective manure management and enteric mitigation strategies will be important to support dairy and livestock methane emission reductions.

Strategies for Achieving Success

- Install state of the art anaerobic digesters that maximize air and water quality protection, maximize biomethane capture, and direct biomethane to sectors that are hard to decarbonize or as a feedstock for energy.
- Increase alternative manure management projects, including but not limited to conversion to "solid," "dry," or "scrape" manure management; installation of a compost-bedded pack barn; an increase in the time animals spend on pasture; and implementation of solid-liquid separation technology into flush manure management systems.
- Implement enteric fermentation strategies that are cost-effective, scientifically proven, safe for animal and human health, and acceptable to consumers, and that do not impact animal productivity. Provide financial incentives for these strategies as needed.
- Accelerate demand for dairy and livestock product substitutes such as plant-based or cell-cultured dairy and livestock products to achieve reductions in animal populations.
- In consideration of pace of deployment of methane mitigation strategies and the scale of complimentary incentives, consider regulation development to ensure that the 2030 target is achieved, assuming the conditions outlined in SB 1383 are met.

[449] MacDonald, James M., Jonathan Law, and Roberto Mosheim. 2020. *Consolidation in U.S. Dairy Farming.* ERR-274. July. https://www.ers.usda.gov/webdocs/publications/98901/err-274.pdf.

Landfill Methane

Achieving the 75 percent organic waste disposal reduction target[450] of SB 1383, and maintaining that level of disposal in subsequent years, would bring annual landfill emissions in 2030 to just below the 2013 baseline. Annual methane emissions will be higher through 2030 than originally anticipated by the SLCP Strategy because the state did not achieve the anticipated reductions in organic waste disposal of 50 percent below 2014 levels by 2020. SB 1383 prohibited the organic disposal regulations from taking effect until 2022,[451] and, as a result, emissions have continued to increase.

Due to the multidecadal time frame required to break down landfilled organic material, the emissions reductions from diverting organic material in one year are realized over the course of several decades. For example, one year of waste diversion in 2030 is expected to avoid 8 $MMTCO_2e$ of landfill emissions, cumulatively, over the lifetime of that waste's decomposition.[452] Near-term diversion efforts are critical to avoid locking in future landfill methane emissions.

CalRecycle's 2020 report, *Analysis of the Progress Toward the SB 1383 Waste Reduction Goals,*[453] estimated that 8 million short tons of composting and anerobic digestion capacity will be needed to manage organic wastes, above the existing and new capacity expected to be available by 2025. The 2019 report, *Co-Digestion Capacity in California,*[454] from the State Water Resources Control Board estimated that at least 2.4 million tons of digester capacity is available at urban wastewater treatment plants if sufficient incentives or funding for collection, receiving, and processing operations are provided to enable utilization of this capacity. The CPUC approved a decision in February 2022 implementing the biomethane procurement program, which will require investor-owned utilities by 2025 to procure 17.6 billion cubic feet (BCF) of biomethane produced from organic wastes to support the landfill disposal reduction and SLCP target and reduce fossil gas reliance for

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[450] The target is from 2014 levels by 2025.
Public Resources Code, § 42652.5. CalRecycle approved the SLCP: Organic Waste Reductions regulations (*https://calrecycle.ca.gov/organics/slcp/*) in 2020 and began implementing them in January 2022. These regulations are designed to achieve the 2025 disposal reduction and edible food recovery targets.

[452] The life cycle emissions reduction is based on anticipated diversion of 27 million short tons of organic waste from CalRecycle (2020) Analysis of the Progress Toward the SB 1383 Organic Waste Reduction Goals (*https://www2.calrecycle.ca.gov/Publications/Details/1693*). Under CalRecycle's SLCP regulations, an alternative to landfill disposal must achieve a life cycle GHG reduction of 0.3 $MTCO_2e$ per short ton of waste diverted.

[453] CalRecycle. 2020. *Analysis of the Progress Toward the SB 1383 Waste Reduction Goals.* *https://www2.calrecycle.ca.gov/Publications/Details/1693*.

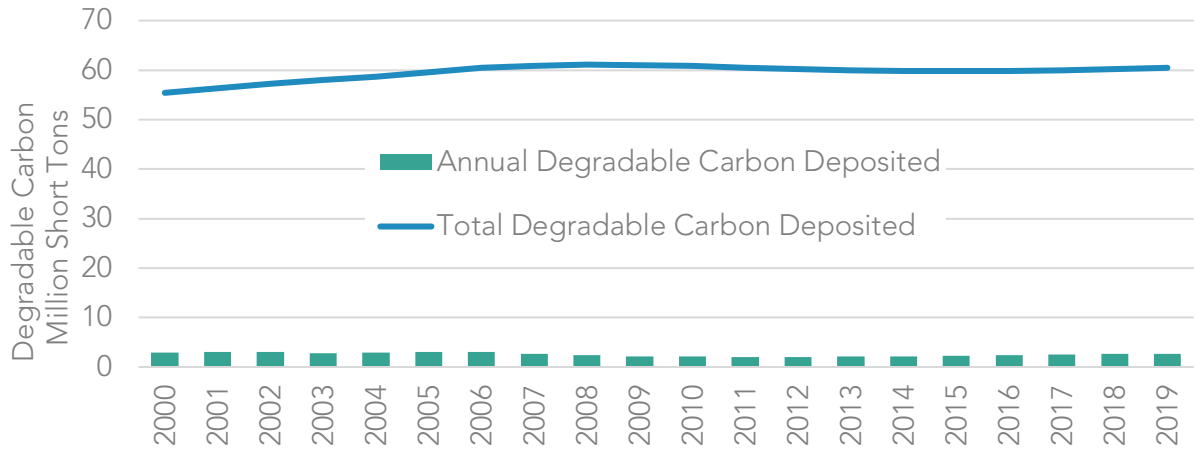
[454] State Water Resources Control Board. 2019. *Co-Digestion Capacity in California.* *https://www.waterboards.ca.gov/water_issues/programs/climate/docs/co_digestion/final_co_digestion_capacity_in_california_report_only.pdf*.

residential and commercial customers.[455] Additionally, the organic waste stream includes more than one million tons of edible food that could be recovered before it enters the waste stream through food rescue programs that combat hunger in communities throughout California.

While reducing organic waste disposal is the most effective means of achieving reductions in waste sector methane, strategies to reduce emissions from waste already in place in landfills also will play a role in achieving near-term reductions. As Figure 4-16 shows, the total degradable carbon (a measure of the amount of waste with potential to generate methane) that is accumulated from waste deposited in previous years is over 20 times greater than the amount added each year. This illustrates that even if we were able to entirely phase out landfilling of organic waste today, the existing waste in place at landfills would continue to generate methane for decades into the future.

Through a combination of improvements in operational practices, use of lower permeability covers, advanced landfill gas collection systems, and increased monitoring to detect and repair leaks, it is estimated that a direct emission reduction of 10 percent is achievable across the state's landfills by 2030. Technologies to utilize landfill gas efficiently can contribute further emission reductions in the energy sector.

Figure 4-16: Degradable carbon deposited in landfills



Strategies for Achieving Success

- Maximize existing infrastructure and expand it to reduce landfill disposal, with strategies including composting, anaerobic digestion, co-digestion at wastewater treatment plants, and other non-combustion conversion technologies.

[455] CPUC. 2022. Decision 22-02-025.

- Expand markets for products made from organic waste, including through recognition of the co-benefits of compost, biochar, and other products.[456]
- Recover edible food to combat food insecurity.
- Invest in the infrastructure needed to support growth in organic recycling capacity.
- Utilize existing digesters at wastewater treatment facilities to rapidly expand food waste digestion capacity.
- Direct biomethane captured from landfills and organic waste digesters to sectors that are hard to decarbonize.
- Implement improved technologies and best management practices at composting and digestion operations.
- Reduce emissions from landfills through improvements in operational practices, lower permeability covers, advanced collection systems, and technologies to utilize landfill gas.
- Leverage advances in remote sensing capabilities to quickly pinpoint large methane sources and mitigate leaks, improve understanding of the factors that lead to better capture efficiency, and explore new technologies and practices that can reliably improve methane control at landfills.

Upstream Oil and Gas Methane Reduction

For oil and gas production, processing, and storage, California is currently on track to achieve a 41 percent reduction in methane emissions by 2025 relative to 2013. The additional reductions needed to meet the 2030 target may be achieved by implementing additional regulatory requirements to further reduce intentional venting of fossil gas from equipment. If necessary, additional reductions from transmission and distribution facilities may be achieved by requiring the utilities to increase inspection and repair activities or further reduce emissions from pipeline blowdowns by implementing methods such as using portable compressors, using plugs to isolate sections of pipelines, flaring vented gas, routing gas to fuel gas systems, and installing static seals on compressor rods. Advances in methane detection technologies (e.g., satellites equipped to detect large methane sources) may also help to identify and mitigate methane emissions quickly across the oil and gas sector.

As California transitions away from fossil fuels, in-state oil and gas production will likely decline. This could result in an increase over time in the number of long-term idle and orphan wells (idle wells lacking a financially solvent, responsible owner) in the state. While California has regulations aimed at helping ensure operators manage their idle wells,

[456] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F4.4. finalejacrecs.pdf (arb.ca.gov).

there could likely be an increase in California's orphan well population. Plugging all orphan wells, of which there are currently over 5,000, could take decades due to the limited resources California has for orphan well plugging. The benefits from plugging wells include methane emission reductions and job creation; employment gains from well plugging and site remediation activities could help temporarily offset job losses from the oil and gas industry. The California Council on Science and Technology's 2018 report on orphan wells, *Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities to Plug and Decommission Orphan Oil and Gas Wells,*[457] found that the potential cost to the state of plugging current orphan wells could be approximately $500 million, and the cost of plugging all active and idle wells could total over $9.1 billion. As oil and gas production in California declines due to reduced demand for fossil fuels, additional funding will likely be needed to cover the costs of plugging wells that have no viable operator.

Strategies for Achieving Success

- Mitigate emissions from leaks by regular leak detection and repair (LDAR) surveys at all facilities.
- Replace high emitting equipment with zero emission alternatives wherever feasible.[458]
- Have CARB and CalGEM lead a Task Force to identify and address methane leaks from oil infrastructure near communities.
- Pursuant to SB 1137, develop leak detection and repair plans for facilities in health protection zones, implement emission detection system standards, and provide public access to emissions data.
- Minimize emissions from equipment that must vent fossil gas by design (e.g., fossil gas powered compressors).
- Install vapor collection systems on high emitting equipment.
- Phase out venting and routine flaring of associated gas (gas produced as a by-product during oil production).
- Continuous ambient monitoring at fossil gas underground storage facilities to quickly detect large methane sources.
- Reduce pipeline and compressor blowdown emissions.

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[457] The California Council on Science and Technology. 2018. *Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities to Plug and Decommission Orphan Oil and Gas Wells.* *https://ccst.us/wp-content/uploads/CCST-Orphan-Wells-in-California-An-Initial-Assessment.pdf*.

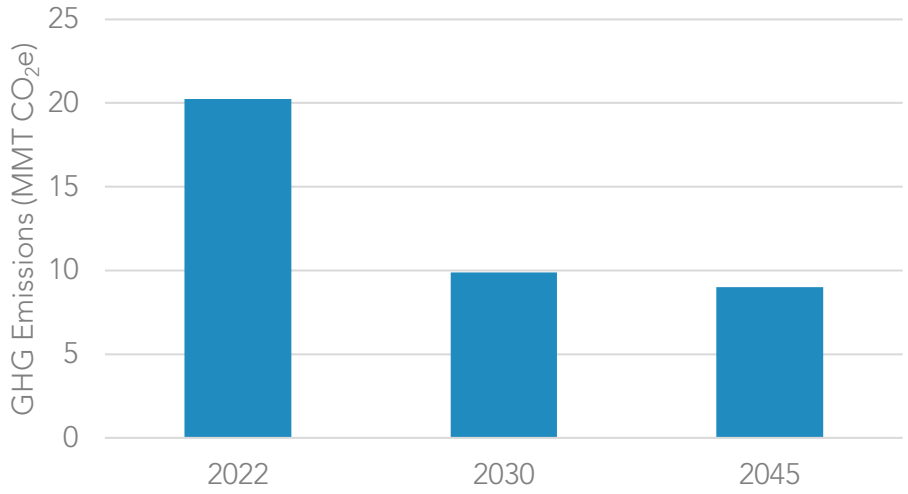
[458] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, P5. *finalejacrecs.pdf (arb.ca.gov)*.

- Leverage advances in remote sensing capabilities to quickly pinpoint large methane sources and mitigate leaks.[459]

Hydrofluorocarbons

In California, all the HFC measures currently in place will help achieve more than 70 percent of the reductions needed to achieve the 2030 HFC goal and provide very significant emissions reductions by 2045 and beyond. However, new targeted measures will be needed to maintain the pace of reductions, as demand for technologies that currently predominantly use high-GWP refrigerants is anticipated to grow. Despite decarbonization efforts, high-GWP HFCs are expected to be among the last remaining persistent GHG emission sources, as shown in Figure 4-17.[460]

Figure 4-17: Hydrofluorocarbon emissions in 2022, 2030, and 2045 in the Scoping Plan Scenario



HFC emissions from new and existing sources should be addressed in tandem with building decarbonization efforts to maximize reductions.[461] As buildings are electrified in an effort to decarbonize them, the use of heat pumps for space conditioning, water heaters, and clothes dryers is expected to increase significantly. Heat pumps, while using

[459] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, CC17. finalejacrecs.pdf (arb.ca.gov).
[460] Energy and Environmental Economics, Inc. 2020. *Achieving Carbon Neutrality.* https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf.
[461] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF26. finalejacrecs.pdf (arb.ca.gov).

electricity, not fossil gas, currently rely predominantly on high-GWP refrigerants. Very low- or no-GWP technologies and solutions are either available or emerging for various heat pump technologies, and likely to develop further as international efforts to mitigate HFCs continue. However, most of these technologies are still nascent in the United States. In addition, some of the alternatives cannot be used until California building codes are updated, which is currently expected at the earliest in mid-2024 for some technologies based on the recently adopted provisions in AB 209[462] requiring the California Building Standards Commission to adopt the latest safety standards for refrigerant containing equipment into California's building codes. The current updates to the building codes will allow the use of many refrigerants with lower GWPs than HFCs currently in use. However, additional building code updates are needed to expand the choices of ultra-low-GWP alternatives, and that will need to happen in the next few years. The adoption of low-GWP refrigerants must occur in parallel with building decarbonization efforts; without such efforts, the vast GHG benefits of the latter will be partially offset, and the proportion of HFC emissions from buildings will continue to grow.

Leaks from existing air conditioning and refrigeration equipment are a major source of statewide and global HFC emissions. Once installed, refrigeration and air conditioning equipment can stay in place for decades, while leaking refrigerants into the atmosphere. This makes it very important that new installed equipment use refrigerants with a GWP as low as possible. The refrigerants inside existing equipment are sometimes collectively referred to as the *installed base* or *banks* of potential HFC emissions. If released spontaneously, the existing HFC banks would equal 60 percent of all annual statewide GHG emissions in California, as illustrated in Figure 4-18.[463]

The sales prohibitions on newly produced refrigerants set forth in SB 1206 (2022) and the national/international HFC phasedown will help in reducing HFC emissions from existing equipment by restricting the supply of and increasing the value of existing high-GWP HFCs, thus enabling a circular economy. In the 2022–2023 state budget, CARB received $45 million in incentive funding for climate-friendly refrigerant technologies; this funding will be critical in shifting the market toward the best available refrigerant technologies in various sectors.

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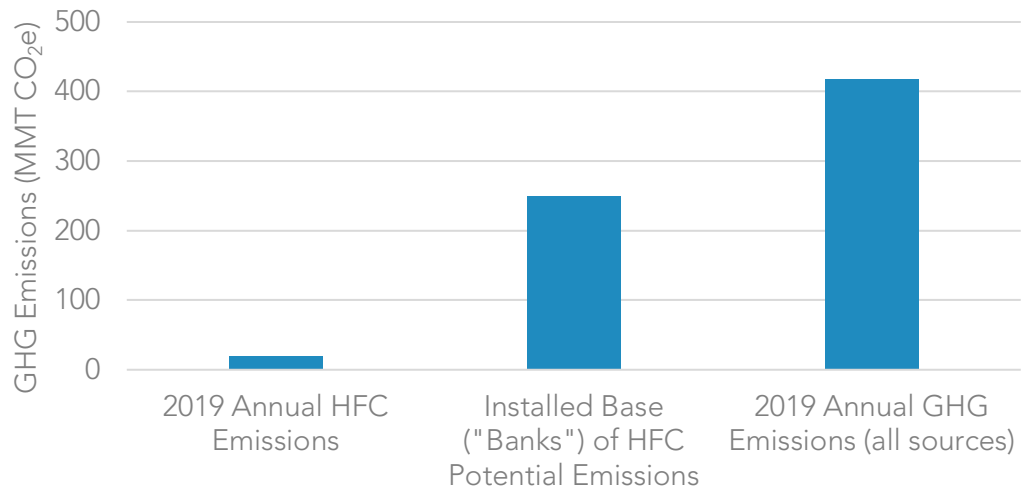
[462] AB 209: Energy and climate change. *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB209.*

[463] CARB. 2021. 2022 Scoping Plan Update – Short-Lived Climate Pollutants Workshop Presentation. September 8. *https://ww2.arb.ca.gov/sites/default/files/2021-09/carb_presentation_sp_slcp_september2021_1.pdf*.

Figure 4-18: Potential emissions from refrigerants in existing equipment



Strategies for Achieving Success

- Expand the use of very low- or no-GWP technologies in all HFC end-use sectors, including emerging sectors, like heat pumps for applications other than space conditioning, to maximize the benefits of building decarbonization.[464]
- Convert large HFC emitters such as existing refrigeration systems to the lowest practical GWP technologies.[465]
- Prioritize small-scale and independent grocers serving priority populations in addressing existing "banks" of high-GWP refrigerants.[466]
- Improve recovery, reclamation, and reuse of refrigerants by limiting sales of new or virgin high-GWP refrigerants and requiring the use of reclaimed refrigerants where appropriate.[467]
- Assist low-income and disadvantaged communities in obtaining low-GWP space conditioning units to protect vulnerable communities from heat stress and wildfire smoke.[468]

[464] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF26. finalejacrecs.pdf (arb.ca.gov).
[465] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF22. finalejacrecs.pdf (arb.ca.gov).
[466] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, JT5 and JT6. finalejacrecs.pdf (arb.ca.gov).
[467] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, JT1. finalejacrecs.pdf (arb.ca.gov).
[468] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, NF28, JT5, and JT6. finalejacrecs.pdf (arb.ca.gov).

- Accelerate technology transitions in California and the U.S. overall by collaborating with international partners committed to taking action on HFCs under the Kigali Amendment to the Montreal Protocol; this includes addressing barriers to adoption of very low- or no-GWP refrigerant technologies such as high upfront costs, shortage of trained technicians, and lag in updating safety standards and building codes.

Anthropogenic Black Carbon

Significant progress has been made since 2013 to reduce anthropogenic black carbon emissions, primarily from decreased combustion of distillate fuels in the agricultural sector, as well as improvements to provide cleaner, on-road combustion technologies. Under current strategies, anthropogenic black carbon from transportation is expected to be reduced by over 60 percent in 2030. Continued reductions in combustion emissions across all sectors from both the state's climate and air quality programs will also help reduce anthropogenic black carbon emissions going forward.

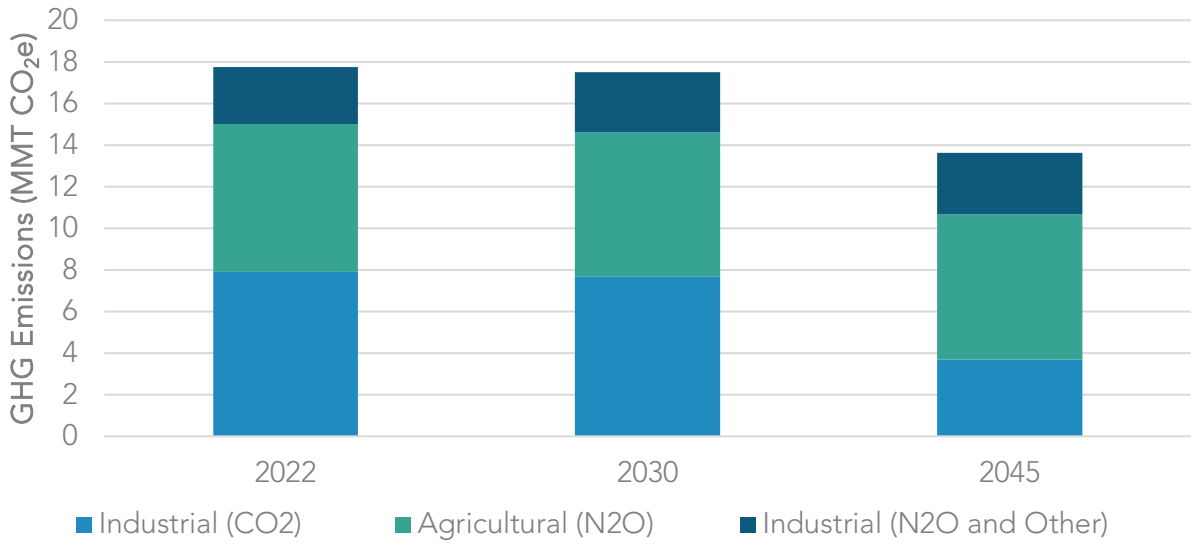
Strategies for Achieving Success

- Reduce fuel combustion commensurate with state's climate and air quality programs, particularly from reductions in transportation emissions and agricultural equipment emissions.[469]
- Invest in residential woodsmoke reduction.

In addition to SLCP emissions, some remaining non-combustion emissions are anticipated to persist in the coming decades, as shown in Figure 4-19. These include CO_2 from industrial processes such as cement manufacturing, oil and gas extraction, and geothermal electric power; N_2O from wastewater treatment, fertilizers, and livestock manure applied to agricultural soils; and other industrial, non-HFC GHG emissions.

[469] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, F1A and Appendix A (Table Summary of Direct Emission Reduction Strategies). "Emissions reductions from energy consumed by California's agricultural sector, including post-harvest processing, use of tractors and other farm equipment, and water import and irrigation." finalejacrecs.pdf (arb.ca.gov).

Figure 4-19: Remaining non-combustion emissions in 2022, 2030, and 2045 in the Scoping Plan Scenario



Natural and Working Lands

California's natural and working lands (NWL) cover approximately 90 percent of the state's 105 million acres,[470] and include forests, grasslands, shrublands and chaparral, croplands, wetlands, sparsely vegetated lands, and the green spaces in urban and built environments. These lands include California Native American tribes' ancestral and cultural lands, parks and green spaces in our cities and communities, and the waters and the iconic landscapes we know and love. The diverse landscapes and biodiversity found throughout California's NWL provide a multitude of benefits to the people of California, including clean water, clean air, biodiversity, food, economic prosperity, recreational opportunities, continuation of traditional tribal ways of life, mental health benefits, and many others.

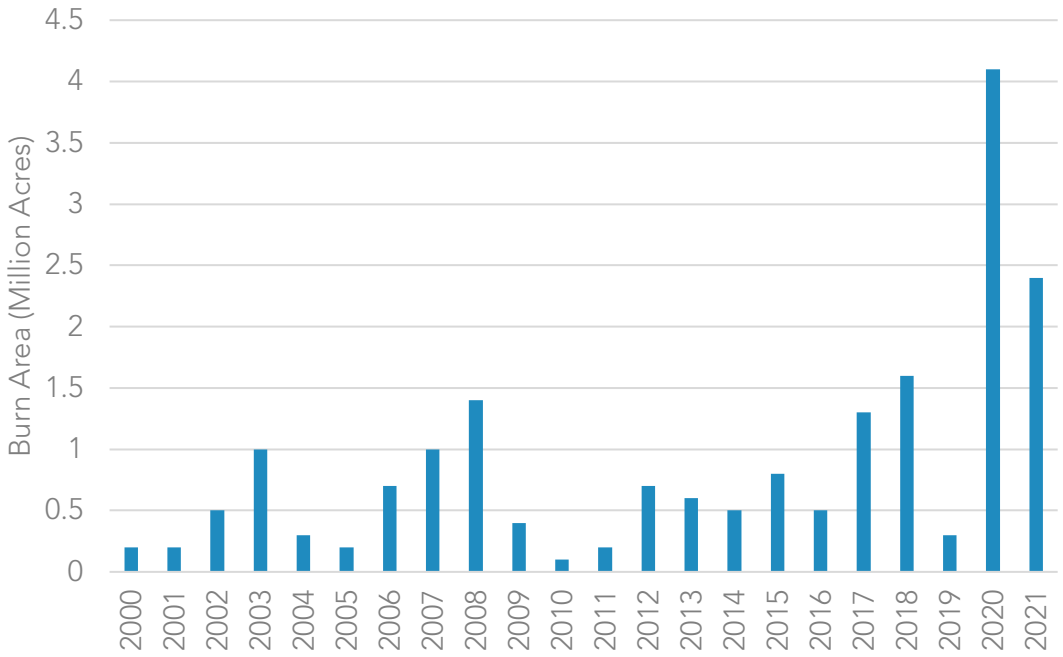
Our lands are a critical sector in California's fight to achieve carbon neutrality and build resilience to the impacts of climate change. Healthy land can sequester and store atmospheric CO_2. Healthy lands also can reduce emissions of powerful SLCPs, limit the release of future GHG emissions, protect people and nature from the impacts of climate change, and build our resilience to future climate risks. Creation of healthy lands through

[470] CNRA. 2022. Natural and Working Lands Climate Smart Strategy. *https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/CNRA-Report-2022---Final_Accessible_Compressed.pdf*.

multi-benefit and mitigation measures can also support tribal and local traditional lifeways. Unhealthy lands have the opposite effect—they release more GHGs than they store and are more vulnerable to future climate change impacts.

Climate change impacts have become more apparent in recent years and are having significant effects on communities throughout the state. One of these impacts is the much more frequent occurrence of unusually large, high-severity wildfires, which are being driven by climate change and by a recent history of fire-exclusion and land management practices that have resulted in forests with high levels of biomass. These recent large and high-severity wildfires have resulted in a significant amount of burned acreage and emissions in California (Figure 4-20).[471]

Figure 4-20: Acreage of burned wildland vegetation area



These wildfires deviate from the lower-severity fires that previously occurred at frequent intervals, around which California's forests evolved. As climate change accelerates, these large, uncharacteristic wildfires are likely to become more common and impact more of our landscapes. Climate change is also expected to have other significant effects on our lands, including more extreme droughts, floods, extreme heat, and the spread of invasive aquatic and terrestrial species, pests, diseases, and parasites. These impacts can lead

[471] CARB. 2022. Wildfire Emission Estimates for 2021. https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/Wildfire%20Emission%20Estimates%202000-2021.pdf.

to negative feedback loops on human and ecological health; for example, increasing the spread of invasive species can lead to increases in pesticide use, if not managed through regulation or mitigation, which can pose risks to human health and the environment.

California's approach to climate action in the NWL sector is not solely focused on maximizing carbon stocks but instead on supporting carbon management that holistically fosters ecosystem health, resilience, provision of overall climate function, and other co-benefits.

Natural systems operate on a longer timescale than the energy and industrial sectors, and benefits from climate action on our lands can take decades to accrue. Scaling climate smart land management in California requires taking action now and playing the "long game" by establishing and maintaining consistent, patient approaches and programs.

Landscapes

For the first time, this Scoping Plan includes modeling for the NWL sector. The focus of the initial modeling is limited to seven land types that align with the those in the NWL Climate Smart Strategy.[472] Work will continue to incorporate more landscapes and management practices into the modeling over time. The initial landscapes included in the modeling for this Scoping Plan are:

- Forests
- Shrublands and Chapparal
- Grasslands
- Croplands
- Wetlands
- Developed Lands
- Sparsely Vegetated Lands

Each of these land types are a key component to the state's approach to increasing climate action in the NWL sector, as called for in Executive Order N-82-20 and AB 1757.[473] The Executive Order directs CARB to update the target for this sector in support of carbon neutrality by 2045 as part of this Scoping Plan, and to take into consideration the NWL Climate Smart Strategy. AB 1757 calls for the development of an

[472] CNRA. 2022. *Natural and Working Lands Climate Smart Strategy. Appendix B.* *https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/Appendix-B_04132022_ada.pdf*.

[473] AB 1757 California Global Warming Solutions Act of 2006: Climate Goal: Natural and Working Lands. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB1757*.

ambitious range of targets for the NWL sector to be integrated into the Scoping Plan and other state policies. It directs CARB and CNRA to work closely together to update the NWL Climate Smart Strategy, and establish an expert advisory committee to inform and advise on NWL modeling, targets, and implementation strategies.[474] Additionally, in 2021, the governor signed SB 27[475] (Skinner, Chapter 237, Statutes of 2021) into law. It directed CARB to establish CO_2 removal targets for 2030 and beyond and take into consideration the NWL Climate Smart Strategy. The governor's Executive Order, AB 1757, and SB 27 go beyond previous direction from the Legislature and past administrations. These directives emphasize the importance of quantifying land-based carbon both statewide,[476] and in programs and policies,[477] setting targets[478] for NWL to support the state's climate objectives, and advancing land management actions[479] that support the health and resiliency of these lands.

Blue carbon (also known as carbon captured and held in coastal vegetation and soils, such as seagrasses, seaweeds, and wetlands)—is also important to consider as we look at long-term climate goals. While this landscape is not currently covered by IPCC inventory guidelines or included in California's NWL Inventory, the United States was the first nation to include blue carbon in its national GHG emissions inventory. California's Ocean Protection Council and San Francisco Estuary Institute are partnering to create a new coastal wetlands, beaches, and watersheds inventory. CARB staff will utilize information from this effort and assess other available data to evaluate how this landscape may be integrated into our efforts in the future as more data become available.[480]

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[474] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N20. *finalejacrecs.pdf (arb.ca.gov)*.
[475] SB 27 Carbon sequestration: state goals: natural and working lands: registry of projects. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB27*.
[476] SB 859 Public resources: greenhouse gas emissions and biomass (SB 859, Committee on Budget and Fiscal Review, Chapter 368, Statutes of 2016). *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB859*.
[477] SB 1386. Resource conservation: working and natural lands. (SB 1386, Chapter 545, Statutes of 2016). *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1386*.
[478] CARB. 2017. 2017 Climate Change Scoping Plan Update. Board Resolution 17-46. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/res/2017/res17-46.pdf*.
[479] Executive Department. State of California. EO B-52-18. *https://www.ca.gov/archive/gov39/wp-content/uploads/2018/05/5.10.18-Forest-EO.pdf*.
[480] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N2. *finalejacrecs.pdf (arb.ca.gov)*.

Trends of Carbon on Landscapes

CARB currently tracks the carbon stock changes though the Inventory of Ecosystem Carbon in California's Lands[481] (NWL Inventory), which is summarized in Chapter 1. The NWL Inventory is a key tool for tracking changes in carbon stocks across the state, and it will serve as the inventory of record for this sector, tracking sector-wide progress toward the target. The NWL Inventory provides a retrospective snapshot of the status of California's lands, and captures the gains or losses of carbon stocks that occur over time. In addition to tracking carbon stock changes, the NWL Inventory is an important tool for understanding the impacts of our efforts to increase climate action in this sector (such as those identified in this Scoping Plan and the NWL Climate Smart Strategy) on NWL carbon stocks. The inventory is also used as the foundation for Scoping Plan scenario modeling and target setting.

CARB's inventory shows that carbon stocks decreased in NWL lands from 2001 to 2011, releasing more carbon than they were storing, and then increased slightly from 2012 to 2014.[482] These trends highlight the interannual and interdecadal variability of lands and their ability to be both a source and a sink of carbon, and the importance of looking at NWL data and trends over multiyear and multidecadal time periods, as opposed to looking only at annual changes. This movement is part of the Earth's carbon cycle, where carbon transfers between the land, ocean, and atmosphere. As part of the carbon cycle, over decades or centuries, fire and plant respiration and decomposition move carbon from the land to the atmosphere, while plant growth and other processes move carbon from the atmosphere to the land. Emissions from fossil-fuel combustion are contributing to putting this cycle out of balance.

Additionally, some historic land management practices that have resulted in the loss of carbon from the soil are also contributing to the atmospheric rise of CO_2 while simultaneously exacerbating the imbalance of the water cycle, which is influenced by and linked to the carbon cycle. These emissions are also contributing to a feedback loop for California's lands: as CO_2 emissions accumulate in the atmosphere—and California experiences more warming, extreme heat events, and droughts—the risk and intensity of carbon losses also increases, which in turn transfers more carbon from the land to the atmosphere. And because forests and shrublands comprise approximately 85 percent of the carbon stocks in California, management strategies and disturbances in forest and

[481] CARB. *An Inventory of Ecosystem Carbon in California's Natural & Working Lands.* 2018 Edition. *nwl_inventory.pdf (ca.gov).* Accessed 3/2/2022.
[482] These trends are consistent estimates in the most recent AB 1504 reporting period.

shrubland carbon play an important role in determining whether California's lands are providing either net carbon sequestration or net emissions on an annual basis.

The gains and losses of carbon on our lands will fluctuate in the future; what is important is to restore carbon in places where it has been lost and reduce large carbon losses on our NWL through active, attentive, and adaptive management. For additional details on the nexus between NWL and GHGs, see pages 5–6 of the NWL Climate Smart Strategy.

Goals and Accelerating Nature-Based Solutions

The state's climate mitigation targets are traditionally identified by individual years, (i.e., tons of GHG emissions in 2020 or 2030). However, because NWL processes fluctuate year to year and because it can sometimes take decades for climate action to fully impact carbon in NWL, it is important to consider the statewide, long-term trends of carbon stock change when identifying how this sector contributes to California's pathway to achieving carbon neutrality. Tracking carbon stock change over a multi-decadal period is the best way to assess the full direct impact climate action has on carbon storage. Such an approach filters out fluctuations from year-to-year weather variations and multi-year natural climate cycles, such as El Niño patterns.

Current data sources and methods allow us to track only certain carbon stocks that exist on NWL. For target tracking to be successful, each carbon pool must be inventoried using a methodology that can detect changes due to management and climate change. Certain carbon pools lack the scientific data and methodologies necessary for target-setting and tracking. For example, soils in forests, shrublands, and grasslands are not included in the Scoping Plan carbon stock target because, currently, there is no way to track statewide soil carbon through time in a way that would capture the effects of increased climate action and climate change.

When considering how NWL contribute to the state's goal of carbon neutrality, all lands' carbon stock gains and losses must be considered, and the Scoping Plan target is set in these terms. It is not sufficient to aggregate climate benefits only within areas where projects, management, or climate action occur. Much of the state does not receive active or quantifiable management, but these areas still contribute to the state's overall carbon stock change and GHG emissions. To incorporate the entire carbon balance toward true carbon neutrality, the Scoping Plan target is set in terms of carbon stock change across the entire state. This incorporates all lands that both receive and do not receive active management, and includes the end result of all sequestration, emissions, and other changes to carbon on the landscape.

However, carbon stock change is not equivalent to emissions. Currently, the data and emission quantification science is not sufficient to enable inventories to comprehensively track all NWL emissions in a way that would enable us to set an NWL target in terms of

statewide emissions and sequestration. There is a great need, across the entire NWL sector statewide, for more empirical data, science, and tools to track all carbon stocks across each carbon pool, and to begin to track emission and sequestration rates. As California implements AB 1757, there is an opportunity to update the data, science, and tools to enable this level of tracking and target setting in the future.

As outlined in Chapter 2, California is projected to lose carbon stocks over the coming decades, but this Scoping Plan analysis also shows that increasing the pace and scale of climate smart land management in California will reduce the carbon stock losses and GHG emissions from the NWL sector. In response to EO N-82-20 and AB 1757, the proposed target for NWL is shown in Table 4-1.

Table 4-1: Scoping Plan modeled target for NWL, based on increasing action on NWL

	Total Carbon Stock % Change from 2014
2045	-4

Achieving this target will require significant expansion of the pace and scale of climate action on California's NWL, including the following:

- Increasing climate smart forest, shrubland, and grassland management to at least 2.3 million acres a year—an approximate 10x increase in management from current levels.
- Increasing climate smart agricultural practices by at least 78,000 acres adopted a year, annually conserving at least 8,000 acres a year of croplands, and increasing organic agriculture to comprise at least 20 percent of cultivated acres in California by 2045—an approximate 7.5x increase in healthy soils practices from previous levels and a 2x increase in total acres of organic agriculture.
- Increasing annual investment in urban trees in developed lands by at least 200 percent above historic levels and establishing defensible space on all parcels by 2045.
- Restoring at least 60,000 acres, or approximately 15 percent of all Sacramento–San Joaquin River Delta (Delta) wetlands, by 2045.
- Cutting land conversion of deserts and sparsely vegetated landscapes by at least 50 percent annually from current levels, starting in 2025.

If the carbon stock target above is met, and the management actions above are implemented, the modeling for NWL indicates that California's lands will be a net source of emissions, producing approximately 7 $MMTCO_2e$ of average annual emissions.

Additional climate smart management practices and additional landscapes, such as those included in the Climate Smart Strategy and discussed below in Additional Management Strategies, have the potential to increase carbon stocks and reduce GHG emissions from NWL beyond the levels modeled for this Scoping Plan.

The purpose of the NWL target and the above estimated outcomes is to provide a numerical guide that can support the state's efforts to accelerate both near-term and long-term climate action on California's lands, prioritizing durable solutions that deliver multiple outcomes. Taking these actions over the coming decades will reduce the potential carbon losses from NWL, reduce GHG emissions from some landscape types (such as croplands and Delta wetlands), and support sequestration of GHGs from NWL between 2025 and 2045. These actions will also deliver significant benefits to Californians beyond advancing our climate goals, such as reducing wildfire emissions and their associated health impacts, increasing habitat for biodiversity, reducing urban heat island effects, reducing harmful pesticide exposure, expanding economic opportunities, and others. Additional information on several economic and health outcomes from the Scoping Plan Scenario is included in Chapters 2 and 3.

Statewide planning and target setting for the NWL sector will only create meaningful change if followed by effective on-the-ground implementation. State government cannot accomplish this implementation alone. Effective large scale climate action is dependent on partnerships among tribal, federal, state, regional, and local partners, and across governmental, private, nonprofit, and commercial sectors. The NWL sector of the Scoping Plan sets a carbon target with climate action recommendations that can be used to achieve the quantified carbon, health, and economic outcomes. Implementation of these actions must be led by local or regional partnerships that plan and execute projects appropriate to the specific conditions. The technical expertise and local knowledge of land managers and stewards in all sectors must be elevated to ensure relevant, efficient, and effective climate action.

Implementation of climate action should contribute to state targets, maximize local benefits, and alleviate environmental injustices and other social inequities. On-the-ground action is largely executed and managed by local and regional actors, but state government agencies must support communities across the state in implementing nature-based climate solutions that address statewide objectives, such as the Scoping Plan carbon target. This includes providing resources and developing frameworks, while greatly increasing capacity and technical assistance to assist and empower local partners. Examples of how this can be done are the Regional Forest and Fire Capacity Program within the forestry sector, the UC Cooperative Extension in the agricultural and forestry sectors—as well as the work of the state's 10 regional Conservancies. These programs provide strong examples to emulate as they facilitate statewide coordination, and information and resource transfer from the state to the regional and local levels. The Regional Forest and Fire Capacity Program provides funding for local and regional groups

to build their organizational capacity to plan and implement wildfire and forest management projects that are informed by their own local expertise. The UC Cooperative Extension is an example of how the state provides technical assistance to local landowners and community organizations, helping them apply the latest science-based management strategies to their lands. California's regional Conservancies play a pivotal role in implementing regional conservation, restoration, and land management efforts through activities such as grant funding, science generation, and planning assistance.

The state also has identified the need to incorporate and elevate traditional indigenous knowledge into climate action on the regional and local scales. Accomplishing this requires close partnerships with tribes for mutual knowledge and resource sharing, while protecting culturally sensitive knowledge and resources. As Tribes are sovereign nations with specialized cultural knowledge and experience in managing lands, climate action on these lands that contribute to the State of California's climate targets can only be accomplished with the full participation and under the leadership of the Tribes that govern those lands.

Strategies for Achieving Success: Crosscutting Items for all NWL

- Implement AB 1757 and SB 27.
- Implement the Climate Smart Strategy.
- Accelerate the pace and scale of climate smart action, consistent with the management levels identified above, as part of a collective effort between federal, state, private, nonprofit, and individual land managers.
- Prioritize and practice equity, including through meaningful community engagement and prioritizing implementation of nature-based solutions that benefit the communities most vulnerable to climate change.[483]
- Advance multi-benefit, collaborative, landscape-level approaches that engage communities and landowners, and incorporate adaptive managements.
- Consult and partner with California Native American tribes to increase co-management and tribal management authority; restore, protect, and enhance natural cultural resources, traditional foods, and cultural landscapes; respect tribal sovereignty; and support tribes' implementation of tribal expertise and Traditional Ecological Knowledge and cultural easements.[484]

[483] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N8. *finalejacrecs.pdf (arb.ca.gov).*
[484] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N1, N6, N16, N17, N18. *finalejacrecs.pdf (arb.ca.gov)*.

- Leverage existing innovative financial and market mechanisms, and explore new ones, between the public, private, and philanthropic sectors to secure funding of climate smart land management.
- In partnership with communities, tribes, and the private sector, expand and develop new infrastructure for manufacturing and processing of climate smart agricultural and biomass products.
- Leverage and support technical assistance providers: such as the UC Cooperative Extension and California's 98 Resource Conservation Districts, that have track records of providing technical assistance to local landowners and implementing agriculture, forestry, natural resource management, and restoration projects across the state.
- Establish and expand mechanisms that ensure NWL are protected from land conversion and parcelization (e.g., conservation easements or Williamson Act), in line with the strategies outlined in CNRA's Pathways to 30x30 California.[485,486] Pair land conservation projects with management plans that increase carbon sequestration, where feasible.
- Increase opportunities for private and philanthropic investments in nature-based climate solutions, utilizing existing voluntary and compliance carbon markets, existing state and local programs, and the California Carbon Sequestration and Climate Resiliency Project Registry established pursuant to SB 27.
- Expand monitoring and tracking of management actions and outcomes consistent with the tracking and monitoring recommendations of the Climate Smart Strategy.

Forests, Shrublands, and Chaparral

At roughly 29 million acres, forests cover 27 percent of California. Shrublands and chaparral cover 31 percent of the state; roughly 33 million acres. Both types are distinct, with their own ecological dynamics and management strategies, and are modeled within a single model that is calibrated to treat them uniquely.

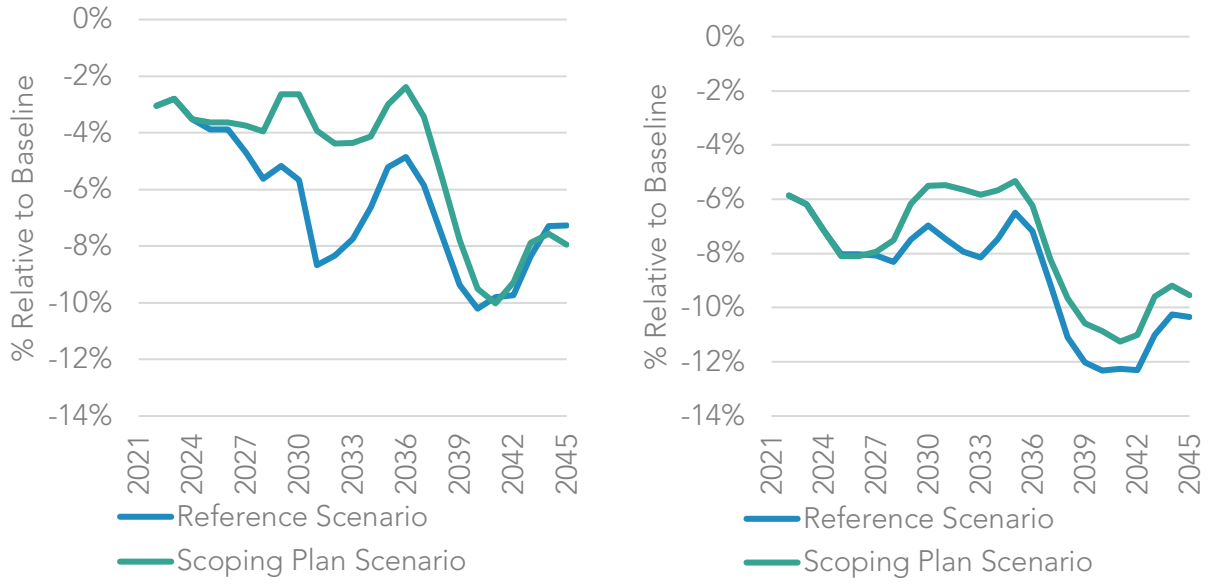
Together, forests, shrublands, and chaparral support a high biodiversity of plants and animals, in addition to high levels of carbon stocks. They provide important air and water quality benefits to all Californians, as well as recreational opportunities and, for forests, harvested wood products for the state. These landscapes are fire-adapted, and historical tribal management of these lands has fostered ecosystem health and resilience. Over the past century, these lands have been impacted severely by fire exclusion, including

[485] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N5, N26, N27. finalejacrecs.pdf (arb.ca.gov).
[486] CNRA. 2022. *Pathways to 30x30 California*. https://www.californianature.ca.gov/pages/30x30.

exclusion of indigenous people's management and past management practices, which has resulted in less resilient ecosystems and communities and more destructive wildfires today. This, along with drought induced stress and mortality, has changed these landscapes from a carbon sink to a carbon source. Climate smart management can help make forests more resilient to climate change and less prone to catastrophic wildfire. Climate-smart management in shrublands and chaparral face additional challenges and uncertainty, but can still provide protection for threatened communities and natural resources. This management, if conducted on a regular basis to maintain forest health, can help reduce emissions from forests, shrublands, and chaparral, and help strengthen and maintain the co-benefits that Californians experience from them.

Under all management levels, forests and shrublands are expected to lose carbon over the next two decades due to climate change and wildfire (Figure 4-21).

Figure 4-21: Forest (left) and shrubland (right) carbon stocks by 2045[487,488]



While this decrease in carbon stocks may be inevitable, forest management under the Scoping Plan Scenario can help direct where and how carbon loss occurs. By proactively managing forests and shrublands, the loss of carbon from wildfire can be lessened as the risk of high severity fire is decreased, with the removed biomass going toward a more

[487] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N13. *finalejacrecs.pdf (arb.ca.gov)*.
[488] This analysis is the aggregation of all forests and shrublands from all ownerships across the entire state of California.

useful purpose such as harvested wood products, bioenergy, and engineered carbon removal. Managing for a diverse and resilient forest landscape also can help forests recover more quickly so that when climate change and wildfire impacts occur, forests will be less affected and can continue to thrive and sequester carbon. Additional details on the climate benefit potential of forests and shrublands/chapparal can be found in Section 2 of the NWL Climate Smart Strategy.

Strategies for Achieving Success

- Accelerate the pace and scale of climate smart forest management to at least 2.3 million acres annually by 2025, in line with the climate smart management strategies identified in this Scoping Plan, the NWL Climate Smart Strategy, and the Wildfire and Forest Resilience Action Plan.[489]
- Establish and expand mechanisms that ensure forests, shrublands, and grasslands are protected from land conversion and that support ongoing, rather than one-time, management actions.
- In collaboration with state and local agencies, accelerate the deployment of long-term carbon storage from waste woody biomass residues resulting from climate smart management, including storage in durable wood products, underground reservoirs, soil amendments, and other mediums.
- Expand infrastructure to facilitate processing of biomass resulting from climate smart management.
- Expand permit streamlining in collaboration with state and local agencies to accelerate implementation of climate smart forest management while protecting natural resources.

Grasslands

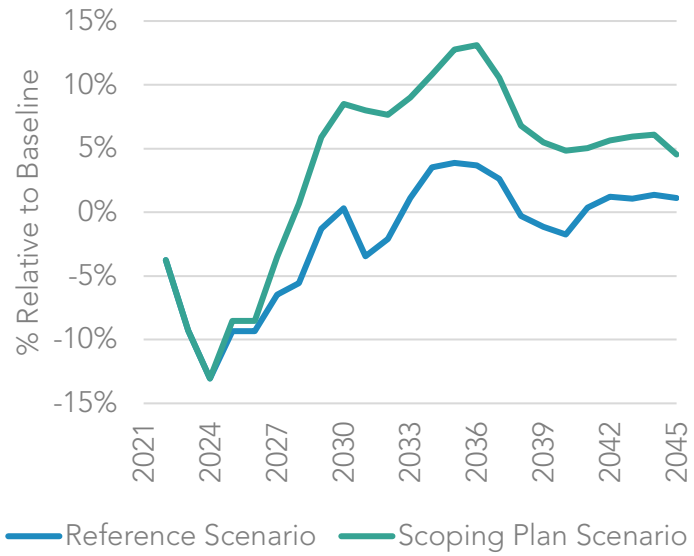
Grasslands cover 9 percent of California, roughly 10 million acres, and are found throughout the state in various landscapes, with concentrations in the foothills surrounding the Sacramento and San Joaquin Valleys. In addition to carbon storage (primarily in the soil), grasslands provide open space, wild habitat, grazing land, and important water filtration and recharge benefits. The protection of grasslands provides an opportunity to reduce sprawl and complement VMT reduction strategies. As grasslands are susceptible to invasive species, climate smart strategies can increase grassland

[489] Forest Management Task Force. 2021. *California's Wildfire and Forest Resilience Action Plan: Recommendations of the Governor's Forest Management Task Force.* https://www.fire.ca.gov/media/ps4p2vck/californiawildfireandforestresilienceactionplan.pdf.

resilience to climate change by improving species diversity and maintaining or increasing soil carbon stocks.

Modeling results show that increased fuels treatments and avoided land conversion can increase carbon stocks on grasslands by 2045, but sequestration rates fluctuate annually. Grasslands are capable of high carbon sequestration rates but are susceptible to carbon losses from wildfire and land conversion. Soil carbon is the major carbon pool on these lands, and continued future improvement of the monitoring and modeling of soil carbon is needed. Similar to forests and shrubland/chaparral, modeling alternatives that include fuels treatments resulted in greater carbon stocks compared to no management, and had lower wildfire emissions. Unlike forests and shrubland/chaparral, which have a general declining carbon stocks trend, the modeling results (Figure 4-22) show grasslands can maintain or increase carbon stocks with active management. Details on the climate benefit potential of grasslands can be found in Section 2 of the NWL Climate Smart Strategy.

Figure 4-22: Grassland carbon stocks by 2045



Strategies for Achieving Success

- Establish and expand mechanisms that ensure grasslands are protected from land conversion/parcelization and that support ongoing, rather than one-time, management actions that improve carbon sequestration.
- Deploy grassland management strategies, like prescribed grazing, compost application, and other regenerative practices, to support soil carbon sequestration, biodiversity, and other ecological improvements.

- Increase adoption of compost production on farms and application of compost in appropriate grassland settings for improved vegetation and carbon storage, and to deliver waste diversion goals through nature-based solutions.

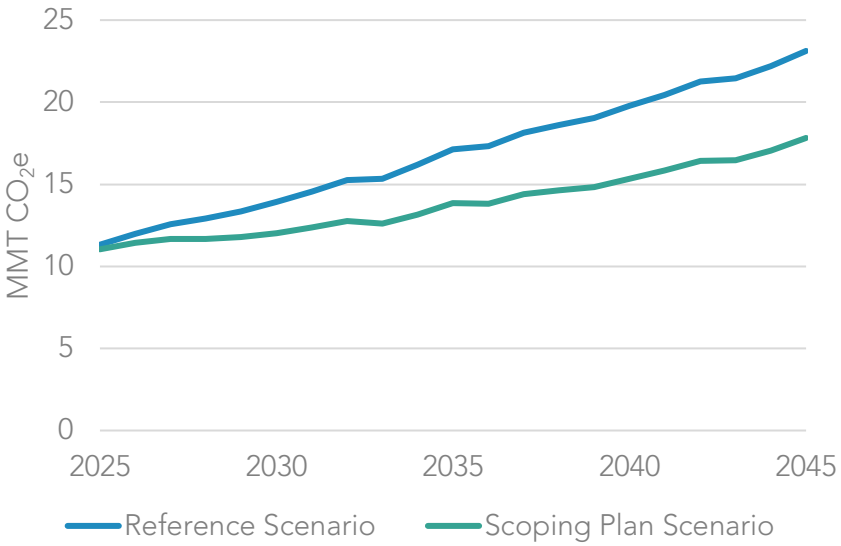
Croplands

Croplands cover 9 percent of the state, roughly 9.5 million acres. This land is some of the most productive agricultural land in the world, and enables California to be a global leader in agriculture. Aside from developed lands, croplands are the most intensively managed landscapes in the state, and are closely tied to society through the food they produce and the constant, direct contact that people have with croplands through the course of management. In addition to food security, croplands provide considerable carbon storage in the soil and, in perennial croplands, in aboveground biomass. Climate smart practices can improve public health; for example, by reducing synthetic fertilizer and pesticide use. They also help to maintain or increase the climate resilience of cropland productivity through improved soil conditions and increased pollinator habitat.

There is also significant potential to transform this sector to increase soil carbon storage, reduce GHG emissions (Figure 4-23), and reduce pesticide exposure and health impacts. Moving to an agricultural system that improves soil health and water holding capacity reduces over-application of nitrogen, reduces the use of pesticides and fumigants, and increases biodiversity and pollinator habitat, supporting California's pathway to carbon neutrality while simultaneously improving the lives of those who live and work in the agricultural community. Croplands are intricately tied to people, communities, and their health, and through climate smart practices and cropland conservation, these lands have the potential to contribute more to society than just food.[490] The implementation of climate smart agricultural practices and diversified organic agriculture can help California achieve social and environmental benefits, like improving water use efficiency, increasing pollinator habitat, and reducing synthetic fertilizer and pesticide use.[491] Additional details on the climate benefit potential of croplands can be found in Section 2 of the NWL Climate Smart Strategy.

[490] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations In-part (N3, N4, N22), N5, N21. *finalejacrecs.pdf (arb.ca.gov)*.
[491] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N11. *finalejacrecs.pdf (arb.ca.gov)*.

Figure 4-23: Cumulative CO_2e emissions from annual croplands in 2045[492]



CARB recognizes the complex nature of croplands, cross-sector relationships, and the need to build on this analysis to further our understanding of cropland dynamics. Many more aspects of cropland management need to be explored for potential climate benefits, such as water and nutrient use management, pest control methods, crop rotations, and other management practices. The impacts of climate change on water availability, annual/perennial crop growth, and future carbon sequestration trends are uncertain, and recent policies such as the Sustainable Groundwater Management Act may also influence cropland management in unforeseen ways. Nonetheless, it is clear that greater climate smart practice implementation can prepare California for the future and yield tangible benefits for the state.

Strategies for Achieving Success

- Accelerate the pace and scale of healthy soils practices to 80,000 acres annually by 2025, conserve at least 8,000 acres of annual crops annually, and increase organic agriculture to 20 percent of all cultivated acres by 2045.

[492] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N11. *finalejacrecs.pdf (arb.ca.gov)*.

- Utilize the recommendations included in CDFA's Farmer and Rancher-Led Climate Change Solutions[493] report to accelerate deployment of healthy soils practices, organic farming, and climate smart agriculture practices.
- Establish or expand financial mechanisms that support ongoing deployment of healthy soils practices and organic agriculture.[494]
- Support strategies that achieve co-benefits of safer, more sustainable pest management practices and the health and preservation of ecosystems, such as implementing the California Department of Pesticide Regulation's (DPR's) Sustainable Pest Management Work Group recommendations.[495]
- Conduct research on the intersection of pesticides, soil health, GHGs, and pest resiliency via a multi-agency effort with DPR, CDFA, and CARB.[496]
- Conduct outreach and education to develop and facilitate the increased adoption of safer, more sustainable pest management practices and tools; reduce the use of harmful pesticides; promote healthy soils; improve water and air quality; and reduce public health impacts.
- In collaboration with state and local agencies, accelerate the deployment of alternatives to agricultural burning that increase long-term carbon storage from waste agricultural biomass, including storage in durable wood products, underground reservoirs, soil amendments, and other mediums.
- Work across state agencies to reduce regulatory and permitting barriers around some healthy soils practices (e.g., composting), where appropriate.
- Utilize innovative agriculture energy use and carbon monitoring and planning tools to reduce on-farm GHG emissions from energy and fertilizer application or to increase carbon storage, as well as to promote on-farm energy production opportunities.

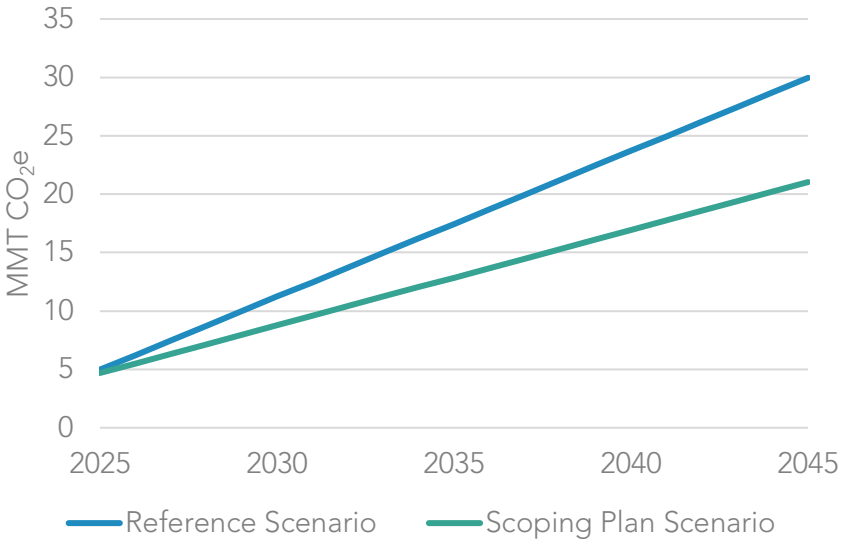
[493] California Department of Food and Agriculture. 2021. Farmer and Rancher Led Climate Change Solutions. *https://www.cdfa.ca.gov/oefi/climate/docs/cdfa_farmer_and_rancher-led_climate_solutions_meetings_summary.pdf*.
[494] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N5, N7. *finalejacrecs.pdf (arb.ca.gov).*
[495] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations N3, N4, N5, N7, N22. *finalejacrecs.pdf (arb.ca.gov)*.
[496] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N11. *finalejacrecs.pdf (arb.ca.gov)*.

Wetlands

Wetlands cover 2 percent of the state (roughly 1.7 million acres) and include inland and coastal wetlands, such as vernal pools, peatlands, mountain meadows, salt marshes, and mudflats. These lands are essential to California's communities as they serve as hotspots for biodiversity, contain considerable carbon in the soil, are critical to the state's water supply, and protect upland areas from flooding due to sea level rise and storms. Wetlands have been severely degraded through reclamation, diking, draining, and dredging practices in the past, resulting in the emissions of the carbon stored in the soils and the loss of ecosystem benefits. Climate smart strategies to restore and protect all the types of wetlands can reduce emissions while simultaneously improving the climate resilience of surrounding areas and improving the water quality and yield for the state. Restored wetlands also can reduce pressure on California's aging water infrastructure. These benefits beyond emissions reductions will help in the future, as climate change is predicted to negatively affect water supply.

Avoided conversion and restoration of Delta wetlands reduces CO_2 and methane emissions from wetlands, with GHG reductions scaling with implementation rates (Figure 4-24). Expansion of conservation and restoration efforts will generate benefits such as the conservation of biodiversity, improved water quality and supply, and reduced flood risk. Additional details on the climate benefit potential of wetlands can be found in Section 2 of the NWL Climate Smart Strategy.

Figure 4-24: Cumulative CO_2e emissions from Delta wetlands by 2045



Strategies for Achieving Success

- Restore 60,000 acres of Delta wetlands annually by 2045 to reduce methane emissions from wetlands and reverse the resulting subsidence.

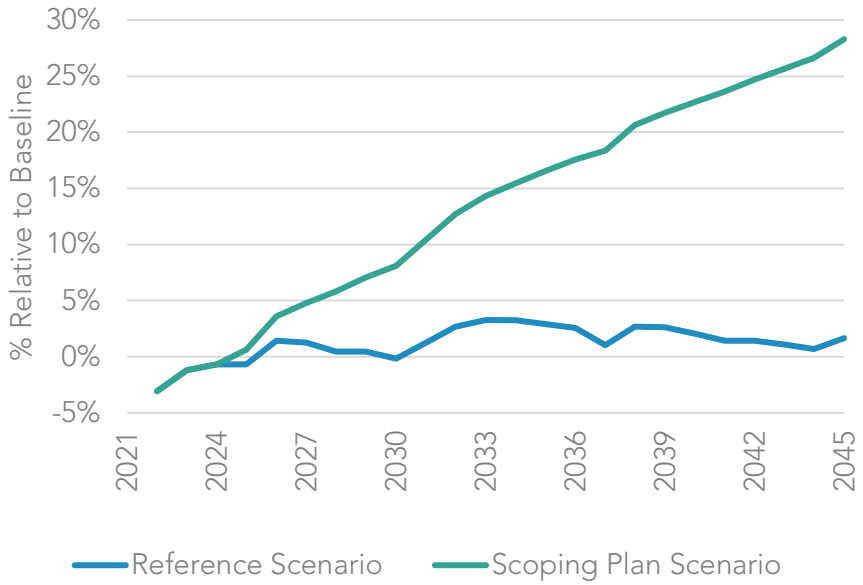
- Identify and prioritize wetland restoration efforts around climate vulnerable communities.
- Leverage other funding and institutions to support wetland restoration projects, including land trusts, local funding (e.g., San Francisco Measure AA), federal funding, and private and philanthropic funding to support wetlands restoration projects.
- Work across state agencies to reduce regulatory and permitting barriers around wetland restoration projects, where appropriate.

Developed Lands

Developed lands cover 6 percent of the state (roughly 6.8 million acres) and include urban, suburban, and rural areas, as well as transportation and supporting infrastructure throughout California. This area encapsulates the land on which the vast majority of Californians reside and call home. The vegetation within cities and communities, and along infrastructure, are all part of developed lands. This vegetation provides numerous benefits to surrounding areas, including carbon storage, air and water filtration, reduced urban heat island effect, and access to nature, aesthetics, and mental health, among others. These areas are susceptible to climate change as well, and climate smart strategies to protect and expand the urban forests, landscaping, green spaces, parks, and associated vegetation can increase their climate resilience and the benefits Californians derive from them. These strategies also have a significant opportunity to benefit disadvantaged communities, who may not have equitable access to these practices or the benefits they provide. Additional details on the climate and equity benefit potential of developed lands can be found in Section 2 and the Introduction of the NWL Climate Smart Strategy.

Urban forests have a significant potential to sequester carbon (Figure 4-25). They are vastly different from wildland forests, as they require investments to maintain and irrigate. This results in the need for a significant increase in investment to increase urban forest carbon. As urban forests become denser and management difficulty increases, the carbon stock returns on investment diminish, making it expensive to maximize carbon in urban forests. Water availability and irrigation efficiency are also an important consideration for increasing urban forest cover. As water becomes scarcer, the prioritization of irrigating trees over lawns or gardens may be required to achieve increases in urban forest carbon.

Figure 4-25: Carbon stocks in urban forests by 2045



Within wildland-urban interface (WUI) areas, defensible space can protect urban and rural communities from wildfire. Analysis results show that 48 percent of parcels are currently fully compliant with defensible space requirements. This highlights how much work needs to be done to protect communities and homes. Defensible space results in a decrease in carbon stocks, as expected when reducing fuels for wildfire.

Strategies for Achieving Success

- Increase urban forestry investment annually by 200 percent, relative to business as usual.
- Increase public awareness of urban forest benefits and, where appropriate, prioritizing irrigation of trees over lawns.
- Provide technical assistance and resources to disadvantaged communities to implement community urban greening projects to provide equitable access to the benefits of urban greening projects.[497]
- Work with state and local agencies to expand technical assistance for and enforcement of the defensible space requirements of PRC 4291 to reduce wildfire risk to homes and structures.

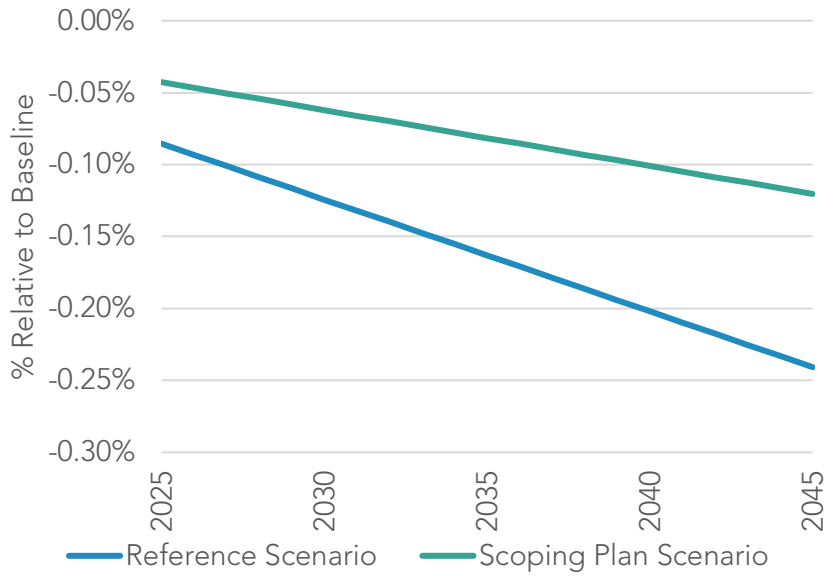
[497] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N8. *finalejacrecs.pdf (arb.ca.gov)*.

Sparsely Vegetated Lands

Sparsely vegetated lands cover 10 percent of the state, roughly 10.2 million acres, primarily in the east and southern parts of California. These lands include deserts, beaches, dunes, bare rock, and areas covered in ice and snow (e.g., higher mountain elevations). The limited carbon storage of these lands varies from bare rock and mineral soil to more vegetated areas, though severe climate limits the amount of biomass. Nonetheless, sparsely vegetated lands are important for open space and provide rare and unique habitats for endemic species and a diversity of wildlife. These lands present important recreational opportunities for Californians and serve as important protective buffers in coastal and low-lying areas. Land use change threatens these lands, and conservation efforts are important for protecting these unique areas of California.[498]

Avoided conversion of sparsely vegetated lands reduces the organic carbon lost from the soil, which is the major carbon pool in this land type (Figure 4-26). In identifying the outcomes for sparsely vegetated lands, CARB modeled avoided land conversion to another land use.

Figure 4-26: Carbon stocks in sparsely vegetated lands by 2045



Strategies for Achieving Success

- Establish and expand mechanisms that ensure sparsely vegetated lands are

[498] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N26. finalejacrecs.pdf (arb.ca.gov).

protected from land conversion, prioritizing those areas most vulnerable to climate change and loss.

Additional Management Strategies

Additional nature-based climate solutions beyond those management strategies modeled for this Scoping Plan are available for implementation, but either cannot currently be modeled and/or affect carbon and the landscape in ways that cannot currently be tracked. Nevertheless, it is important to take action even where these technical gaps exist. Some of these actions, such as cultural burning and indigenous farming practices, have been used on large scales for decades or even centuries, while others are relatively new concepts. The state nevertheless recommends implementing the additional solutions listed here to achieve potential additional climate benefits, as well as other co-benefits. These additional solutions were drawn from the NWL Climate Smart Strategy and stakeholder, tribal government, and interagency feedback.[499]

Considerations

Although these practices are recommended, because of the lack of in-depth modeling and analysis available, several considerations must be addressed when implementing them. These considerations also apply to the management strategies included in the Scoping Plan Scenario.

- Future climate change impacts are uncertain: The negative impact that climate change can have on the ability of these practices to maintain expected climate benefits is uncertain and may significantly change in the future. Climate change is expected to further diminish the already constricting growing conditions in California, with increasing droughts, more extreme weather events, and expanding disturbances from fire, insects, and disease. It is estimated that suitable habitat for many native plant and animal species could shift, creating novel ecosystems without historical precedent. Close monitoring of all practices, including no management, across our NWL will be critical to understand if and how future climate change affects outcomes and how to adapt management to meet the needs of the system under climate change.[500]

[499] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N24. *finalejacrecs.pdf (arb.ca.gov)*.
[500] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N15. *finalejacrecs.pdf (arb.ca.gov)*.

- Local conditions: Not every practice is applicable, feasible, or even desirable in every location across California. Implementation of these practices should account for local conditions and needs that may affect the appropriateness of that practice.
- Long-term carbon storage: The ability to sequester additional carbon into NWL is only beneficial to the climate if that carbon stays out of the atmosphere. Many of the additional practices listed here may require continual incentives or interventions to ensure permanence of carbon storage in the soil and biomass. For example, in croplands, it is difficult to estimate how much of the carbon stored by no-tillage can be released by a single subsequent tillage, but a return to conventional tillage would usually be expected to erase most gains.[501,502]
- Scaling actions: There are uncertainties on how these practices may impact both the environment and communities when significantly expanded. For this reason, it is best to take a cautious and measured approach to ramping up actions to a larger scale.
- Infrastructure and operational needs: Scaling up the implementation of some of these practices demands transformational change in the supporting infrastructure and operational frameworks. For example, increasing forest management to the degree included in the Scoping Plan Scenario will require significant changes to wood-processing infrastructure, workforce capacity, permitting processes, technical assistance, and other operational constraints. The increased application of compost to croplands, and potentially to rangelands, will require a significant increase in organic waste and dairy manure collection to increase compost supply, in line with SB 1383. This will also require additional compost production facilities as well as compost/organic waste transportation and application methods.
- Co-benefits: Many co-benefits from these practices exist beyond the climate benefits. These co-benefits include improved public and worker health; improved microbial, insect, and wildlife habitat; enhanced biodiversity; greater labor demand in the nature-based economy; and improved climate resilience.
- Labor and Economics: Many of these practices require additional labor, and an evaluation of how many more jobs are needed to carry out many of these practices

[501] Muñoz-Romero, V., R. J. Lopez-Bellido, P. Fernandez-Garcia, R. Redondo, S. Murillo, and L. Lopez-Bellido. 2017. “Effects of tillage, crop rotation and N application rate on labile and recalcitrant soil carbon in a Mediterranean Vertisol.” *Soil Tillage Res.* 169, 118–123.
[502] Mitchell, J. P., A. Shrestha, W. R. Horwath, R. J. Southard, N. Madden, J. Veenstra, and D. S. Munk. 2015. “Tillage and cover cropping affect crop yields and soil carbon in the San Joaquin Valley.” *California. Agron. J.* 107, 588–596.

is currently unknown. There will also be the need to explore the costs and economic benefits of implementing these additional practices.

- Retreatments: All of these practices have limits on how long they can enhance carbon sequestration. Many of these practices need to be periodically repeated, followed by complementary practices, or maintained through time. This increases costs and requires diligence and long-term stewardship.

Additional NWL Actions and Strategies

Below is a set of additional actions that should be taken on California's natural and working lands. Again, these practices were not modeled for this Scoping Plan, and all of the considerations listed above should be taken into account before implementing the following actions.

- Conservation of all NWL types (in line with the NWL Climate Smart Strategy and CNRA's Pathways to 30x30 California) is critical to ensuring continued carbon sequestration and provision of co-benefits from these lands for all Californians.[503]
- Reforestation following disturbance, using appropriate species, is an impactful practice that can help prevent conversion away from forestland and establish new trees to sequester carbon. The number of acres that may need reforestation following high severity wildfires is estimated to continue to increase into the future.
- Restoration of shrublands, chaparral, riparian zones, and oak woodlands across California includes a variety of practices to alter their structure and return endemic species to the areas. These unique habitats provide multiple co-benefits to the state, such as clean water, reduced wildfire risk, and biodiverse habitats for flora and fauna.
- Conservation and restoration of wetlands, beyond the Delta wetlands included in the NWL modeling, can protect these unique habitats and the climate benefits they provide. These wetland types can include but are not limited to coastal wetlands, mountain meadows, vernal pool complexes, alkali sinks and meadows, and floodplains.
- Conservation and restoration of seagrasses and seaweeds provide a number of benefits, including carbon storage and sequestration, habitat provision for many culturally and commercially important species of fishes and invertebrates, shoreline protection, and tourism opportunities.[504]

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[503] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N26, N27. finalejacrecs.pdf (arb.ca.gov).
[504] AB 32 EJ Advisory Committee. 2022 Scoping Plan Recommendations, N2. finalejacrecs.pdf (arb.ca.gov).

- Prescribed herbivory utilizes various livestock to consume vegetation to reduce fuel loads across an area. This fuel management practice can be used in forests, grasslands, and shrublands as an effective alternative to herbicide use, and should be considered wherever local conditions allow.
- Urban and community greening efforts such as green schoolyards, urban farms, rain gardens, community gardens, community composting, and many more provide numerous health benefits to communities.
- Additional Healthy Soils Program practices on annual croplands such as conservation cover and crop rotation, biomass planting for borders, wind barriers, riparian areas, and improved nutrient management can improve soil health, water retention, and increase carbon stocks.
- Healthy Soils Program practices on perennial croplands and rangelands, such as compost application and alley cropping/cover cropping to improve soil health, water retention, erosion control, and biomass growth.[505]
- Stacking of these Healthy Soils Program practices, where appropriate, in perennial and annual systems, can synergistically improve soil health and provide multiple benefits.
- Mulching adds high carbon materials to croplands or fallowed lands to reduce competing vegetation and retain moisture. This practice can support other benefits such as reduced water use and reduced synthetic pesticide and fertilizer use, as well as provide a use for suitable forest and agricultural waste biomass.
- Reductions in the use of synthetic fertilizers in cropland management, generally supported by the implementation of new management tools or technologies, can lead to reductions in GHG emissions from the production and application of fertilizers. This benefit is in addition to the co-benefits of reduced chemical runoff into waterways and reduced exposure of human populations to their harmful effects.

[505] Various types of organic amendments are being researched for application to particular landscape types. For example, compost application to rangelands is a relatively new practice that has been shown to improve soil health and increase carbon sequestration in the short term, though the science on the long-term impacts of this practice is still developing and the supply of available compost may be limiting.

Chapter 5: Challenge Accepted

This chapter provides an overview of the next steps and partnerships that will be needed to successfully implement this Scoping Plan. The path forward is not dependent on one agency, one state, or even one country. It will take action on a global level to address the threat climate change poses. But, the work begins at home.[506] The state can lead by engaging Californians and demonstrating how action at the state, regional, and local levels of government, as well as action at community and individual levels, can contribute to addressing the challenge before us. We must build partnerships with academic institutions, private industry, and others to support and accelerate the transition to carbon neutrality. Ultimately, the success of this Scoping Plan will be measured by our ability to implement the actions modeled in the Scoping Plan Scenario at all levels of government and society. This will depend on a mix of legislative action, regulatory program development, incentives, institutional support, workforce and business development, education and outreach, community engagement, and research and development and deployment. Optimizing this mix will help to ensure that clean energy and other climate mitigation strategies are clear, winning alternatives in the marketplace and in communities—to promote equity, drive innovation, and encourage consumer adoption. Bold institutional action will catalyze continued research and push private investment to create jobs and bring innovative ideas to reality.

State-level Action

Achieving the targets described in this Scoping Plan will require continued commitment to and successful implementation of existing policies and programs and identification of new policy tools and technical solutions to go further, faster. California's Legislature and state agencies will continue to collaborate to achieve the state's climate, clean air, equity, and broader economic and environmental protection goals. It will be necessary to maintain and strengthen this collaborative effort, and to draw upon the assistance of the federal government, regional and local governments, tribes, communities, academic institutions, and the private sector to achieve the state's near-term and longer-term emission reduction goals and a more equitable future for all Californians.

[506] This "polycentric" approach to climate challenges, engaging many levels of government, was articulated in leading papers by Nobel laureate Elinor Ostrom. See, for example, Ostrom, E. 2014. "A Polycentric Approach to Coping with Climate Change." *Annals of Economics and Finance* 15-1, 97–134.

Regulations and Programmatic Development

Meeting the AB 32 2020 GHG emissions reduction target several years earlier than mandated demonstrated that developing mitigation strategies through a public process, where all stakeholders have a voice, leads to effective actions that address climate change and yields a series of additional economic and environmental co-benefits to the state. Following adoption of this Scoping Plan, state agencies will continue to update and implement new and existing programs to align with the outcomes in the plan. Community, tribal, and stakeholder engagement will be a critical part of this work. Several state agencies, including CARB, the CEC, the California State Transportation Agency (CalSTA), the CPUC, and others will need to be part of various subsequent rulemaking processes. Each of these agencies' leadership and technical staff will engage with the public through public meetings, written and oral comment, and other methods of engagement. This work will be informed by evaluations of the health, air quality, environmental, equity, and economic benefits and impacts of regulations, including an assessment of the societal cost of carbon, as required under AB 197.

Incentive Programs

As described in Chapter 1, incentive programs are one of the most important tools the state has in advancing our low carbon future, especially for climate vulnerable communities. The programs ensure clean technology and energy are accessible and are critical to closing ongoing opportunity gaps. These programs also leverage private-sector investment and build sustainable, growing markets for clean and efficient technologies, and they are particularly necessary to support GHG emission reduction strategies for priority sectors, sources, and technologies. Clean technologies are often already the best and lowest cost option over their lifetimes but incentive funding is critical to ensure that they are broadly available, especially in climate vulnerable communities. Incentives also build on California's long track record of driving innovative technology developments, and creating new industries, with targeted investment. The Inflation Reduction Act also provides a new source of funding and tax incentives that must be leveraged to help achieve the state's climate goals.

Many state funding programs are designed to achieve multiple objectives simultaneously: reduce emissions from GHGs, criteria pollutants, and toxic air contaminants; manage natural and working lands for carbon sequestration; and address health and opportunity gaps in disadvantaged communities. California's incentive programs focused on jump-starting the transition to a zero emission transportation future are a good example of this "stacked" approach. The state is investing billions of dollars through programs such as the On-Road Heavy-Duty Voucher Incentive Program and Clean Cars 4 All in order to replace the light- and heavy-duty vehicles most responsible for the state's GHG emissions and poor air quality, all while bolstering the nascent ZEV market. Further strategies aid in developing new technologies, in ramping up access for all, and in shifting to cleaner

modes of transport; for instance, by supporting investments in walkable, bikeable communities and transit, as well as in vehicles. This funding strategy is, of course, paired with the regulatory approach described above.

Local Action

Local action by cities can support and amplify efforts to reduce GHGs. For example, the City of Oakland requires all new construction to be all-electric and is currently working on electrifying existing buildings.[507] In addition, starting in 2023, the City of Sacramento will require all new buildings under three stories to be all-electric, and it extends the mandate to all new construction by 2026 with some limited exemptions. The City of Sacramento also requires levels of EV charging infrastructure in new construction starting in 2023, higher than the minimum state requirements, and provides parking incentives for zero-emission carsharing and EV charging.[508] Local governments asserting this type of leadership are critical partners in supporting state-level measures to contain the growth of GHG emissions associated with the transportation system and the built environment.

California must accommodate population and economic growth in a far more sustainable and equitable manner than in the past. Good climate policy can and should create affordable and pleasant places to live, with effective transport and clean air for all—a future in which local governments and communities are central partners. Local governments have the primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth, economic growth, and the changing needs of their jurisdictions. They also make critical decisions on how and when to deploy transportation infrastructure, and can choose to support transit, walking, bicycling, and neighborhoods that do not force people into cars. Local governments also have the option to adopt building ordinances that exceed statewide building code requirements, and play a critical role in facilitating the rollout of ZEV infrastructure. As a result, local government decisions play a critical role in supporting state-level measures to contain the growth of GHG emissions associated with the transportation system and the built environment—the two largest GHG emissions sectors over which local governments have authority.

Local governments are also frequently the source of innovative and practical climate solutions that can be replicated in other areas. Their efforts to reduce GHG emissions within their jurisdictions are vital to achieving the state's near-term air quality and long-term climate goals. Local governments must continue to take action that affirmatively

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[507] City of Oakland. Building Electrification. *https://www.oaklandca.gov/projects/building-electrification*.

[508] City of Sacramento. Electrification of New Construction. *http://www.cityofsacramento.org/SacElectrificationOrdinance*.

builds the projects and expend the funds needed to further the state's collective path toward equitable emissions reductions. As such, aligning local jurisdiction action with state-level priorities to tackle climate change and the outcomes called for in this Scoping Plan is critical to achieving the statutory targets for 2030 and 2045. Local governments can implement climate strategies that can effectively engage residents by addressing local conditions and issues that also deliver local economic benefits.

Local Climate Action Planning and Permitting

California encourages local jurisdictions to take ambitious, coordinated climate action at the community scale; action that is consistent with and supportive of the state's climate goals.[509] As discussed in more detail in Appendix D (Local Actions), local jurisdictions can do much to enable statewide priorities, such as taking local action to help the state develop the housing, transport systems, and other tools we all need. Indeed, state tools—such as the Cap-and-Trade Program or zero-emission vehicle programs—do not substitute for these local efforts. Multiple legal tools are open to local jurisdictions to support this approach, including development of a climate action plan (CAP), sustainability plan, or inclusion of a plan for reduction of GHG emissions and climate actions within a jurisdiction's general plan. Any of these can help to align zoning, permitting, and other local tools with climate action.

Once adopted, the GHG emissions reductions plans detailed in CAPs can provide local governments with a valuable tool for coordinated climate planning in their community. When a local CAP complies with CEQA requirements, individual projects that comply with the CAP are allowed to streamline the project-specific GHG analysis.[510,511] Effectively, local governments that adopt a CEQA-compliant CAP enable project developers to use this streamlined approach. This saves time and resources and provides more consistent expectations for how GHG reduction measures are applied across projects in the jurisdiction. While the state encourages local governments to follow this approach, we acknowledge not all jurisdictions have the resources to develop a CAP that meets the CEQA requirements.

In addition to being required for a local CAP to comply with CEQA, local GHG reduction targets have long been recommended as part of the process of developing a climate

[509] This plan provides more detailed guidance and tools to local governments in Appendix D (Local Actions).
[510] Cal. Code of Regs., tit. 14, § 15183.5.
[511] California Governor's Office of Planning and Research. n.d. "General Plan Guidelines - Chapter 8 Climate Change."

action plan.[512] One challenge local jurisdictions have faced is how to evaluate and adopt quantitative, locally appropriate goals that align with statewide goals. An effective response to this challenge is to focus on goals that can help implement overall state priorities—enabling the key transformations California needs.

There are many ways that local governments can make key contributions to this transformation, depending on the characteristics of their jurisdiction and community. For example, some jurisdictions will inherently have more land capacity to remove and store carbon, whether through natural and working lands or by other means. Other jurisdictions will be host to GHG-emitting facilities that serve necessary functions and will take time to transition to clean technology (e.g., municipal wastewater treatment plants, landfills, and energy generation and transmission facilities). It is important to recognize that we will need to build new energy production and distribution infrastructure, and repurpose existing ones, for clean technology and energy before we are able to phase down existing fossil sources. There also will be a need to handle the significant amount of biomass resulting from sustainable forest management for catastrophic wildfire prevention, agricultural waste, and landfill diversion.

Regional efforts can support change too: energy and transportation systems that serve Californians do not stop at jurisdictional boundaries, and some local decisions can have ramifications for other communities. For instance, Metropolitan Planning Organizations (MPOs) can help to integrate local efforts by planning consistent with the Scoping Plan and Climate Action Plan for Transportation Infrastructure, including by removing polluting roadway capacity expansions from project pipelines and instead focusing on climate-friendly solutions. These varied capabilities and needs should be taken into account in setting targets for local climate plans. For instance, although net zero targets can often be valuable and achievable, and mitigation is important, targets should be considered in the larger context of these goals. This all means any GHG targets on a local scale should take into consideration the actions and outcomes included in this Scoping Plan. Jurisdictions considering “net zero” targets should carefully consider the implications such targets may have on emissions in neighboring communities and the ability of the state to meet our collective targets.

Jurisdictions without formal CAPs also have important opportunities within this context. These jurisdictions can still take actions that effectively translate key state plans, goals, and targets, including those articulated in this Scoping Plan for local action. For instance, state ZEV targets can advance local efforts to promote broad and equitable access to charging and fueling. Similarly, local jurisdictions can enable reduced dependence on

[512] Climate Smart Communities. 2014. Climate Action Planning Guide. https://cdrpc.org/wp-content/uploads/2015/05/CAP-Guide_MAR-2014_FINAL.pdf.

single-occupancy vehicles by supporting dense infill housing and transit, among other actions. Such actions can be reflected in particular project plans, in general plans, or through other local policies. Regional partnerships among these jurisdictions can also help tap resources and provide for more effective overall action.

Unlocking CEQA Mitigation for Local Success

The California Environmental Quality Act also provides important tools for lead agencies to support the achievement of the state's GHG and VMT reduction goals. Although many climate-friendly local government actions already fall into categories that may not require a full CEQA analysis, thanks to streamlining or other tools, and although certain product types (such as affordable infill housing) are generally clearly consistent with state climate goals, CEQA analyses may still sometimes be required. CEQA can be a powerful and useful tool to engage the public, identify additional opportunities to support climate efforts, and localize change. It is important that lead agencies look for ways to use CEQA to support these core purposes, ensuring that these processes do not become sources of delay but instead unlock more opportunities. The uncertainty analysis in Chapter 2 evaluates how project implementation delays can lead to missed state climate targets and continued dependence on fossil energy. Mitigation measures applied in the communities affected by projects subject to CEQA have the added benefit of improving health, social, and economic resiliency as climate impacts worsen.

Appendix D (Local Actions) explores the role of local government action and CEQA in detail. As discussed there, an important CEQA-related tool is mitigation—which can be used to further drive local action consistent with state climate goals. When a lead agency determines that a proposed project would result in potentially significant GHG impacts due to its GHG emissions or a conflict with state climate goals, the lead agency must impose feasible mitigation measures to minimize the impact. Appendix D (Local Actions) provides suggestions for prioritizing the various types of mitigation, starting with on-site GHG-reducing design features[513] and mitigation measures, such as methods to reduce VMT and support building decarbonization, access to shared mobility services or transit, and EV charging. After exhausting all the on-site GHG mitigation measures, CARB recommends prioritizing local, off-site GHG mitigation measures, including both direct investment and voluntary GHG reduction or sequestration projects, in the neighborhoods impacted by the project. This could include, for example, development of a neighborhood green space, investment in street trees, or expansion of transit services. Implementing GHG mitigation measures in the project's vicinity would allow the project proponent and the lead agency to work directly with the affected community to identify and prioritize the

[513] Cal. Code of Regs., tit. 14, § 15126.4(c)(2) and (3).

mitigation measures that meet their needs while minimizing multiple environmental and societal impacts.

Once all potential on-site and local off-site GHG mitigation measures have been incorporated to the extent feasible, Appendix D (Local Actions) provides further suggestions for prioritizing other mitigation types, including non-local off-site mitigation, and voluntary offsets issued by a recognized and reputable voluntary carbon registry (as listed on CARB's website[514]) may be appropriate. Additional in-state mitigation also may be available in the upcoming SB 27[515] (Skinner, Chapter 237, Statues of 2021) registry, which will serve as a database of projects in the state that drive climate action on natural and working lands. Lead agencies should use substantial evidence to demonstrate that the project proponent explored and prioritized investments in feasible, local mitigation prior to moving mitigation to a geography located farther away from the project.

Communities and Environmental Justice

As noted in Board Resolution 20-33,[516] it is incumbent on CARB to function as an agent of responsible social change, especially when it is clear that environmental injustices continue to persist for low-income communities, tribes, and communities of color.

State law defines *environmental justice* as the fair treatment of all people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.[517] Government Alliance for Race and Equity (GARE)[518] defines *racial equity* as when race can no longer be used to predict life outcomes and outcomes for all groups are improved.

For this Scoping Plan to be successful, it must address environmental justice and advance racial equity. Implementation of the plan needs to address the needs of those communities that are disproportionately burdened by climate impacts and continue to face significant health and opportunity gaps. Now, we need to ensure our actions allow these communities to not only have a seat at the table, but also inform and shape the policies

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[514] CARB. 2022. Offset Project Registries. https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/offset-project-registries.

[515] SB 27. Carbon sequestration: state goals: natural and working lands: registry of projects. (SB 27, Skinner, Chapter 237, Statutes of 2021). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB27.

[516] CARB. 2020. Resolution 20-33: A Commitment to Racial Equity and Social Justice. October 22. https://ww2.arb.ca.gov/sites/default/files/barcu/board/res/2020/res20-33.pdf.

[517] Gov. Code, § 65040.12, subd. (e).

[518] Local and Regional Government Alliance on Race and Equity. 2015. *Advancing Racial Equity and Transforming Government: A Resource Guide to Put Ideas into Action.* Page 9. https://racialequityalliance.org/wp-content/uploads/2015/02/GARE-Resource_Guide.pdf.

to ensure their communities thrive. With this Scoping Plan, the state also adds a new tool to identify which communities will be the least resilient in the face of selected climate impacts and will see disproportionate economic impacts as a result. As described in Chapter 3, the CVM will enable the state to target programs and policies to build resiliency in the specific regions that will feel climate impacts more acutely due to existing health and opportunity disparities leading to disproportionate economic impacts. This tool will be critical in the state's efforts to address climate impacts while accounting for environmental injustices and racial inequities. CARB will incorporate the CVM into its work as it moves forward and will share this new tool with other agencies to align our efforts. The goal is to keep expanding the CVM to incorporate additional climate impacts to better identify disproportionate economic impacts as community level data becomes available.

AB 617 is another important tool for both Air Districts and CARB to bring resources to communities that have long been disproportionately burdened by poor air quality. While AB 617 does not require local agencies to participate in the Community Air Protection Program, several AB 617 communities are finding ways to bring local land use agencies to the table to respond to community priorities. We look forward to more opportunities to foster relationships with local authorities and continued collaboration between state and air district programs.

In alignment with AB 32, and to ensure environmental justice and racial equity were integrated into this Scoping Plan, CARB reconvened the AB 32 Environmental Justice Advisory Committee (EJ Advisory Committee) to advise CARB on the development of this Scoping Plan. Since reconvening in May 2021, the EJ Advisory Committee has engaged in the following activities:

- In October 2021, the EJ Advisory Committee sent a letter to the governor requesting a timeline extension for the Scoping Plan process. In response to the EJ Advisory Committee's letter, CARB modified this Scoping Plan process[519] and committed to an active engagement with the EJ Advisory Committee following the approval of this Scoping Plan. The EJ Advisory Committee also presented to the CARB Board[520] at its October 2021 Board meeting, reiterating its request for a timeline extension, as well as sharing additional concerns about process.

[519] Randolph, L. M. 2021. LMR October 19 response to Environmental Justice Advisory Committee Letter. *https://ww2.arb.ca.gov/sites/default/files/2021-10/LMR%20October%2019%20response%20to%20EJAC%20Letter%20Final.pdf*.

[520] Argüello, M. D., K. Hamilton, S. Taylor, and P. Torres. 2021. EJ Advisory Committee Co-Chair Informational Presentation to CARB Board. October 28. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2021/102821/21-11-4pres.pdf*.

- In December 2021, the EJ Advisory Committee shared its responses to Scenario Input Questions,[521] as well as a narrative document outlining their concerns[522] around the process, the need for evaluation, and the need for a tribal representative. In response to the EJ Advisory Committee Scenario Input Questions, CARB incorporated the EJ Advisory Committee responses into the Scenario Assumptions document,[523] and modeled results from PATHWAYS.[524] In response to the EJ Advisory Committee's concerns, CARB worked diligently to appoint a tribal representative[525] in February 2022, and to outline additional opportunities for the EJ Advisory Committee to engage in the Scoping Plan process.[526]
- In March 2022, the EJ Advisory Committee presented at the joint EJ Advisory Committee / CARB Board meeting[527] and walked through their preliminary draft recommendations to inform this Scoping Plan. In April, the EJ Advisory Committee shared its revised preliminary draft recommendations[528] to inform this Scoping Plan.
- In September 2022, the EJ Advisory Committee presented at the joint EJ Advisory Committee / CARB Board meeting[529] and engaged in discussion about priority items as they relate to incorporating environmental justice into the Scoping Plan. By the end of September, the EJ Advisory Committee shared its final

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[521] EJ Advisory Committee. 2021. EJ Advisory Committee Final Responses to CARB Scenario Inputs. December 2. *https://ww2.arb.ca.gov/sites/default/files/2021-12/EJAC%20Final%20Responses%20to%20CARB%20Scenario%20Inputs_12_2_21.pdf*.

[522] EJ Advisory Committee. 2021. EJ Advisory Committee Responses to Scenario Input Questions. EJ Advisory Committee narrative document regarding scenario input recommendations. December 1. *https://ww2.arb.ca.gov/sites/default/files/2021-12/EJAC%20Narrative%20Document%20re%20Scenario%20Input%20Recommendations%2012_1_2021.pdf*.

[523] CARB. 2021. PATHWAYS Scenario Modeling. *https://ww2.arb.ca.gov/sites/default/files/2021-12/Revised_2022SP_ScenarioAssumptions_15Dec.pdf*.

[524] E3. 2022. CARB Draft Scoping Plan AB32 Source Emissions Initial Modeling Results. March 15. *https://ww2.arb.ca.gov/sites/default/files/2022-03/SP22-Model-Results-E3-ppt.pdf*.

[525] CARB. AB32 EJ Advisory Committee Meeting, February 28, 2022 CARB Update. *https://ww2.arb.ca.gov/sites/default/files/2022-02/CARB%20EJAC022822presentation.pdf*.

[526] Fletcher, C. 2021. CARB Response to EJ Advisory Committee Narrative. CARB. December 15. *https://ww2.arb.ca.gov/sites/default/files/2021-12/CARB%20response%20to%20EJAC%20Narrative.pdf*.

[527] EJ Advisory Committee. 2022. EJ Advisory Committee Presentation: Preliminary Draft Recommendations. March 10. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/031022/ejacpres.pdf*.

[528] AB 32 EJ Advisory Committee. Draft Recommendations. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/031022/ejacrecsrevised.pdf*.

[529] EJ Advisory Committee. 2022. EJAC Presentation. September 1. *https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/090122/ejacpres.pdf*

recommendations[530] to inform this Scoping Plan. To the extent possible, CARB has incorporated and cited these recommendations through this Scoping Plan.

In addition to the activities listed above, Central Valley EJ Advisory Committee members hosted a successful community engagement workshop[531] in San Joaquin Valley in February 2022 with over 100 attendees. Members of EJ Advisory Committee hosted a statewide community engagement workshop[532] in June 2022 with more than 165 attendees. Throughout the EJ Advisory Committee's process, members of the Committee continued to work with their communities to ground truth their recommendations to inform the development of the Scoping Plan. The EJ Advisory Committee worked hard to ensure the voices of those communities most burdened by climate impacts were reflected in the plan. The EJ Advisory Committee will continue to play an ongoing role in the implementation of this Scoping Plan to ensure environmental justice and racial equity are prioritized in our effort to address the climate challenge before us.

To the extent possible, the EJ Advisory Committee's recommendations were integrated throughout the plan. This plan directly cites instances where there is alignment between the plan and the EJ Advisory Committee recommendations. This approach seeks to ensure there is more transparency and identify consensus that exists, as well as relevant ways equity and environmental justice are addressed in this plan and in the planning for future related implementation activities. CARB is dedicated to its efforts to ensure this plan does not leave communities behind.

As this Scoping Plan moves into the implementation phase, there will be a need to better understand how to address EJ Advisory Committee recommendations on the following topics:

- Actions under the jurisdiction of other agencies: there are certain EJ Advisory Committee recommendations that are outside of CARB's jurisdiction. As the EJ Advisory Committee continues to convene, it would be helpful to understand the

[530] EJ Advisory Committee. 2022. EJAC 2022 Scoping Plan Recommendations. September 30. https://ww2.arb.ca.gov/sites/default/files/barcu/board/books/2022/090122/finalejacrecs.pdf

[531] San Joaquin Valley Climate Justice & the Scoping Plan. 2022. https://ww2.arb.ca.gov/sites/default/files/2022-07/SJV%20Climate%20Justice%20%26%20the%20Scoping%20Plan%20Workshop%20Report%20out%20%26%20Recommendations_5.2022.pdf

[532] EJAC. 2022. *EJAC/Community Engagement Synthesis Report '22.* https://ww2.arb.ca.gov/sites/default/files/2022-07/EJAC-CommunityEngagement-SynthesisReport-2022-English%26Spanish.pdf.

role that CARB can play as it relates to the EJ Advisory Committee's recommendations for actions outside CARB's jurisdiction and coordinates with sister agencies.

- Actions that require legislative direction: there are certain EJ Advisory Committee recommendations that would require legislative action. As the EJ Advisory Committee continues to convene, it will be helpful to understand how CARB can work with the EJ Advisory Committee to share these recommendations with the appropriate members of the Legislature.
- Actions directly tied to implementation activities: This Scoping Plan is not an implementation document; it is a plan to chart a course to continue to reduce GHG emissions and achieve carbon neutrality. Once the Scoping Plan is approved, there will be follow-up action at CARB, as well as at other agencies. In these follow-up efforts, there will be a role for ongoing EJ Advisory Committee engagement.
- Actions to implement recent legislation, such as SB 905.

CARB proposes to continue to work with the EJ Advisory Committee to better understand how to move forward on EJ Advisory Committee recommendations that fall into the topics listed above and any other recommendations that were not included in this plan. It is also important to note that there are numerous recommendations where CARB shares the goals of the EJ Advisory Committee and can assist in implementation steps. Examples include the following:

- CARB shares the goal of prioritizing non-fossil energy generation and supports non-fossil projects and opportunities to locate behind-the-meter clean resources in communities of concern in programs such as the Solar on Multifamily Affordable Housing program.
- CARB will engage with agencies and academic institutions to further workforce development.
- Many other recommendations related to financial support for various energy projects, such as microgrids, are within the purview of the CPUC or local publicly owned utilities. Similarly, utility scale projects are within the jurisdiction of other agencies. However, CARB supports strategies identified in the recommendations such as offshore wind to reduce the reliance on fossil fuel generation.
- CARB is supportive of rooftop solar, although it is not within CARB's jurisdiction to determine how incentives for those projects are structured.
- CARB is supportive of strong energy decarbonization goals, recognizing that increased reliance on electrification in transportation and other sectors will create significant demand for electricity, and therefore ensuring reliability of a decarbonized grid is a critical need for the state.
- In the transportation sector, CARB is supportive of the EJ Advisory Committee's recommendations to maintain aggressive zero emission vehicle goals consistent

with its statutory mandate to ensure regulations are technologically feasible and in alignment with Governor Newsom's ZEV Executive Order (EO N-79-20). CARB looks forward to continued engagement on rulemakings that will implement these goals.

- As noted elsewhere in this plan, CARB is supportive of the Caltrans California Transportation Plan 2050 and the California Climate Action Plan for Transportation Infrastructure.
- CARB is supportive of additional public support for transit. CARB is supportive of locating EV charging in low-income communities and communities of color.
- CARB is supportive of prioritizing funding incentives for transit and heavy- and medium-duty vehicles, although CARB does believe there is an important role for incentives that support adoption of light-duty vehicles for the time being. CARB will also be opening a rulemaking on the Low Carbon Fuel Standard to ensure it continues to support clean fuels that will displace petroleum fuels and will consider the EJ Advisory Committee recommendations on this program.
- In the industrial sector, in addition to the strategies discussed more fully in this Scoping Plan, CARB continues to work with the Legislature, local agencies, and air districts to support, implement, and enforce effective reductions in emissions of GHGs and air pollutants in stationary sources. The air districts have the authority to directly issue permits addressing a facility's criteria pollutant and toxics emissions levels. These levels are set after careful permit review, under district regulation and statute. However, AB 617 directs and authorizes CARB to take several actions to improve data reporting from facilities, air quality monitoring, and pollution reduction planning for communities affected by a high cumulative exposure burden. CARB will continue to implement AB 617 and look for ways to strengthen the Community Air Protection Program.
- Considerations around the phaseout of oil and gas extraction and refining, and the role of carbon capture are discussed more thoroughly in Chapter 2.

As CARB continues to engage with the EJ Advisory Committee—in addition to the EJ Advisory recommendations that have been integrated throughout this plan—below are the following commitments that CARB is making to ensure that environmental justice is integrated in this plan and its implementation:

- Building decarbonization is a pillar of this Scoping Plan and CARB commits to working closely with state and local agencies to implement the EJ Advisory Committee recommendations that call for prioritization for residents in low-income communities and communities of color in this transition.
- CARB commits to sharing the EJ Advisory Committee's recommendations with the CEC, CPUC, and other agencies administering funds to support building

decarbonization, and to work closely with those agencies as they engage in public processes to further building decarbonization.

- CARB has committed to review the Cap-and-Trade program and determine what potential legislative or regulatory amendments could be necessary to ensure the program continues to deliver GHG reductions needed to achieve the statutory climate goals. In that process, CARB will consider the recommendations of the EJ Advisory Committee[533] and Independent Emissions Market Advisory Committee,[534] as well as others.

Critically, the EJ Advisory Committee makes numerous recommendations centered around tracking progress of the various strategies in this Scoping Plan. Currently, progress is tracked and reported in numerous ways, including the annual GHG inventory and reports to the Legislature. Part of the ongoing work of implementation, however, will include consideration of ways to provide more data and information to the public, such as rates of deployment of clean energy and technology as described in Chapter 1. CARB will also continue to collaborate with CDPH and OEHHA on health metrics to track cumulative benefits of air pollution and climate programs, especially in low-income communities and communities of color.

As noted earlier in this document, the EJ Advisory Committee will continue to play a vital role in the Scoping Plan and its implementation to ensure environmental justice and racial equity are prioritized in our effort to address the climate challenge before us. This includes ongoing EJ Advisory Committee engagement to advise CARB on the development of the Scoping Plan and any other pertinent matters in implementing AB 32. The ongoing EJ Advisory Committee will help to ensure integration of environmental justice in implementation efforts as it relates to AB 32, and also help CARB as we work toward a future where race is no longer a predictor for life outcomes.

Academic Institutions and the Private Sector

Academic institutions produce and present the latest science on both the impacts of, and actions to reduce, climate change damages. They are also leading the way by

[533] California Legislative Information. Bill Text – AB 32. Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006. (AB 32, Nuñez, Chapter 488, Statutes of 2006). *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32*.

[534] California Legislative Information. Bill Text – AB 398. California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption. (AB 398). *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398*.

establishing their own climate goals and GHG emissions reductions targets.[535, 536, 537] They are incubators for innovation and knowledge in clean energy and technology and play an important role in adding to the wealth of robust information to inform policies and programs. Academic institutions have the ability to fill knowledge gaps and push us toward new frontiers. As we move forward, we will continue to see these institutions as partners and resources that can help CARB look for ways to accelerate and introduce actions to reduce GHG emissions and remove and store carbon.

As such, it will be important to maintain and enhance relationships with academic institutions, including community colleges. Community colleges are more likely to have a large proportion of first generation students or students that come from low-income communities or communities of color. The perspective of this diverse student body will be critical to inform discussions on climate change damages and mitigation efforts. This student body is also a future workforce, and courses to teach the skills for a sustainable economy are a chance to close historical opportunity gaps. Importantly, many of the students at community colleges are local residents and community members. This engagement provides another way to invest in communities across our state. The Foundation for California Community Colleges is already leading the way through innovate programs such as their Good Jobs Challenge - California Resilient Careers in Forestry.[538] These types of programs could be replicated across other sectors. CARB will evaluate how to leverage the requirements in AB 680 on workforce development in the California Climate Investments programs with the work at the Foundation for California Community Colleges.

As noted in Chapter 1, public and private partnerships will be important as we move forward in the great energy transition. But the private sector is also important in the context of research and development and deployment. Many of these companies have the resources and expertise to build and produce the clean technology and energy we will need. It was through the efforts of several private companies (Bell, Exxon, Telecom

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[535] University of California. Our Commitment. *https://www.universityofcalifornia.edu/initiative/carbon-neutrality-initiative/our-commitment*.
[536] California State University. Energy, Sustainability, & Transportation. *https://www.calstate.edu/csu-system/doing-business-with-the-csu/capital-planning-design-construction/operations-center/Pages/energy-sustainability.aspx*.
[537] California Community Colleges Chancellor's Office. Climate Action and Sustainability. *https://www.cccco.edu/About-Us/Chancellors-Office/Divisions/College-Finance-and-Facilities-Planning/Facilities-Planning/Climate-Action-and-Sustainability?msclkid=4a72350ec4f511ecaf292c6b14ac9a4f*.
[538] Foundation for California Community Colleges. 2022. Good Jobs Challenge. Developing Resilient Careers in Forestry for Californians. *https://foundationccc.org/What-We-Do/Workforce-Development/Good-Jobs-Challenge*.

Australia) that the photovoltaic solar panels in use today were developed.[539] Similarly, it was companies such as General Electric and Texas Instruments that contributed to the development of hydrogen fuel cells.[540] This Scoping Plan includes the known and emerging clean technologies and fuels available today. The private sector spirit of invention, improvement, and innovation must continue to deliver new tools in the fight against climate change.

Individuals

This Scoping Plan not only projects ambitious availability of clean technology and energy, but also includes aggressive assumptions about consumer adoption of ZEVs, heat pumps, and other energy efficiency practices, among others. When it comes to climate change mitigation, the sum of the parts matters. Only when we add up the impacts of the choices we make do we understand the true impact on GHG emissions. Today, many Californians have opportunities to choose between driving a car, taking a bus, biking, or walking. Many can choose to install a heat pump or buy an electric cooktop. Together, we can increase these opportunities and pick the future we want. We can start or transform businesses that create clean jobs, innovate new technologies, or introduce new systems. We can engage with fellow workers to support durable paths for labor in a clean economy. And we can choose to engage with our community, tribes, and our governments to advocate for change, call out challenges, and propose solutions. Our choices will help determine California's climate future. Down one path is a future of climate impacts that will continue to worsen and further increase disparities across communities. Down the other is a future that avoids the worst impacts of climate change, improves air quality—especially for the most burdened communities—and fosters new economic and job opportunities to support a sustainable economy.

Importantly, we must acknowledge that historical decisions have resulted in health and opportunity gaps for residents in low-income communities and communities of color. Not everyone has the resources or access to make these choices—to buy a ZEV, install a heat pump, or use public transit to get to work. It is here that government can help. Government, at multiple levels, can fund programs and structure policies to provide consumers with more choice and to support them in adopting cleaner technology options. Whether through affordable energy rates or assistance in purchasing zero emission vehicles and appliances, we can use the transition to a carbon neutral economy as an opportunity to close some of these persisting opportunity gaps. By acting now, we can

[539] Californiasolarcenter.org. Passive Solar History. http://californiasolarcenter.org/old-pages-with-inbound-links/history-pv/.
[540] Fuel Cell Store. History of Fuel Cells. https://www.fuelcellstore.com/blog-section/history-of-fuel-cells?msclkid=04a19450c50211ec8d20f2afff4039fe.

change our planet’s fate and build a more resilient, healthier, and equitable future for all Californians.

Elk Hills Power Project

The Elk Hills Power Project is a nominal 550-megawatt natural gas-fired, combined-cycle, cogeneration power plant located near the community of Tupman, Kern County. The project was certified by the CEC on December 6, 2000, and began commercial operation on July 24, 2003.

DOCKET NUMBER
99-AFC-01

CAPACITY
550 MW

LOCATION
Kern County

TECHNOLOGY
Combined Cycle

PROJECT STATUS

Operational (Natural Gas-Fired)

PROJECT TYPE

Application for Certification

Project Description

The Elk Hills Power Plant (EHPP) is located on a 12-acre site within the Elk Hills Oil and Gas Field, in western Kern County, near the community of Tupman. The project is directly adjacent to the highly disturbed and developed 35R Gas Processing Facilities and the 35R Cogeneration Plant, both operated by Occidental of Elk Hills, Inc. (OEHI). The 74-square mile Elk Hills Oil and Gas Field is a fenced and secured area. The nearest residence is located more than 5 miles from EHPP.

EHPP is a nominal 550-megawatt (MW) combined-cycle, natural gas-fired, cogeneration power generating plant. The plant is powered by two General Electric 7FA technology combustion turbine generators (CTGs). Exhaust gas from the CTGs is directed to two supplementary fired heat recovery steam generators (HRSG) for the generation of high-pressure, intermediate pressure, and low-pressure steam that drives the steam turbine generator. Supplementary firing (duct burner firing) capability is provided in each HRSG to generate additional steam for peak power production. The EHPP facility utilizes Selective Catalytic Reduction systems for the control of oxides of nitrogen emissions and oxidation catalysts for the control of carbon monoxide and volatile organic compound emissions. A mechanical draft cooling tower provides heat rejection for the steam cycle. The cooling tower is comprised of six cells and is equipped with high-efficiency drift eliminators. One diesel-fired internal combustion engine is used to drive a fire water pump.

EHP delivers electricity to the EHP 230-kilovolt switchyard, which then is transmitted via a generation tie line to the interconnection point at the Pacific Gas and Electric's Midway Substation. The 9.8-mile water supply pipeline extends from the plant site east to the West Kern Water District facilities near Tupman. In addition, a 4.4-mile wastewater disposal pipeline extends from the plant heading south generally paralleling Elk Hills Road, terminating at Class 1 injection wells.

On August 16, 2011, the California Energy Commission approved Post-Certification Amendment (TN 61726) to allow EHPP to deliver useful cogenerated thermal energy to support natural gas processing facilities in the adjacent OEHI 35R Gas Processing Facilities.

Providing thermal energy to the 35R Gas Processing Facilities reduces load at the EHPP cooling tower and thereby reduces the overall water use by EHPP.

Collapse All

Project Amendment List

- **Correction to Verification for Facility Design Condition of Certification GEN-6**, TN 18596, 01/12/2001, Staff approval of inaccurate verification concerning appropriate documentation and CBO/CPM notification procedures.
- **Approval of Modification of LAND-1 Verification**, Not in Docket, 03/19/2001, Staff approval of a modification to verification permitting the project to submit required documents to Energy Commission prior to the start of construction of permanent facilities, rather than prior to ground disturbance activities.
- **Approval of Integration of New or Re-Powered Generating Units with CAL-ISO**, TN 21920, 08/09/2001, Staff approval to add Condition of Certification TSE-4 to Ensure Coordinated Integration of New Generating Unit with California's Electricity Grid.
- **Approval of Modifications to Condition of Certification AQ-C2**, TN 22856, 10/24/2001, Staff Approval of Modifications to Condition of Certification AQ-C2 to clarify requirements of oxidizing soot filter suitability reports for diesel-fired construction equipment, and revision of timing of suitability report submittals.
- **Order Approving Revision of Transportation Condition of Certification TRANS-7**, TN 27815, 01/13/2003, Order No. 03-0108-01d, Commission approval to modify Condition of Certification TRANS-7 to allow the existing temporary construction equipment access road to be used as the permanent, primary entrance road to the project.
- **Order Approving Modification of Air Quality Conditions of Certification**, TN 28447, 03/21/2003, Order No. 03-0319-01a, Commission approval to allow for tendering of PM10 emission reduction credits based on the outcome of initial source tests and allow for a temporary increase in commissioning emissions.
- **Order Approving Increase of Startup-Shutdown Emissions**, Not in Docket, Order No. 03-0723-09, Commission approval for an increase in criteria air emissions during startup-shutdown phases, increase in the size of emergency fire water pump, and modification of cooling tower operation.
- **Order Approving a Petition to Reduce PM10 Emission Rates**, TN 31147, 03/24/2004, Order No. 04-0317-1(c), Commission approval to reduce PM10 emission rates based on results of initial source tests and operating data from similar combined-cycle power plants.
- **Order Approving a Petition to Extend Cold Startup Time Limits**, TN 33792, 03/30/2005, Order No. 05-0316-02, Commission approval to extend the duration of cold startup time limits from four to six hours.

- **Order Approving Change of Nine Air Quality Conditions of Certification**, TN 44066, 01/09/2008, Order No. 08-0102-04, Commission approval to change nine Air Quality conditions of certification.
- **Approval of Petition to Move Approximately 1,200 Feet of Water Line**, TN 45734, 04/07/2008, Staff approval of modifications to approximately 1,200 feet of water line 4 miles SE of project.
- **Approval of Phase 1 Switchyard Modifications**, TN 50883, 04/07/2009, Staff approval of Phase 1 Switchyard conversion of PG&E 115kV system to PG&E 230 kV system.
- **Approval of Phase 2 Switchyard Modifications**, TN 53544, 10/05/2009, Staff approval of Phase 2 Switchyard conversion of PG&E 115kV system to PG&E 230 kV system.
- **Order Approving Amending Air Quality Conditions of Certification**, TN 58487, 09/16/2010, Order No. 10-0908-07, Commission approval to change the cooling tower PM10 emission limits for consistency with SJVAPD.
- **Approval of Requested Modification to Allow Operation as a Cogeneration Facility**, TN 61726, 08/19/2011, Staff approval to add connections to high/intermediate pressure steam and condensate system allowing EHP to deliver cogenerated thermal energy to support natural gas processing facilities in the adjacent Occidental of Elk Hills, Inc. facilities.
- **Order Approving a Petition to modify Air Quality Condition of Certification AQ-11**, TN 203237, 10/22/2014, Order No. 14-1007-04, Commission approval to modify condition of certification AQ-11 to comply with all current applicable LORS.
- **Approval of Requested Modification to Install Two Vacuum Pump Skids**, TN 210259, 02/10/2016, Staff approval to install two 100 percent capacity vacuum pump skids to replace the present steam-jet-based vacuum system.

Attention: Non-hypertext items above will need to be requested from the Compliance Project Manager, along with the document TN number, if provided above.

POWER PLANT CERTIFICATION AND EXEMPTION PROCESSES

The CEC has the exclusive authority to certify all thermal power plants 50 megawatts (MW) and larger and related facilities proposed for construction in California. The Application for Certification (AFC) process is a certified regulatory program under the California Environmental Quality Act (CEQA). As a certified regulatory program, the CEC does not prepare environmental impact reports (EIRs) in an AFC proceeding, but instead prepares environmental assessment documents that are functionally equivalent to EIRs. A certificate issued by the CEC is in lieu of any permit, certificate, or similar document otherwise required by any state, local or regional agency, or federal agency to the extent permitted by federal law, and supersedes any applicable statute, ordinance, or regulation of any state, local, or regional agency, or federal agency to the extent permitted by federal law.

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2023 ANNUAL REPORT OF THE INDEPENDENT EMISSIONS MARKET ADVISORY COMMITTEE

February xx, 2024

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Danny Cullenward, Committee Vice Chair, Policy Director – CarbonPlan,

Meredith Fowlie, Class of 1935 Endowed Chair in Energy – University of California, Berkeley, Department of Agricultural & Resource Economics

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Convener: California Environmental Protection Agency – Yana Garcia, Secretary; Sarah Izalt, Deputy Secretary; Bill Dean, Senior Advisor.

Introduction

Dallas Burtraw and Danny Cullenward

This is the sixth annual report of the Independent Emissions Market Advisory Committee (IEMAC), which was established by AB 398 in 2017. Pursuant to Health and Safety Code § 38591.2, the Committee is directed to report annually to the California Air Resources Board (CARB) and the Joint Legislative Committee on Climate Change Policies on the environmental and economic performance of California's carbon market and other relevant climate policies.

Across its first five annual reports, the Committee has commented on the role and performance of the carbon market, which now plays a larger role in the state's overall climate policy portfolio than it did when it was first created. As the Committee has emphasized, the carbon market adds an important element of cost effectiveness and provides an incentive to achieve additional low-cost emission reductions that might not otherwise be achieved through direct regulation. The market's carbon price also signals the state's long-term commitment to its climate policy goals and can help guide new investments. A well-designed emissions limit with the market's supply-demand balance in order provides the greatest possible confidence of achieving greenhouse gas reduction goals.

The IEMAC's 2023 report arrives at an important time for the carbon market. The program completed its eleventh year of successful administration and compliance, with policymakers and stakeholders increasingly focused on its future. In 2023, CARB began a series of informal workshops to discuss potential updates to the program to increase its ambition in line with the 2022 Scoping Plan. The outcome of CARB's formal regulatory process, which is expected to begin in 2024, will be especially important in charting the carbon market's future — a future that matters not just for California's climate goals, but also for other jurisdictions that directly collaborate with California or look to its example for guidance.

The Committee has commented previously on several issues now before CARB. Central to the potential update to the carbon market is an adjustment of allowance supply and how allowances are initially distributed. The program update provides an opportunity for CARB to reevaluate the balance between freely allocated and auctioned allowances and the impact of the design on affordability, leakage, and proceeds accruing to the Greenhouse Gas Reduction Fund. The Committee welcomes CARB's discussion of potential adjustments to future allowance supplies that address the accumulation (or "bank") of unused allowances in private accounts and options for post-2030 program allowance budgets. We have observed that changes in the allowance supply will likely change the allowance price which will affect the financial value of banked allowances, potentially constituting a windfall increase in the value of banked allowances. The committee has discussed the advantages of rule-based adjustments to

the market including for example a program design that automatically locks in emissions reductions stemming from regulatory programs by ratcheting down the market allowance supply. For two years the Committee has engaged the Environmental Justice Advisory Committee in considering whether emissions reductions are achieved evenly and to the benefit of disadvantaged communities. The program update provides an opportunity to ensure this outcome as well.

The Committee has repeatedly emphasized the importance of providing confidence in the program's continued operation, which is relevant to shaping investor expectations and achieving cost-effective reductions. Last year's IEMAC report included a chapter introducing some of the legal issues that might arise in the market's operation after 2030. It recommended that policymakers take appropriate steps to clarify the program's post-2030 future, to which CARB's subsequent workshops have meaningfully contributed. Whether or not legislative action is legally required, the Committee highlights the value that legislative reauthorization would provide.

The Committee notes that California has recently increased the pace of its statewide emission reductions. The most recent inventory data indicate statewide emission reductions fell about 11.6 million tCO_2e/year from 2019 through 2021 — a period that includes the slowdown from the global pandemic that led to a sharp one-time reduction in emissions as well as the first major recovery year. Emissions in 2021 were reported at 381.3 million tCO2e. CARB is projecting a provisional emission reduction of about 10.9 million tCO_2e in 2022. The trend since 2019 is a significant improvement over the trend from 2017 through 2019, for which CARB reports emission reductions of about 3.0 million tCO_2e/year. Nevertheless, the faster pace in recent years is not yet on track to achieve either the minimum statutory target of 258.6 million tC02e set by SB 32 (40% below 1990 emissions) by 2030 nor the more ambitious 2022 Scoping Plan Scenario 224.1 million tCO2e (48% below 1990 emissions) by 2030. Together, these trends highlight the importance of clarifying the carbon market's future.

This year's annual report contains four chapters on greenhouse gas accounting, carbon market links with other jurisdictions, affordability, and carbon management. We hope it will contribute to some of the pressing questions about the design of the carbon market and its role in furthering California's statewide greenhouse gas emission limits. A brief summary of each chapter follows.

Greenhouse gas accounting. The first chapter addresses greenhouse gas accounting systems in California. Emissions accounting is central to the design and effectiveness of climate policy programs. California's greenhouse gas emissions accounting system includes three key components: the statewide greenhouse gas inventory used to track compliance with statutory emission limits, the mandatory reporting regulation under which CARB calculates compliance obligations in the carbon market, and CARB's official estimate of 1990 emissions, which forms the baseline against which statutory targets for 2020, 2030, and 2045 are expressed.

Notably, the chapter describes how the exclusion of biogenic CO2 emissions from the statewide greenhouse gas inventory may exaggerate the climate benefits of replacing fossil fuels with biofuels in the transportation sector. It also illustrates how updates to the statewide greenhouse gas inventory to improve the inventory's accuracy have also had the practical effect of weakening California's statutory policy targets, a downside that could be mitigated by updating the 1990 emissions baseline. Finally, it recommends that CARB report additional information in its annual statewide greenhouse gas inventory to give context about the emission reduction trends needed to achieve its statutory and Scoping Plan targets.

Affordability. The second chapter addresses two sides of affordability. California households are forcefully affected by the changing climate through reduced labor productivity and agricultural yields, increased property damage, escalating wildfire risk, and more. Further, households pay for the costs of policy to reduce emissions of greenhouse gases. Californians with the fewest resources are the most vulnerable to both climate change impacts because they have fewer resources to adapt and respond, and to policy costs because they spend a larger share of their income on energy.

How we choose to pay for climate change mitigation and adaptation will determine, to a significant extent, how cost effectively and equitably we make the climate transition. This report elevates two affordability imperatives: cost containment and equitable cost allocation. Where it is possible to do so, overall costs of meeting emissions reduction targets can be lessened by placing a stronger reliance on the GHG emissions market and reducing the reliance on prescriptive regulation. Nonetheless, regulations often have a justification, and market outcomes can be better aligned with regulations by reducing allowance supply in the market in response to emissions reductions achieved by regulation.

Reducing allowance supply is key to achieving the ambitious emissions goals in the 2022 Scoping Plan. How the reduction is implemented will affect the share of allowance value that is distributed for free to utilities and industry and the share that accrues to the Greenhouse Gas Reduction Fund. The ongoing program review provides CARB with an opportunity to review the role of these channels for distributing allowances to ensure that each serves its intended purposes.

Market links. The third chapter addresses opportunities to link the carbon market with other jurisdictions. Even as California has played an important leadership role on climate policy, the state alone cannot reverse climate change nor ensure the livelihood and health of California residents. Those outcomes depend on national and global action. Successful climate policy in California requires the fulfilment of AB 32's directive to provide policy leadership nationally and globally. Linking carbon markets provides one avenue in this direction.

Market links have played a prominent role in carbon markets around the world. California's market is already linked to a similar program in Québec and was previously

linked with an earlier program in Ontario; other leading programs, such as the east coast states' Regional Greenhouse Gas Initiative and the European Union's Emissions Trading System, are also multilateral efforts that feature links between individual jurisdictions' carbon markets.

California is likely to have the opportunity to explore linkage with Washington state's new carbon market, and its eleven years of experience operating a carbon market is likely to serve as a key point of reference for policymakers in other states, such as New York. A market link is one of the ways the state can exhibit climate policy leadership and collaborate with other jurisdictions, similar to the work California has done in designing standards for energy efficiency, mobile source emission regulations, and clean energy policies that are frequently copied and modified by other governments. Cooperation is particularly important as California and a handful of other climate leaders — including Washington state, Canada, and the European Union — have made carbon pricing a central pillar of their climate policy portfolios.

Subsurface carbon management. The fourth chapter addresses point-source carbon capture and storage (CCS) technologies and a subset of carbon removal technologies such as direct air capture (DAC) that contemplate injecting captured CO2 underground. These technologies could play a significant role in reducing emissions and achieving California's 2045 carbon neutrality target, as well as increase investment in communities that have historically relied on the fossil fuel industry for economic development. At the same time, their deployment raises significant questions about their climate, social, and local environmental impacts. This chapter introduces some of the critical issues that face policymakers focused on these technologies. The IEMAC plans to continue working on these issues in 2024.

Greenhouse Gas Emissions Accounting

Danny Cullenward

Introduction

The California Air Resources Board (CARB) maintains three important accounting systems that track greenhouse gas emissions: the state's 1990 emissions baseline ("1990 baseline"), emissions data collected under its mandatory greenhouse gas reporting regulation ("MRR data") (CARB 2023a), and the statewide greenhouse gas inventory ("GHG Inventory") (CARB 2023b). These three systems play a critical role in the state's climate policy portfolio. Compliance obligations in the statewide cap-and-trade program are based on the MRR data, which also directly inform the GHG Inventory as of its 2022 Edition. Meanwhile, the GHG Inventory tracks the state's progress toward statutory emission reduction targets that are defined in relation to the 1990 baseline — reducing emissions below 1990 levels by 2020, at least 40% below 1990 levels by 2030, and at least 85% below 1990 levels by 2045.[1]

Because the 1990 baseline determines the overall level of state policy ambition and CARB uses the GHG Inventory data to measure progress toward state climate targets, it is important to understand how the state's greenhouse gas accounting systems are constructed and whether there are any opportunities to improve their consistency and accuracy. To that end, this chapter looks at how California's greenhouse gas accounting systems address four methodological issues: global warming potentials, biogenic CO_2 emissions, land sector emissions and removals, and a recent change to integrate the MRR data with the GHG Inventory. It then closes with a discussion and two technical recommendations.

Global warming potentials and CO_2-equivalence

Following convention and statutory guidance,[2] CARB reports the CO_2-equivalence (CO_2e) of emissions of multiple greenhouse gases across its accounting systems using global warming potentials (GWPs). The idea is straightforward: the CO_2e of a non-CO_2 greenhouse gas is determined by multiplying the number of tons emitted by that gas'

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[1] Health & Safety Code § 38550 (2020 target) (added by Assembly Bill 32 (Stat. 2006, Ch. 488)); *id*. at § 38566 (2030 target) (added by Senate Bill 32 (Stat. 2016, Ch. 249)); *id.* at § 38562.2(c) (2045 target) (added by Assembly Bill 1279 (Stat. 2022, Ch. 337)).

[2] *Id*. at § 38505(g) (defining "greenhouse gases" to include seven different species); *id*. at § 38505(c) (defining "carbon dioxide equivalent" as "the amount of carbon dioxide by weight that would produce the same global warming impact as a given weight of another greenhouse gas"); *id*. at § 38505(h) (defining "greenhouse gas emissions limit" in terms of carbon dioxide equivalent).

GWP. Like an exchange rate, a GWP makes it possible to quickly convert one gas (or currency) into another.

Technically, a GWP is calculated over a fixed time horizon by comparing the cumulative radiative forcing of two greenhouse gases over that fixed time horizon. In practice, most greenhouse gas inventories, including CARB's, use 100-year GWPs. For example, the 100-year GWP for methane (CH_4) is defined as the ratio between (1) the cumulative radiative forcing of one ton of CH_4 summed over 100 years and (2) the cumulative radiative forcing of one ton of CO_2 summed over 100 years. Perhaps the most prominent exemption to this general convention is New York's statutory requirement to use 20-year GWPs.[3]

When California began regulating greenhouse gas emissions, it was common to use 100-year GWPs published in the 1995 IPCC Second Assessment Report. CARB initially adopted the same approach and determined that 1990 statewide emissions were 427 million tCO_2e (CARB 2007a, CARB 2007b). As other regulators began to update their GWPs to reflect the best available science, CARB updated its estimate of 1990 emissions using 100-year GWPs drawn from the 2007 IPCC Fourth Assessment Report. CARB re-estimated 1990 emissions at 431 million tCO_2e, based on 2007 IPCC 100-year GWPs (CARB 2014a, CARB 2014b) — a modest increase of about 1% that reflected the higher GWPs reported by the IPCC.

Although the 1990 baseline and GHG Inventory adopted 2007 IPCC GWPs in 2014, the MRR data used 1995 IPCC GWPs through 2020. As of 2021, all three inventory systems consistently report CO_2e based on 2007 IPCC 100-year GWPs. Additional updates might be needed going forward, as the United States has committed to track its CO_2e emissions using 100-year global warming potentials from the 2013 IPCC Fifth Assessment Report (U.S. EPA 2023: ES-3).

Biogenic CO_2 emissions

Burning fossil fuels releases CO_2. CO_2 is also emitted when combusting biomass, such as wood waste or crop residues. But across California's greenhouse gas accounting systems, CO_2 emissions are treated differently depending on whether they derive from fossil fuels or biogenic sources: fossil CO_2 emissions are "included," while biogenic CO_2 emissions are "excluded." Excluded biogenic CO_2 emissions are still reported to CARB, but CARB does not include them as a liability in the cap-and-trade program nor as part of its statewide emissions.

[3] New York Environmental Conservation Law § 75-0101 [4] (defining "carbon dioxide equivalent" as "the amount of carbon dioxide by mass that would produce the same global warming impact as a given mass of another greenhouse gas over an integrated twenty-year time frame after emission.").

As climate policy scholar Leehi Yona explains, the special treatment afforded to biogenic CO_2 emissions derives from a set of little-known 2006 IPCC guidelines developed for land-sector emissions (Yona et al. 2022, Yona 2023).[4] The standard argument for excluding biogenic CO_2 emissions from official greenhouse gas inventories is premised on the notion that biogenic CO_2 emissions re-release carbon that plants originally sequestered from the atmosphere, such that there is no net climate consequence. But scientists have long understood that the land-use and supply chain consequences of bioenergy and biomass production vary widely, such that the presumption of zero net emissions from all biofuels is inaccurate (Searchinger et al. 2009).

CARB's Low Carbon Fuel Standard (LCFS) reflects this understanding and uses lifecycle assessment methods instead of broad assumptions about biogenic CO_2 emissions. Under the LCFS, fuels sold in California are assigned a carbon intensity score, calculated as the total CO_2e per unit of fuel energy content. Consistent with the contemporary understanding of the climate costs and benefits of biofuels, LCFS carbon intensity scores are based on lifecycle assessment methods that account for carbon sequestration, production emissions, land use impacts, and combustion emissions.

For example, CARB estimates that the lifecycle emissions of conventional gasoline sold in California results in emissions of 100.82 gCO_2e/MJ fuel.[5] Meanwhile, CARB estimates that the average carbon intensity of a prominent gasoline substitute, ethanol, has emissions of just under 60 gCO_2e/MJ fuel (CARB 2024a: Figure 5a) — about 40% less than gasoline.

Although CARB calculates that ethanol reduces emissions by about 40% relative to gasoline in the LCFS program, it books the outcome in the GHG Inventory as though ethanol reduces emissions by 100% because the GHG Inventory excludes all biogenic CO_2 emissions. Booking a 40% reduction as a 100% reduction exaggerates its benefits by about 250%.

The accounting consequences of this practice are substantial. CARB's GHG Inventory shows that excluded biogenic CO_2 emissions — which are tracked, but not included in the statewide data used to measure compliance with California's greenhouse gas emission limits — rose 22.9 million tCO_2, from 24.8 million tCO_2e in 2000 to 47.7 million tCO_2e in 2021 (CARB 2023b). Transportation fuel suppliers, who are the entities responsible for most biofuel-related emissions, reported that their excluded biogenic

[4] The GHG Inventory included biogenic CO_2 emissions until its 2016 Edition.

[5] California Code of Regulations, Title 17, § 95488.5 (Table 7-1).

CO_2 emissions rose 16.4 million tCO_2, from 8.7 million tCO_2 in 2012 to 25.1 million tCO_2 in 2022 (CARB 2023a).[6]

Land sector emissions and removals

Biogenic CO_2 emissions aren't the only excluded category of greenhouse gas emissions that are reported but not included in key California accounting systems. The other major category of excluded emissions comes from the land sector, often called AFOLU (agriculture, forestry, and other land use) in international climate policy circles.[7]

Land sector emissions can be difficult to estimate and are frequently controversial. They have recently re-emerged in California climate policy debates after the record-breaking 2020 and 2021 wildfire seasons, which CARB projects caused emissions of 106.7 and 85.1 million tCO_2, respectively (CARB 2022b: Figure 2). Although CARB published a separate Natural and Working Lands Inventory (CARB 2018), neither those data nor the wildfire emissions are included in the GHG Inventory and therefore neither is used as a basis for evaluating California's progress in reducing statewide emissions.[8]

However, CARB's 1990 baseline emissions include both emissions from and sequestration in the land sector, which CARB estimated resulted in a net sink of about 6.7 million tCO_2 (CARB 2007a: Table 2). Thus, although the GHG Inventory does not include land sector emissions or atmospheric removals, the 1990 baseline does.

Integrating the MRR data and the GHG Inventory

In 2022, CARB made a substantial change to the methodology used to calculate the GHG Inventory (CARB 2022a: 5). Previously, the MRR data were one of many sources used to inform the GHG Inventory, but CARB now describes the MRR data as the "primary" source used today (CARB 2023b: 36). These changes produced a substantial change in California's historical emissions, which CARB has retroactively updated to reflect the latest GHG Inventory methods, consistent with longstanding practice.

Figure 1 shows the change in the GHG Inventory data from comparing the most recent 2023 Edition (CARB 2023b) against the 2021 Edition, which was the last version

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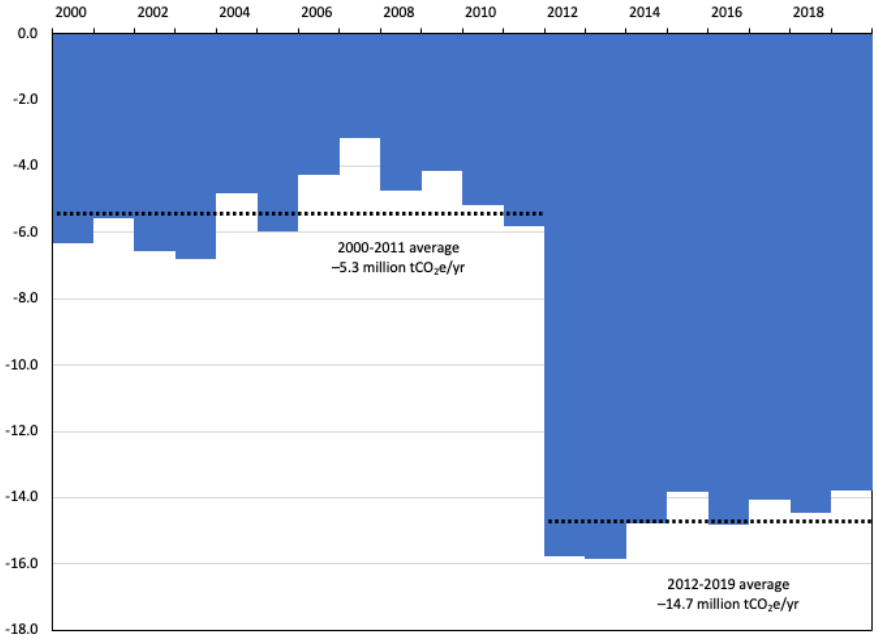
6 As explained further below, the MRR program began to collect full-scope data beginning in 2012, whereas the GHG Inventory includes projections back to 2000. MRR data are lagged by about one year, and thus 2022 data are the most recent as of this writing; in contrast, GHG Inventory data are lagged by about two years, and thus 2021 data are the most recent as of this writing.

7 California's GHG Inventory also tracks but excludes other emissions sources, such as international air travel and marine shipping. These sources are deemed international bunker fuels and their emissions are separately regulated by international treaties.

8 Land sector emissions are not included in the MRR data, although they are part of the cap-and-trade program, in which about 208 million tCO_2 in forest carbon offsets have been issued (CARB 2024b).

published before the decision to rely more directly on MRR data (CARB 2021). Two results are notable. First, reported emissions fell substantially across the entire historical period. Second, the pattern of changes exhibits a discontinuity in the year 2012. The bifurcation reflects the lack of full-scope MRR data prior to 2012; due to these limits, CARB's GHG Inventory methods rely primarily on MRR data only beginning in emissions in calendar year 2012 and afterwards (CARB 2022a).

Figure 1: Change in GHG Inventory, 2023 Edition vs. 2021 Edition (million tCO_2e)



For the earlier period in which MRR data are not available (2000 through 2011), CARB's current estimate of statewide emissions fell by an average of 5.3 million tCO_2e each year. And for the later period in which MRR data are available (since 2012), CARB's current estimate of statewide emissions fell by an average of 14.7 million tCO_2e each year.

The impact of these changes is substantial, both in terms of the lower emissions now reported in the GHG Inventory and because the methodological changes have not yet been applied to re-estimate the 1990 baseline. The premise of CARB's methodological update is that the MRR data are more accurate and reliable, in part because the MRR program requires third-party verification and has been subject to extensive refinement over more than a decade (CARB 2022a). Because California's greenhouse gas emissions limits are expressed relative to the 1990 baseline, however, changing the GHG Inventory methods without updating the 1990 baseline can reduce the stringency of state climate policy targets.

Specifically, if the 1990 baseline is artificially high, which is implied by the substantial reduction in the GHG Inventory observed since adopting the MRR data as its primary source, then the emissions limits may be similarly biased because the emission limits

are expressed as reductions relative to the 1990 baseline. This would result in a *de facto* weakening of statewide greenhouse gas emission limits (IEMAC 2022: 32-34). If such an outcome has occurred, it could be remedied by re-estimating the 1990 baseline.

Discussion

A comparison of four methodological issues common across three California greenhouse gas accounting systems illustrates some of the challenges facing climate regulators, as well as opportunities to improve the consistency and accuracy of reported outcomes (see Table 1).

Table 1: Greenhouse gas accounting issues in California

Methodology	**1990 Baseline**	**MRR data**	**GHG Inventory**
Global warming potentials used?	2007 IPCC GWPs (beginning in 2014)	2007 IPCC GWPs (beginning in 2021)	2007 IPCC GWPs (beginning in 2014)
Biogenic CO_2 emissions included?	No	No (Yes before 2016)	No
Land use emissions and removals included?	Yes	No	No
Based on current MRR data?	No	Yes	Yes

Two of the methodological issues are treated consistently across the three accounting systems. As of 2021, the 1990 baseline, MRR data, and GHG Inventory all use common 100-year global warming potentials drawn from the 2007 IPCC Fourth Assessment Report. Similarly, as of 2016, all three accounting systems exclude biogenic CO_2 emissions.

Although the choice of global warming potentials and biogenic CO_2 emissions are now consistently addressed across the three accounting systems, the resulting outcomes are not as accurate as they could be. When it comes to global warming potentials, the differences are not likely to be particularly large due to the relatively modest changes in GWP metrics across the 2007, 2013, and 2021 IPCC reports (U.S. EPA 2023: Table 1-

3). In contrast, excluding biogenic CO_2 emissions has much more significant consequences. Notably, the GHG Inventory does not capture the lifecycle emissions CARB assigns to the growing quantity of biofuels credited under the Low Carbon Fuel Standard.

Meanwhile, the third and fourth methodological issues illustrate significant inconsistencies. Although neither the MRR data nor the GHG Inventory include land-sector emissions and removals, the land sector was included in the 1990 baseline as a net sink of about 6.7 million tCO_2. More recently, CARB's decision to integrate the MRR data and GHG Inventory programs substantially reduced emissions reported in the GHG Inventory by about 14.7 million tCO_2e in each year. Although there are good reasons to believe this methodological update has significantly increased the accuracy of reported statewide emissions, the large changes it caused in the GHG Inventory suggest that the 1990 baseline may need to be reviewed for consistency.

Finally, however CARB determines California's 1990 baseline and reports progress toward statutory greenhouse gas emission limits in the GHG Inventory, it would help to provide additional context on the pace of observed emission reductions and trends needed to achieve policy targets going forward.

For example, the GHG Inventory reports that 2021 emissions were 381.3 million tCO_2, down about 23.1 million tCO_2 since 2019 (or about 11.5 million tCO_2 per year since 2019) (CARB 2023b). Furthermore, based on the reductions reported in the final 2022 MRR data, CARB projects preliminary 2022 GHG Inventory emissions of 370.4 million tCO_2, or an additional 10.9 million tCO_2 reduction from 2021. These data represent good news that reflect well on the efforts CARB and other policymakers have made to reduce emissions. Nevertheless, it is difficult to interpret the meaning of these accomplishments without additional context about what is required to meet California's climate targets.

To help give additional context, Table 2 and Table 3 report the annual reductions required to achieve California's minimum 2030 climate target (40% below 1990 emissions)[9] and the higher ambition target identified in the 2022 Scoping Plan (48% below 1990 emissions),[10] based on the official 2021 data and preliminary 2022 projections from the GHG Inventory, respectively (CARB 2023b). These tables show that a reduction of 10-12 million tCO_2 per year is close to but still below the pace needed to realize the statewide emissions limit set by Senate Bill 32 (about 13-14 million tCO_2 each year) and significantly below the pace required to realize the emission

[9] Calculated here as 60% of CARB 1990 baseline estimate (431 million tCO_2e), 258.6 million tCO_2e.

[10] Based on the total gross emissions projected in 2030 for the 2022 Scoping Plan scenario, not including gross carbon dioxide removals (CARB 2022c), 226.3 million tCO_2e.

reductions contemplated by the 2022 Scoping Plan (about 17-18 million tCO_2 each year).

Table 2: Annual reductions needed through 2030, based on official 2021 data (units: million tCO_2)

Scenario	2030 Target	2021 emissions (official data)	Annual Reductions Needed
Senate Bill 32 40% below 1990	258.6	381.3	–13.6
2022 Scoping Plan 48% below 1990	226.3	381.3	–17.2

Table 3: Annual reductions needed through 2030, based on preliminary 2022 projections
(units: million tCO_2)

Scenario	2030 Target	2022 emissions (projection)	Annual Reductions Needed
Senate Bill 32 40% below 1990	258.6	370.4	–14.0
2022 Scoping Plan 48% below 1990	226.3	370.4	–18.0

Recommendations

1. CARB should evaluate the four accounting issues discussed in this chapter — the choice of global warming potentials, the treatment of biogenic CO_2 emissions, the inclusion of land-sector emissions and removals, and the integration of the MRR data into the GHG Inventory — to determine if there are ways to more consistently and accurately report greenhouse gas emissions and removals

across its 1990 baseline estimate, MRR data, and statewide GHG Inventory.

2. As part of its annual GHG Inventory update, CARB should report the average annual pace of emission reductions across the emissions included in its GHG Inventory that would be required to meet all statutory targets (e.g., 40% below 1990 emissions by 2030) as well as any higher levels of ambition CARB adopts in Scoping Plans or similar documents (e.g., the 48% target identified in the 2022 Scoping Plan).

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Affordability and the Climate Transition

Meredith Fowlie and Dallas Burtraw

California is on the front lines of the climate crisis. Extreme heat, drought, rising sea levels, and escalating wildfire risk are significantly impacting the health, safety, and well-being of all Californians. These climate impacts are imposing large economic costs through multiple channels (e.g. reduced labor productivity, reduced agricultural yields, and property damages). Moreover, these costs are not equally distributed. Californians with the fewest resources are the most vulnerable to these climate change impacts.

Avoiding the most damaging effects of climate change will require significant investment in economy-wide decarbonization. This includes investments in new renewable energy generation; electricity transmission and distribution infrastructure; the electrification of transportation, buildings, and some industrial sectors. Adapting to climate change impacts will also require large investments in wildfire risk mitigation, disaster preparedness, flood controls, and other adaptation strategies.

As California confronts both the formidable costs of unmitigated climate change, and the formidable costs of slowing the pace of climate change, concerns about affordability and equity loom large. The 2022 Scoping Plan notes:

An important part of our equity consideration is ensuring the transition to a zero-emission economy is affordable and accessible, and that it uplifts disadvantaged, low-income communities and communities of color. Some aspects of the transition will have associated costs (e.g., escalating efforts to retrofit existing homes and businesses to support electric appliances and vehicles and increased costs of insurance). The state must ensure that these costs do not disproportionately burden consumers.

Low-income households will be disproportionately burdened if California does not change how we pay for climate change adaptation and mitigation investments. A recent increase in California's retail electricity prices provides an important case in point. Residential customers of California's largest utility recently saw that their monthly utility bills will increase by $34.50 (on average) in 2024. Two key drivers of this increase: massive investments in wildfire risk mitigation (a form of climate change adaptation) and a growing "cost shift" caused by net energy metering incentives for rooftop solar PV customers.[11]

This practice of increasing retail electricity prices above the social marginal cost of providing electricity services to pay for non-incremental costs (such as wildfire risk

[11] The January 2024 Electric Rates Report issued by the Public Advocates Office at the CA Public Utilities Commission lists wildfire mitigation and rooftop PV solar incentives among the top three drivers of retail electricity rate increases statewide. https://www.publicadvocates.cpuc.ca.gov/-/media/cal-advocates-website/files/press-room/reports-and-analyses/240119-caladvocates-q4-2023-quarterly-rate-report.pdf

mitigation) will slow our progress on electrification. Importantly, it is also inequitable. Rising electricity prices impact low-income households disproportionately because these households spend a relatively greater share of their income on direct energy use for electricity, gasoline, and home heating (Borenstein, Fowlie, and Sallee, 2022).

How we choose to pay for climate change mitigation and adaptation will determine, to a significant extent, how cost effectively and equitably we make the climate transition. The severe risks posed by climate change warrant significant investments in mitigation and adaptation. As the costs of mitigating and adapting to climate change increase, policymakers must work to contain these costs and allocate them judiciously.

The directive of this Committee is to report on the design and performance of California's greenhouse gas (GHG) emissions market. In what follows, we discuss the role of GHG market with respect to these two affordability imperatives: **cost containment** and **equitable cost allocation**.

Cost Containment

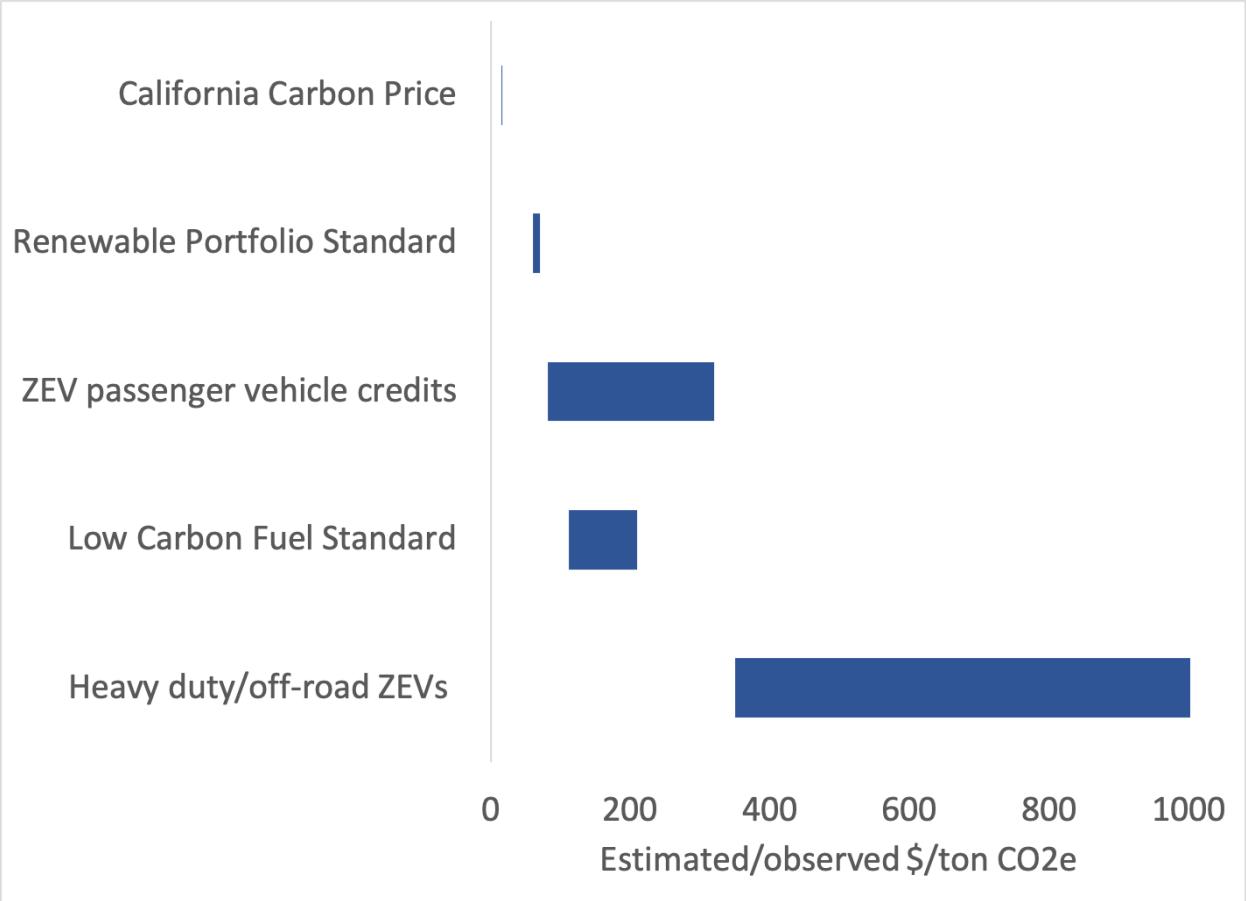
California climate policy makers are using emissions pricing, in combination with direct regulation, to achieve our GHG abatement goals. In previous reports from the Committee, and again in discussions this year, a recurring theme has been how to improve the alignment of prescriptive regulations with the GHG emissions market to improve cost effectiveness and to amplify the effectiveness of each.

California's market based GHG emissions trading program offers some important cost advantages relative to prescriptive regulation. Under a cap-and-trade program, regulated firms must acquire and surrender tradeable allowances to offset their GHG emissions. The compliance flexibility enabled by a GHG allowance trading system provides an incentive for regulated entities to seek out and deploy least-cost GHG emissions abatement strategies, including those that are not visible or known to the regulator when the policy is implemented. A related advantage of this more flexible approach: the GHG market can flexibly deploy abatement strategies in a way that leverages technological innovations and responds to changes in economic activity, weather events, etc.

California has historically relied more heavily on prescriptive, sector-specific regulations, versus the GHG market, to deliver GHG emissions reductions. These include regulations promoting vehicle fuel efficiency, renewable energy investments, etc. Sometimes these regulations are justified by the intent to drive innovation or overcome technology adoption coordination failures. However, a strong reliance on prescriptive approaches can increase the overall cost of meeting our GHG abatement targets if the prescriptive approaches target relatively costly GHG abatement options.

The cost per ton of CO2e emissions avoided is one coarse metric which can be used to compare climate change mitigation strategies and associated programs. The graph below

compares an assortment of estimated cost-per-ton-of-GHG-abated (some marginal, some average) for some key California programs:



Notes: This graph illustrates comparisons across programs at different points in time drawing from the following sources: GHG allowance prices (2018-2020) are reported here. LCFS prices (2018-2020) are reported here. Cost estimates for the RPS in 2018 are from this LAO report. Cost estimates for the ZEV credit program are estimated here. Cost estimates for heavy-duty ZEVS are from this LAO report (other ZEV program costs estimated in this report are off the chart).

The graph shows that the estimated cost-per-ton CO2e abated under some prescriptive California programs have at various times significantly exceeded what we've been paying for GHG abatement in the emissions market. Table 3-11 from the Scoping Plan also estimates high abatement costs for some measures considered in the Scoping Plan Scenario (e.g. building electrification). Mandating expensive GHG abatement measures when emissions allowance prices are relatively low could significantly increase the costs of meeting our CO2e abatement targets. Put differently, a well-functioning GHG market has a critical role to play in our cost containment efforts.

A stronger reliance on the GHG emissions market to deliver cost-effective abatement could significantly reduce the overall costs of meeting our GHG emissions reduction targets. But this would require policy changes that would tighten the GHG market and thus increase the market clearing GHG allowance price. The structure of the supply schedule for introducing allowances into the market with a price floor and a series of price steps - price-responsive allowance supply – is expected to reduce price volatility and assure compliance entities that they will have access to allowances in a tight market. Additional price steps, including an emissions containment reserve, could further improve integration of prescriptive regulations with the GHG allowance market by harvesting emissions reductions achieved by direct regulation to ratchet down allowance supply.

Cost Allocation

Roughly half of California's GHG market emissions allowances enter the market through a revenue-raising auction with proceeds going to the Greenhouse Gas Reduction Fund. The other half of the allowance supply is freely distributed to industry to protect competitiveness, mitigate emissions leakage, and benefit ratepayers (in the case of utilities). How these allowances are allocated, and how auction revenues are used, has potentially significant implications for cost allocation. A potential update to the design of California's GHG market provides an opportunity to re-evaluate the distributional implications of free allocation, and the protocols guiding the use of the GGRF funds.

As part of its ongoing workshop process to update the GHG market and align it with the with the state's more ambitious climate policy goals reflected in the 2022 Scoping Plan, CARB is considering an adjustment to the supply of allowances, which is likely to increase the GHG market allowance price. We are already observing price movements consistent with anticipation of a more stringent cap. Since the first quarter of 2021, with the pandemic recovery, completion of the Scoping Plan process, and the initiation of workshops to consider updates to the GHG market, the allowance price has increased 117%.[12] This increase in price maps into an increase in the value of banked allowances held in private hands.[13] We expect that reducing the supply of allowances will likely cause further increases in the allowance price.[14] Depending on how the allowance supply is adjusted, this increase in value will accrue to the Greenhouse Gas Reduction Fund and/or the million recipients of free allocations.

If the reduction in allowance supply is implemented primarily through a reduction in allowances allocated to industry, the increase in the allowance price will cause proceeds to the Greenhouse Gas Reduction Fund to increase. How these funds are allocated is a

[12] The auction clearing price in the first quarter of 2021 was $17.80 and for the fourth quarter of 2023 it was $38.73 (nominal dollars).
[13] The value of over 300 million privately held (banked) allowances have increased by more than $6 billion (nominal dollars).
[14] The effect of limiting allowance supply on the asset value of allowances depends on the elasticity of allowance demand. Borenstein et al. 2019 find allowance demand to be relatively inelastic especially in the short run. Burtraw et al. 2022 arrive at a similar finding in modeling the electricity sector.

policy decision ultimately shaped by the legislature. Using these funds to reduce the cost burden borne by low-income households and communities could offer an important way to advance our overarching equity and affordability goals.

Alternatively, if reductions in allowance supply are implemented primarily through a reduction in auctioned allowances, a greater share of the allowance value increase will flow into free allocations. The distributional impacts of this approach will depend significantly on how GGRF expenditures are impacted and which of the industry or utility allocations are preserved. California's GHG emissions market reform thus presents an important opportunity to re-evaluate how allowance value is being distributed to ensure that allowances are being allocated judiciously and in line with affordability/equity objectives.

Recommendations

1. A well-functioning GHG emissions market has a critical role to play in identifying least cost abatement options and containing the overall cost of meeting GHG targets. The role of the GHG market should be maintained and expanded over time.
2. Cost-containment and equitable cost allocation should be guiding principles of California's GHG market design, reform, and implementation.
3. Allowance supply changes will be needed to bring the GHG market in line with California's increasingly ambitious GHG targets. How these supply adjustments are implemented will impact how future GHG abatement costs are allocated across households and firms. These adjustments should be evaluated according to the guiding principles we describe.
4. Free allowance allocations to industry and the designated use of free allocation to utilities should be reviewed judiciously to ensure that these allocations are serving their intended purpose.

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Propagating California's Program Success and the Vision of AB32 through Program Linking

Katelyn Roedner Sutter and Dallas Burtraw

California is rightly proud of its world-leading efforts to address climate change, but greenhouse gas emissions and even air pollution do not respect state borders. Furthermore, California emits only approximately 1% of global greenhouse gas emissions. However, a similar effect is true for emission reductions – the benefits of California's success spill over into other jurisdictions. While efforts to reduce climate pollution within the state are essential to meeting our greenhouse gas reduction goals, often the even greater value is in exporting our innovations in climate and air quality to other jurisdictions to maximize reductions. California's leadership in policy design and technology development provides global benefits. To maximize the value of these efforts, California should not remain passive and should indeed encourage the propagation of its climate and technology policies.

The state's seminal Global Warming Solutions Act of 2006 (AB32) accelerated the state's tradition of environmental leadership and placed it at the forefront of national and international efforts to reduce emissions of greenhouse gases. Acknowledging that national and international efforts are necessary, the Act calls for California's actions to have far-reaching effects by encouraging other states, the federal government, and other countries to act. These actions by other jurisdictions have positive feedback effects for California that have been documented extensively elsewhere, such as:

- Creating new economic opportunities for California's clean energy technology and economy;
- Reducing the specter of emissions leakage and economic activity to businesses in unregulated jurisdictions;
- Improving regional air quality;
- Aligning the regulatory environment for business;
- Improving administrative, monitoring, and enforcement activity;
- Influencing climate policy development at an ever-broadening scale; and
- Most importantly, driving emission reductions to slow the impending environmental crisis.

Many transformational climate policies developed in California have been adopted in other jurisdictions including vehicle efficiency standards enabled under the federal Clean Air Act, clean energy and storage policy directives, and energy efficiency

standards. Notably, Quebec has a cap-and-trade program like California's, which enabled early linking of the two markets under the Western Climate Initiative (WCI) to maximize emission reductions. State agencies have a history of generosity in sharing insights into the state's policy experiences in all these areas. However, the propagation of emissions caps has been slower than proponents of AB32 would have hoped or anticipated.

Linking the California and Quebec carbon market with additional jurisdictions would yield numerous benefits for each jurisdiction including the opportunity for greater emission reductions, easing the administrative burden of program implementation, potentially lower cost of compliance for covered entities, and the less-tangible but essential momentum for climate action. California has a well-thought-out framework for regulation and enforcement of the carbon market that can serve as a model for other jurisdictions. CARB might look for opportunities to further build on its existing openness in sharing expertise with even greater technical assistance for other jurisdictions because the adoption of ambitious policies elsewhere and the emergence of a regional carbon market would benefit California.

In 2021, Washington State passed the Climate Commitment Act, which established an economy-wide cap-and-invest program. This program was created with the intention of future linkage with the California-Quebec market. Illustrating the depth of California's influence in policy design, Washington's program mirrors California's in key ways, making it likely a compatible partner for program linkage. Washington's Department of Ecology announced in November 2023 that they intend to pursue formal program linkage with the California-Quebec market, and the state legislature is currently considering a bill that would further align the Washington program with the WCI to facilitate a smooth linkage process. Given the strides Washington is making in aligning with California, and the urgent need to maximize greenhouse gas emission reductions, California should now initiate its own process for evaluating linkage.

By linking markets, California and Quebec can join forces with Washington to drive even greater climate progress through a broader and more stable regionally linked market. A bigger, linked market provides more opportunities for companies to identify lower-cost options to reduce their emissions, and the increased liquidity of a larger market provides greater insulation against price shocks and reduced volatility – whether those fluctuations are influenced by natural disasters or political conditions. A more stable regional market provides incentives for covered entities to invest in emissions abatement and provides greater confidence in the ability of all participating jurisdictions to achieve their climate goals at a time when multiple analyses show the importance of sub-national action to achieving climate targets.

California's leadership is needed to meet this moment – both in the state and across borders. California could be an active and proactive partner to the many states for which its policy is a model. In the near term, this could include expeditiously undertaking the

linkage evaluation process regarding Washington's program, and continuing conversations between agency staff and other policy leaders.

In addition to Washington's cap-and-invest program, the prospect of economy-wide carbon pricing is gaining momentum elsewhere; New York is in the process of finalizing the rules for its own cap-and-invest program, and Maryland is considering cap-and-invest as part of their Climate Pollution Reduction Plan. As these programs grow across the country, California's decade of experience in running an economy-wide carbon market is an invaluable source of knowledge – one that other states will need to tap into as they design their programs. When these programs become operational, California should prioritize exploring program linkage and seek out all opportunities for collaboration in the building and operation of compatible markets.

Recommendation

1. IEMAC calls for CARB to look for opportunities to expand its administrative and logistical support to jurisdictions developing or considering carbon limit policies, including but not limited to New York and Maryland; consider soliciting carbon limits and carbon pricing on a regional and national basis; and initiate its process for a linkage determination with Washington.

Subsurface Carbon Management

Brian Holt and Dallas Burtraw

CARB's 2022 Scoping Plan lays out an official pathway to achieve carbon neutrality within California. This plan and existing climate policy emphasize the prevention of greenhouse gas emissions as the dominant and preferred pathway to carbon neutrality. By most accounts, renewable energy resources with energy storage is the least-cost pathway to deep emissions reductions, but obstacles to the complete substitution away from fossil fuels remain. In addition, process emissions in industry remain a significant challenge. To achieve carbon neutrality, any remaining emissions after achieving maximal sectoral reductions through substitution away from fossil fuel will likely require add-on post-combustion technology at point sources such as natural gas power plants, biomass power plants and concrete plants to capture and concentrate carbon dioxide from flue gas and store it underground. The storage component primarily involves injection of CO_2 into geologic formations (such as depleted oil and gas reservoirs and saline formations), and to a small degree its use in industrial materials (e.g., concrete).

Carbon capture and storage (CCS) may also play a role in the application of technology to lessen the effect of prior legacy emissions. CCS may be coupled with direct air capture (DACCS) of carbon from the atmosphere to reduce atmospheric concentrations. When biomass is used for electricity production and coupled with CCS (BECCS), it can yield negative emissions if the captured emissions are greater than the net emissions from bioenergy combustion, the energy used to capture and inject flue gas CO_2, and the complex dynamics of land use and land opportunity costs. Because bioenergy with CCS involves the combustion of biomass that regrows over time, its physical climate impact is characterized by emissions upfront that are reduced by CCS and climate benefits that accrue over time. Other examples of technologies that may yield negative emissions involve the development of carbon sinks in soils and forests, production of biochar, biochemical processes in oceans and enhanced chemical weathering of rock.

The focus of this chapter is on CCS as applied to emissions reductions at emitting facilities. As mentioned above, CCS is directly relevant to some approaches to carbon dioxide removals from the atmosphere, and recent legislation (SB 905) comingles directives to CARB for development of a unified framework for subsurface carbon management for captured emissions and direct air capture. Consequently, this chapter also has relevance to a subset of carbon removal technologies that involve subsurface carbon management.

Possibilities

The 2022 Scoping Plan shows that CCS at industrial and electricity generating facilities is anticipated to capture 13 $MMTCO_2e$ by 2030 and 25 $MMTCO_2e$ by 2045. Carbon dioxide removals at natural and working lands, DACCS, and BECCS are expected to

total 7 $MMTCO_2e$ in 2030 and 75 $MMTCO_2e$ by 2045. Governor Newsom has recognized the importance of strategies for CO_2 capture at industrial facilities and removal from the atmosphere. The Governor directed CARB to accelerate development of natural and engineered carbon removal and carbon abatement projects with a CO_2 target of 20 $MMTCO_2$ for 2030 and 100 $MMTCO_2$ for 2045, as well as signing 2022 legislation on carbon abatement and removal and storage, including: AB 1279, SB 905, and SB 1137. Related legislation (AB 1757) addresses carbon sequestration in natural and working lands.

CCS projects have been implemented at various locations since the 1970s, largely on coal-fired power plants, with over two dozen projects operational around the world. As of November 2019, more than half of global large-scale CCS facilities (representing approximately 22 $MMTCO_2$/yr in capacity) were in the U.S., mostly due to sustained governmental support for these technologies. Over 100 projects are at the stages of advanced or early development and are expanding beyond coal-fired plants to fossil gas, fuel production, and electricity generation facilities.

In California, subsurface carbon management presents opportunities for economic development in industries and communities that are subject to the greatest losses from the energy transition away from fossil fuels. California's deep sedimentary rock formations in the San Joaquin Valley represent world-class CO2 storage sites that would meet the highest standards, with storage capacities of at least 17 billion tons of CO2.

There are seven cement plants operating in California currently. These plants have emissions associated with combustion and process-related activities. Combustion emissions account for 30-40 percent of the total emissions at cement plants, with the remaining emissions are related to process-related activities (Rissman et al. 2020). Cement is a good candidate for CCS due to the high temperature processes needed to produce cement, although high temperature electric heat and non-fossil hydrogen may soon provide feasible alternatives to combustion. SB 596 calls for a 40 percent reduction in GHG intensity in cement emissions from 2019 levels by 2035, and then net zero emissions by 2045. To meet in-state demand, the state relies on cement both produced in the state and imported. Additional reductions will need to be pursued and considered as part of implementation of SB 596, which directed CARB to develop a comprehensive strategy for the state's cement sector, and to achieve net-zero emissions of greenhouse gases associated with cement used within the state as soon as possible, but no later than December 31, 2045.

Currently, there are seventeen petroleum refineries operating in California. Despite ambitious emissions reductions at refineries described in the Scoping Plan, and implementation of Executive Order N-79-20 that precludes the sale of new emitting vehicles by 2035, there will remain some demand for petroleum fuels for legacy vehicles on road applications, and in aviation, rail, and marine applications. Petroleum refineries will need to implement technology to decarbonize their operations and reduce their

emissions. The Scoping Plan assumes CCS at petroleum refineries as one of those potential strategies, although only a small number of these sources may be technically amenable to continuous operation of CCS. Some advocates of carbon management anticipate that construction activity from a build out of CCS at existing and new facilities would contribute to the production of low carbon intensity hydrogen, transportation fuels, and electricity, although some experts would question what constitutes "low-carbon" hydrogen, potential leakage of methane and CO_2 capture rates.

Addressing Risks

Stakeholders have raised multiple concerns related to the inclusion of CCS and carbon dioxide removal in the Scoping Plan. One focus has been on potential negative health and air quality impacts in communities from operation of facilities utilizing CCS that continue to emit other emissions, especially in communities already overburdened by air pollution. Community-level concerns have also focused on safety concerns related to potential leaks of carbon dioxide from storage facilities.

Critics have also questioned the economic viability of the CCS and direct air capture carbon dioxide removal technology, suggesting that modeling and policy planning are misguided by including them in future scenarios. The economic viability of these technologies depends on policy support at the federal and state level. There has yet to be a comprehensive evaluation of technological impacts or identification of best practice and preferred policy pathways, especially with respect to carbon dioxide removals. The development of a unified policy framework mandated under SB 905 may take important steps in resolving this shortcoming.

Environmental advocacy stakeholder concerns also focus on the presumed moral hazard resulting by the focus on mechanical carbon management because it may enable continued fossil fuel use and delay investments in non-emitting technologies. Attention given to carbon dioxide removal, in particular, may deter mitigation by reducing the salience of climate change mitigation. This may be especially true if carbon dioxide removal substitutes directly for mandatory emissions reductions.

Industry stakeholders express uncertainty about the lack of understanding and clarity over the potential role for CCS in the cap-and-trade program. A protocol exists for the LCFS program, but uncertainty about is applicability to the carbon market introduces regulatory risk that is a barrier to project development.

These stakeholder concerns are already substantially covered under the scope of SB 905 and may be resolved with full implementation of the legislation, which we discuss below. Nonetheless, successful policy must address these concerns, including through the development of guardrails that define which types of carbon management projects are consistent with the state's climate goals as well as those that appropriately balance the economic development opportunities for and environmental risks to local communities.

Policy

Substantial government support for CCS and some forms of carbon dioxide removals from the atmosphere is in place at the federal and state level depending on the specific application and products. The Inflation Reduction Act provides tax incentives for the capture and sequestration of CO_2 in Section 45Q, although we note it is calibrated to gross CO_2 sequestration rather than net emissions reductions, providing imperfect incentives for efficient implementation. The Act incentivizes low-carbon hydrogen production under Section 45V with a lifecycle calculation that rewards low-carbon production. At the state level, CARB adopted a CCS Protocol in 2018 as part of amendments to the Low Carbon Fuel Standard that enables crediting of CCS projects for oil and fuels production under lifecycle pathway applications. At this time, no CCS projects have been credited under the LCFS protocol.

The next expected policy advances in facilitating carbon management in California will be implemented under SB 905, adopted in 2022, which directs CARB in consultation with other state agencies, to create a CCS program aimed at accelerating the deployment of carbon management technologies. Responsibilities for CCS in California are assigned to CARB, the California Natural Resources Agency, and California Geological Survey. Under SB 905, CARB must adopt regulations for CCS and technologies or strategies to remove CO_2 from the atmosphere and put it into long-term storage. CARB must also make available a permitting portal to allow project operators to submit all permit-related information through one online platform. SB 905 also requires California Natural Resources Agency to: 1) establish a framework for intrastate pipelines carrying carbon dioxide fluid and 2) to publish a framework for governing agreements for the purposes of managing carbon dioxide storage project reservoirs. The California Geological Survey is tasked with developing a Geologic Carbon Storage Group that will provide expertise and guidance on carbon storage.

There are various unresolved policy questions that are important for subsurface carbon management. For CCS to be applied to emitting sources covered under the cap-and-trade program, it would be valuable to clarify whether the CCS protocol applied to the LCFS is sufficient guidance for the cap-and-trade program. While some proponents feel the application is a straightforward extension of that protocol, others seek greater certainty including clarity about the liability for leakage and protocols to ensure permanence of carbon storage. Regulatory uncertainty, whether justified or not, will impede investment, and this uncertainty needs to be resolved before investments will occur.

There remain difficult questions about the role of mandates and additional incentives for carbon dioxide removals in California's policy framework that stretch beyond the framework that will be established under SB 905. The cap-and-trade programs' carbon price provides an economic incentive to reduce covered entities' CO_2 emissions and serves as a price point against which CCS could be economically justified. However, there are conflicting views on whether carbon dioxide removals should be given credit

as offsets in the cap-and-trade market and resolving this will be an important issue for CARB and the legislature. A different approach might involve the introduction of a new compliance obligation, analogous to a storage mandate or renewable energy mandate in the electricity sector, mandating a removal credit for each specified number of tons of emissions covered in the cap-and-trade market. Other approaches to introducing incentives or requirements are possible.

California policy makers have a chance to incentivize and shepherd the development of subsurface carbon management in a way that respects environmental integrity and community values. Discussions about how this is achieved should move to central stage in 2024.

Recommendations

1. The state should develop of guardrails that define which types of subsurface carbon management projects are consistent with the state's climate goals as well as those that appropriately balance the economic development opportunities for and environmental risks to local communities.
2. CARB should move to resolve and clarify the protocol for the application of CCS at emitting sources.
3. CARB and the legislature must clarify the incentives and/or mandates for application of carbon removals through direct air capture before such investments can take place.

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Third Quarter 2023 Results

November 01, 2023

CALIFORNIA RESOURCES CORPORATION | CARBON TERRAVAULT

A DIFFERENT KIND OF ENERGY COMPANY

Presenters

Francisco Leon — *President & Chief Executive Officer*

Nelly Molina — *EVP & Chief Financial Officer*

Executive Summary– Delivering on Our Plan

A DIFFERENT KIND OF ENERGY COMPANY

CASHFLOW

- Generated $71MM of free cash flow[1] during the third quarter and $403MM year to date
- Year to date, returned ~52% or $207MM of free cash flow[1] to stakeholders in form of
  - share repurchases of $143MM,
  - dividends of $59MM, and
  - debt repurchases of $5MM (not including an additional $30MM debt repurchase post 3Q)
- Raising fixed dividend[2] by 10%

CARBON

- Announcing two new CO_2 sequestration projects at CTV Clean Energy Park at Elk Hills
  - First capture to storage CTV project from an existing source at Elk Hills Cryo Gas Plant with first expected CO_2 injection by the end of 2025: 100KTPA
  - Storage-only renewable natural gas (RNG) facility with NLC Energy (NLCE): 150KTPA
- EPA's Class VI permit tracker[3] shows CTV I draft permit issued before YE23

CALIFORNIA

- CRC's natural gas incremental inventory[4] > 1 Tcf in Sacramento and San Joaquin basins
- 2024E business plan preview:
  - Line of sight to permitting progression. Plan to start 2024 with 1 rig and increase activity in 2H24
  - Increased EHPP capacity revenue
  - $55MM + in est. cost reductions
  - EHPP turnaround

Note: please see slide 30 for details on the footnotes on this slide.

Cashflow

Delivered Consistent Operational & Financial Performance

	3Q23E[1]	3Q23A
Brent ($/bbl)	$75.28	$85.95
Brent realized price with hedge ($/bbl)	$65.99	$66.12

CRC GUIDANCE	Guidance[1]	Results
Net Total Production (MBOE/D)	86 – 88	85
Net Oil Production (MBO/D)	52 – 54	51
Operating Costs ($MM)	$185 – $205	$196
CMB Expenses[2] ($MM)	$5 – $10	$9
Adj. G&A[3] ($MM)	$52 – $60	$51
Total Capital ($MM)	$52 – $67	$33
Free Cash Flow[3] ($MM)	$30 – $50	$71
Other Guidance Items		
Natural Gas Marketing Margin ($MM)	$20 – $25	$47
Electricity Margin ($MM)	$40 – $50	$44
Transportation Expense ($MM)	$13 – $18	$16

Total quarterly return of cash to stakeholders ($MM)	3Q23A
Share Repurchases ($MM)	$20
Dividend Payment ($MM)	$19
Debt Repurchases ($MM)	$5
Total ($MM)	$44

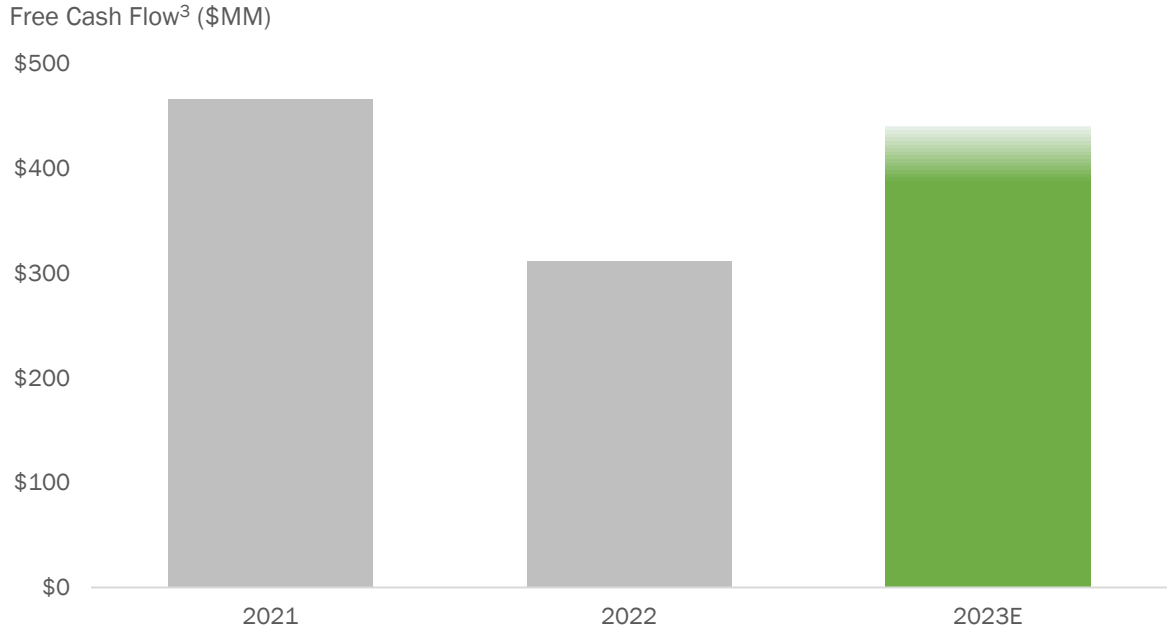
~$11/bbl

rise in QoQ Brent prices contributed to an increase of ~$7MM in operating cash flow[4]; negatively impacted net oil production by 1.2 mbo/d due to PSC effects

62%

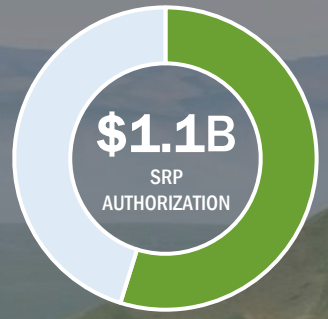
of quarterly free cash flow[3] returned to stakeholders in form of dividends, share repurchases and debt buybacks

STRONG 3Q23 RESULTS PAVE A WAY FOR DELIVERING ROBUST ANNUAL FREE CASH FLOW[3] GENERATION



Note: please see slide 30 for details on the footnotes on this slide.

Proven Commitment to Shareholder Returns



Repurchased To-Date

$497 Million Remaining

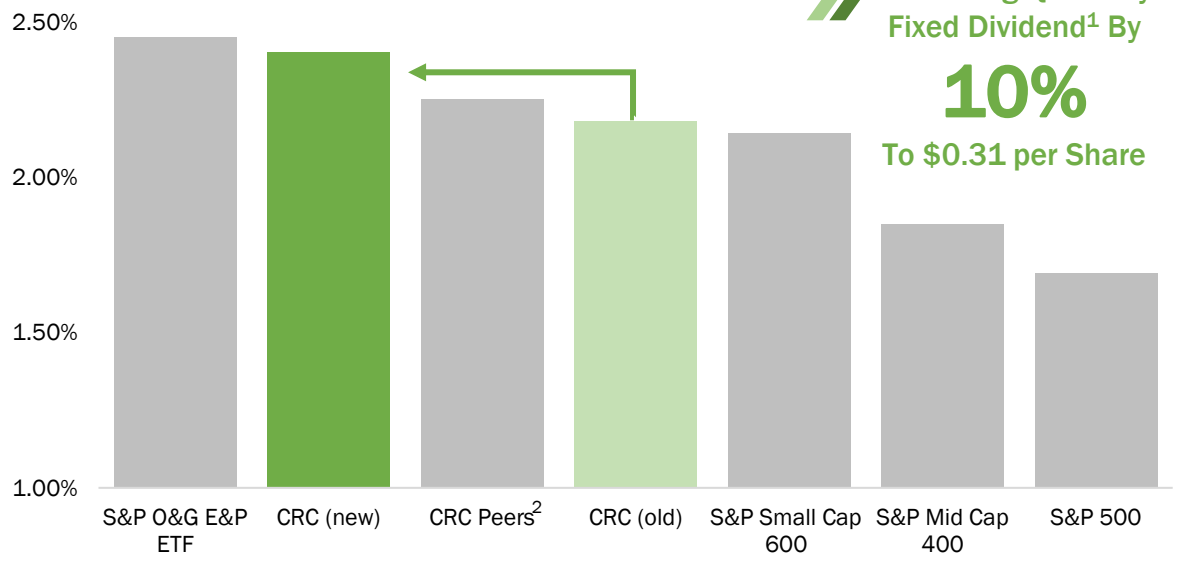
Above Average Fixed Return Yield vs. Market Participants & Peers

Existing $1.1B SRP with $497MM Remaining

Year to Date, Repurchased $35MM in Debt ***(Including Post 3Q23 Repurchases)***

RAISING FIXED DIVIDEND FOR THE THIRD YEAR IN A ROW

Annualized Fixed Dividend yield (%)



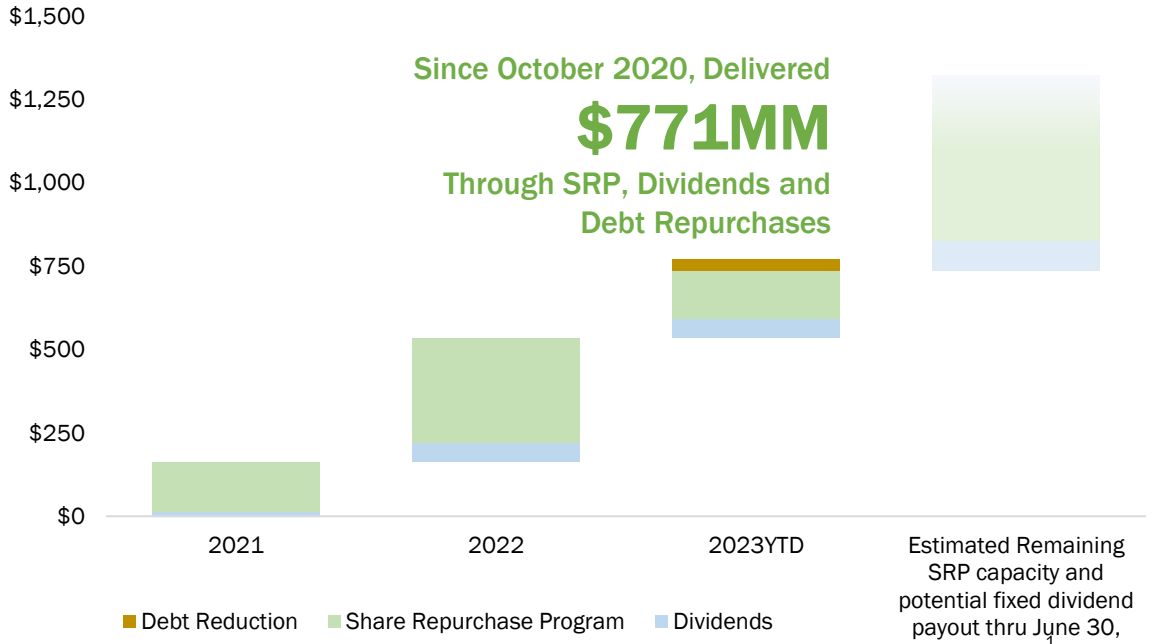
Increasing Quarterly Fixed Dividend[1] By

10%

To $0.31 per Share

CONTINUOUSLY CREATING VALUE FOR STAKEHOLDERS

Cumulative Amount Returned to Shareholders and Debt Repurchases ($MM)



Since October 2020, Delivered

$771MM

Through SRP, Dividends and Debt Repurchases

Note: please see slide 30 for details on the footnotes on this slide.

CARBON
TERRAVAULT
THE FOREFRONT OF CARBON MANAGEMENT

Announcing CRC's First Capture to Storage Project at Elk Hills Gas Plant

A DIFFERENT KIND OF ENERGY COMPANY

DECARBONIZING CRC'S OPERATIONS & TARGETING

~6.5% REDUCTION[1] IN EMISSIONS INTENSITY OF ELK HILLS POWER PLANT

CTV'S FIRST CCS PROJECT TO CAPTURE AND STORE 100 KMTPA

PROJECT DETAILS FOR CAPTURE TO STORAGE PROJECT AT ELK HILLS

- CRC to construct a pre-combustion project at the CTV Clean Energy Park at Elk Hills to remove CO_2 from inlet gas, *increasing operational efficiency of the cryogenic gas processing plant, improving propane recovery, and reducing the carbon intensity of the electricity* generated from the Elk Hills Power Plant
- Expected to capture *100KMTPA of CO_2 and* to be stored at CTV I storage vault
- The capture project is targeting *45Q credit generation as well as the potential for LCFS qualification and Cap & Trade (C&T) avoidance,* and anticipates paying *CTV JV an injection fee for CO_2 sequestration services*
- *Project provides the ability to control the full CCS value chain*
  - CTV JV storage only economics are in line with previously disclosed type curve[2]
  - Capture + storage economics net to CRC are in line with previously disclosed IRR range[2] of 10% to 30%
- Project *FID targeted in 1H24*[3]; commercial *operations targeted in 2H25*

CO_2 INJECTION RATE (KMTPA)	✓	100 KMTPA (Planned)
PROJECT EST. CAPITAL REQUIREMENTS ($/MT)	✓	WITHIN OUR PREVIOUSLY DISCLOSED TYPE CURVE[2] OF $5 TO $15 OF CAPITAL PER MT OF CO_2 FOR A STORAGE-ONLY SOLUTION
PROJECT EST. EBITDA[4] ($/ MT)	✓	WITHIN OUR PREVIOUSLY DISCLOSED TYPE CURVE[2] OF $50 TO $75 OF EBITDA[4] PER MT OF CO_2 FOR A STORAGE-ONLY SOLUTION

Note: Due to CTV's 51% ownership of the storage entity, CTV JV, the metrics above are shown on a storage-only basis for comparison purposes to previously announced projects.

Note: please see slide 30 for details on the footnotes on this slide.

NLC Energy Greenfield Renewable Natural Gas (RNG) Facility

ABOUT NLC ENERGY

- NLC Energy LLC, (NLCE) designs, builds, owns, and operates RNG facilities that convert organic waste into useful commodities like clean Renewable Natural Gas (RNG)
- Low-carbon RNG replaces higher-carbon fossil fuels across the transportation, utilities, and manufacturing sectors
- The company is headquartered in Nashua, NH and has an operational RNG plant in Denmark, WI

CDMA DETAILS FOR NLCE GREENFIELD RNG FACILITY[1]

- NLCE to construct a *greenfield production facility* at the CTV Clean Energy Park at Elk Hills that *is expected to generate up to 7,000 MMBtu per day of RNG*
- CTV JV will provide *permanent sequestration for 150KMTPA of CO_2 initially* using CTV I storage vault, including the lease of land for the *RNG* facility
- Project *FID targeted for late 2024*; commercial *operations targeted by 2027*
- CTV JV and NLC are also discussing *CRC's potential financial participation in the RNG facility*

CO_2 INJECTION RATE (KMTPA)	✓	150 KMTPA (Planned)
PROJECT EST. CAPITAL REQUIREMENTS ($/MT)	✓	WITHIN OUR PREVIOUSLY DISCLOSED TYPE CURVE[3] OF $5 TO $15 OF CAPITAL[2] PER MT OF CO_2 FOR A STORAGE-ONLY SOLUTION
PROJECT EST. EBITDA[2] ($/ MT)	✓	WITHIN OUR PREVIOUSLY DISCLOSED TYPE CURVE[3] OF $50 TO $75 OF EBITDA[2] PER MT OF CO_2 FOR A STORAGE-ONLY SOLUTION
OFFTAKE INTEREST	✓	RNG PRODUCTION OFFTAKE WITHIN THE CTV CLEAN ENERGY PARK AND CRC OPERATIONS COULD FURTHER REDUCE EXISTING AND FUTURE EMISSIONS OF FACILITIES

Note: please see slide 30 for details on the footnotes on this slide.

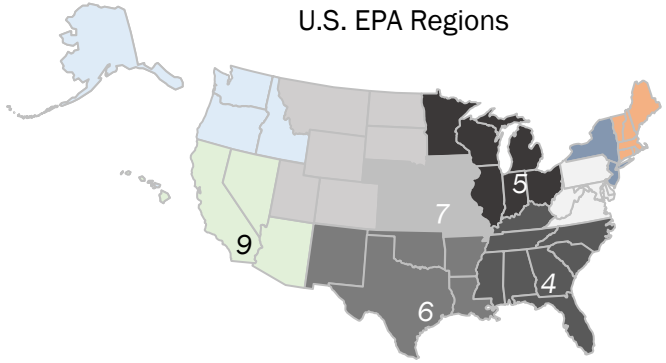
Solidifying CTV Class VI Permitting Leadership

CTV Leads CA/Region 9 with EPA Class VI Permit Submissions

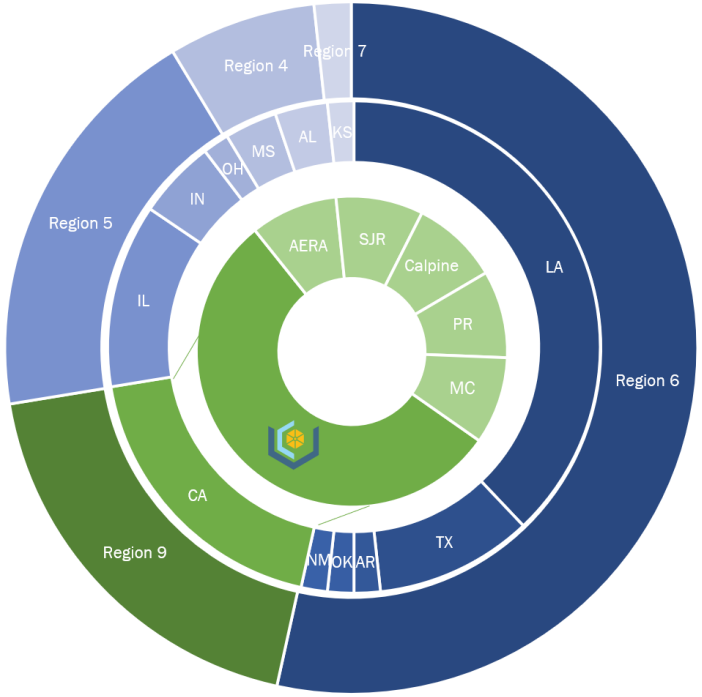
~10%

of Currently Submitted EPA Class VI Permits are From CTV[1]

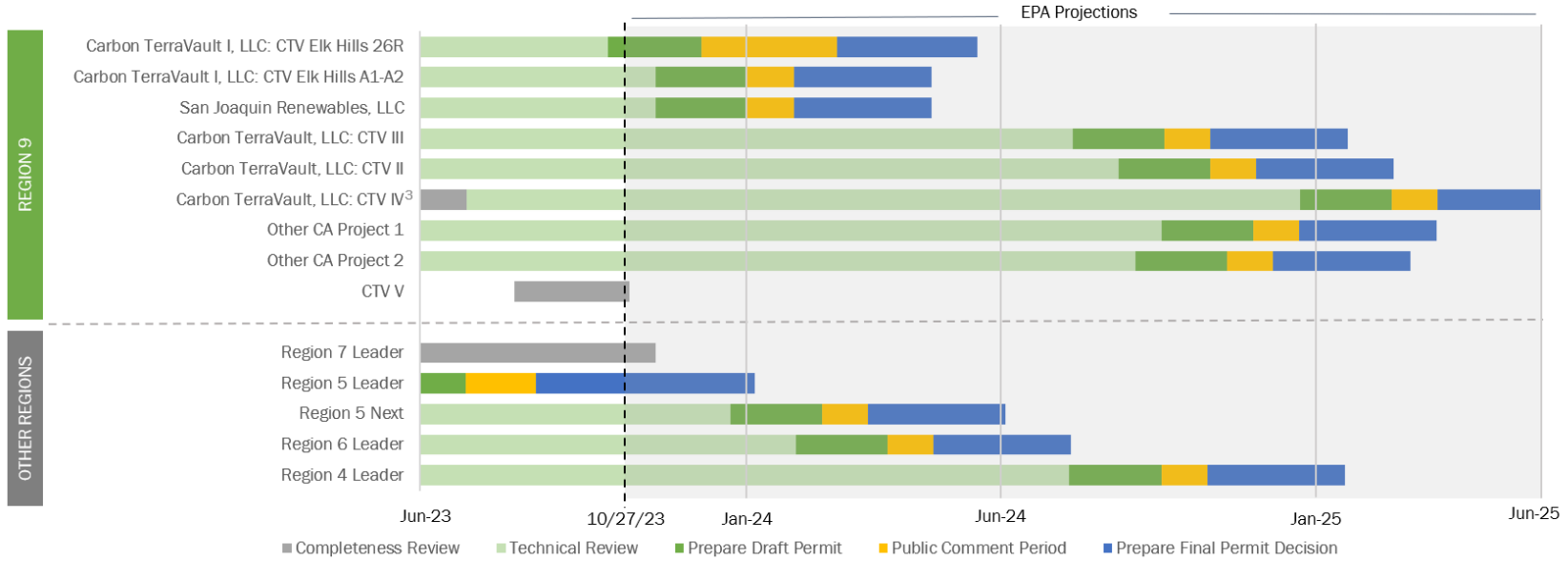
U.S. EPA Regions



- CTV Elk Hills 26R (CTV I) is expected to be receive draft permit before year end
- CTV Elk Hills 26R (CTV I) permit approval would be first in California and first permit for storage into a depleted oil and gas reservoir
- Proactively engaging with the local communities to share information about the positive benefits of these projects in the local communities



EPA Projected Permit Timeline[2]



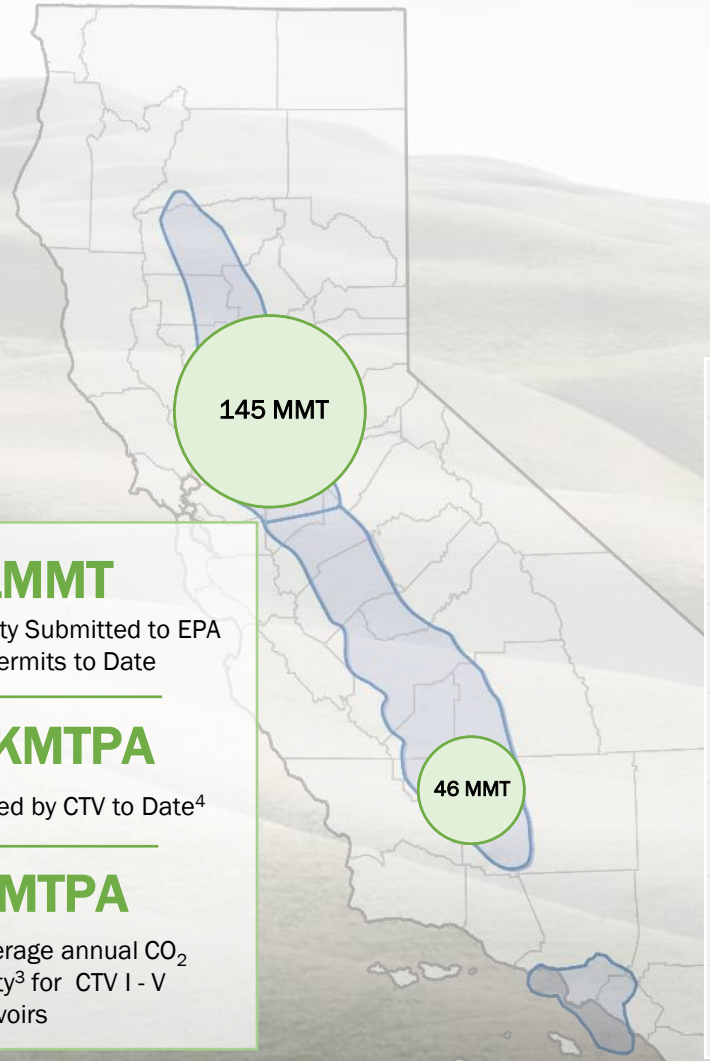
(1) Subject to issuance of EPA class VI permits. (2) Source: EPA Tracker, https://www.epa.gov/uic/current-class-vi-projects-under-review-epa,
(3) Projected to complete preparation of final permit decision at the end of June '25

Positioned to Be California's Premier Carbon Management Provider

100KMTPA for CRC's own CCS brownfield project within the CTV Clean Energy Park at Elk Hills

Signed an additional storage only CDMA[1] for an injection rate of 150KMTPA with NLC Energy

Targeting first CO_2 injection at CTV I by the end of 2025



191MMT

CTV Storage Capacity Submitted to EPA For Class VI Permits to Date

1,065KMTPA

of CDMAs Announced by CTV to Date[4]

4.8MMTPA

Est. combined average annual CO_2 injection capacity[3] for CTV I - V reservoirs

Vault	CTV I	CTV II	CTV III	CTV IV	CTV V
EPA Permit Application Administratively Complete	Yes	Yes	Yes	Yes	In Progress
Targeting Class VI Draft EPA Permit Receipt	~YE23	~2024	~2024	~2025	~2025
California's Basin	SJ Basin	Sacramento Basin			
Annual Regional CO_2 Emissions[2] *(MMTPA)*	~30	~60			
Est. Average Annual Injection Capacity[3] *(MMTPA)*	~1.2	~0.6	~1.8	~0.9	~0.4
Potential Total Storage Capacity *(MMT)*	46	23	71	34	17
Remaining and Available CO_2 Injection Capacity (%)[5]	43%	100%	~77%	100%	100%

Note: please see slide 30 for details on the footnotes on this slide.

California

California Needs Low Carbon Intensity Domestic Natural Gas

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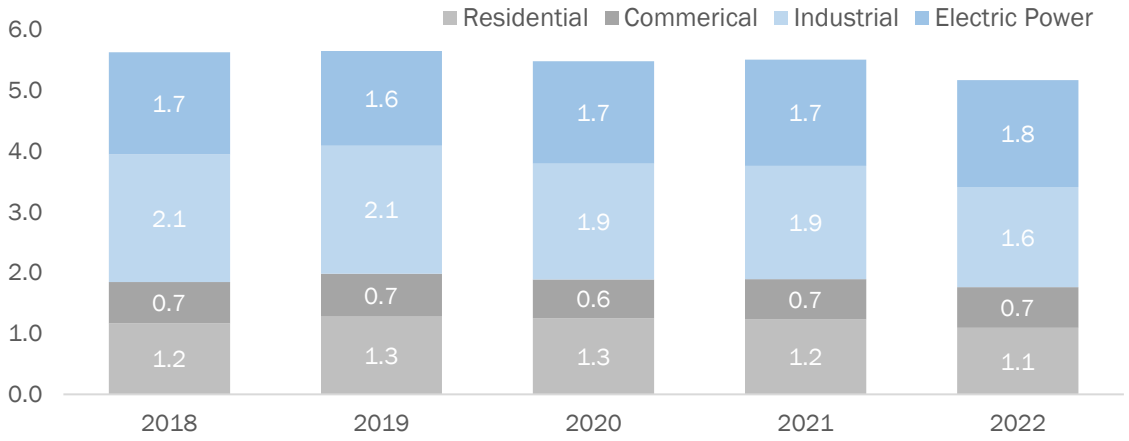
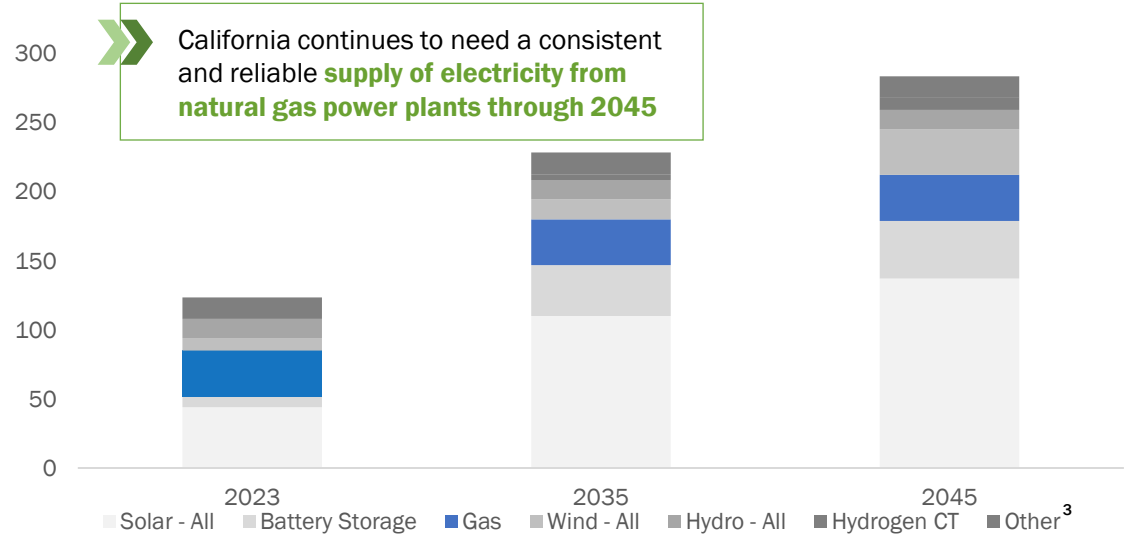
POWER AND INDUSTRY CONSUME ~70% OF THE STATE'S NATURAL GAS[1]

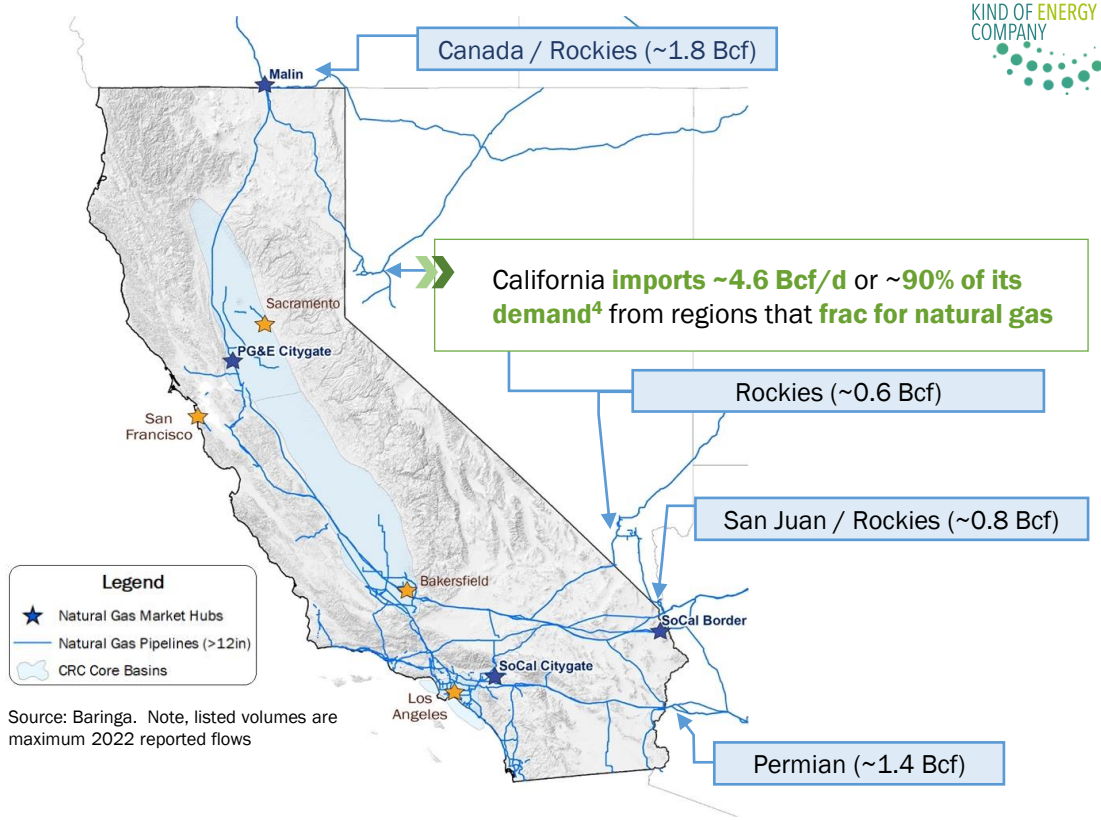
California's Natural Gas Demand (Bcf/d)



EVEN IN 2045, NATURAL GAS POWER PLANTS PLAN TO CONTRIBUTE 12%[2]

Total Capacity (Giga-watts)





Source: Baringa. Note, listed volumes are maximum 2022 reported flows

California Will Continue to Receive a Premium to Henry Hub

- CRC expects natural gas to play a key role in supporting energy transition
- CA imports 90% of its gas needs. Lack of flexibility with the legacy natural gas infrastructure will continue to drive elevated prices and volatility in periods of high demand[5]
- CRC expects relatively strong natural gas prices with the premium to Henry Hub to continue

(1) EIA; excludes Vehicle Fuel which was less than 0.029 mcf/d from 2018 to 2022 (2) CARB Scoping Plan 2022 (3) Other includes pumped storage, shed DR, geothermal, nuclear, biomass, CHP and coal (4) CARB (5) Internal estimates

CRC's Natural Gas Inventory Depth – 1Tcf[1] Opportunity

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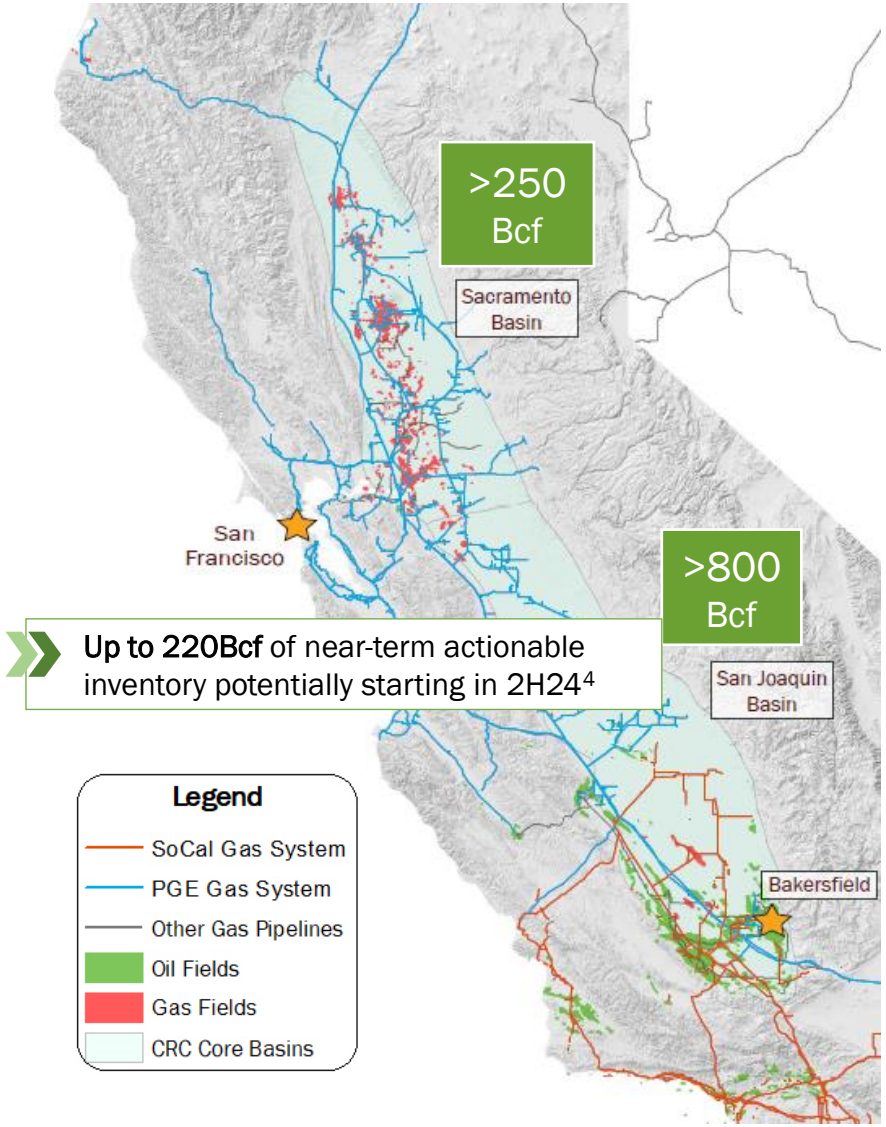
CRC's Incremental Inventory[1] by Basin



Up to 220Bcf of near-term actionable inventory potentially starting in 2H24[4]

CRC is pursuing a **Responsibly Sourced Gas[2] (RSG)** certification for the majority of its natural gas assets

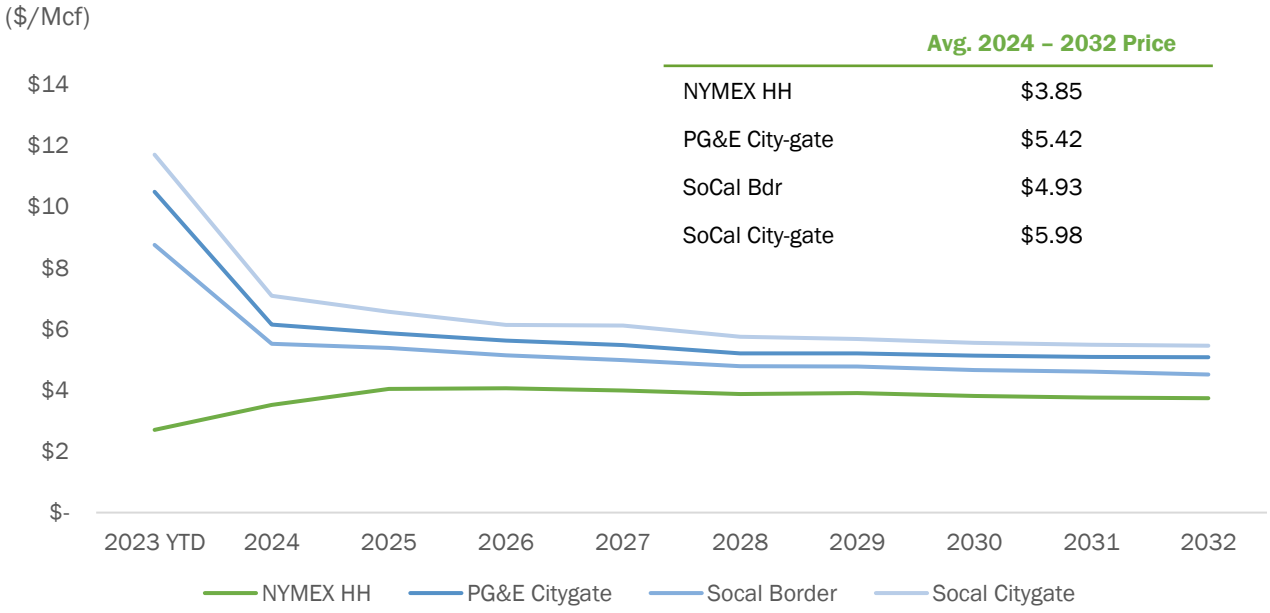
Sacramento Basin Incremental Inventory[1]

- ~110Bcf of actionable inventory
- Resource:
  - >250 Bcf of dry gas
  - ~300 locations

San Joaquin Basin Incremental Inventory[1]

- ~700Bcf of actionable inventory
- Resource:
  - >800 Bcf of associated gas
  - ~1,100 locations

CALIFORNIA'S NATURAL GAS FORWARD CURVES[3]



	Avg. 2024 – 2032 Price
NYMEX HH	$3.85
PG&E City-gate	$5.42
SoCal Bdr	$4.93
SoCal City-gate	$5.98

Note: please see slide 31 for details on the footnotes on this slide.

Preliminary 2024 E&P Business Outlook

A DIFFERENT KIND OF ENERGY COMPANY

LINE OF SIGHT TO WELL PERMITTING PROGRESSION IN 2024

EXPECTED INVENTORY OF SIDETRACKS, WORKOVERS, NATURAL GAS TO INCREASE ACTIVITY IN 2H24

CONTRACTED CAPACITY REVENUE[1] FROM EHPP TO INCREASE BY ~$45MM

IN 2024 VS 2023E

ON PATH TO ACHIEVE $55MM +

IN TARGETED YE2023 RUN RATE REDUCTIONS[2]
IMPLIES ~$2/BOE REDUCTION TO CRC'S OPERATING COST[3]

EST. ELK HILLS PLANTS TURNAROUND IMPACT IN 1Q24

20	$34MM
MMCF/D	CAPITAL

(1) Capacity revenue is a part of electricity revenue on CRC's income statement. (2) Includes YE2023 reduction in non energy operating costs and Adj. E&P corporate and other G&A. (3) Internal estimates.

4Q23 Guidance

2023E Corporate Guidance *(as of November 1st, 2023)*

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CRC 2023E GUIDANCE[1]:	FY 2023E E&P, Corp. & Other	FY 2023E CMB	FY23E Combined	4Q23E E&P, Corp. & Other	4Q23E CMB	4Q23E Combined
Net Total Production[1] (MBOE/D)	**85 – 87**	—	85 – 87	**82 – 85**	—	82 – 85
Net Oil Production[1] (MBO/D)	**51 – 53**	—	51 – 53	**49 – 51**	—	49 – 51
Operating Costs ($MM)	**$815 – $850**	—	$815 – $850	**$185 – $195**	—	$185 – $195
CMB Expenses[2] ($MM)	—	$40 - $50	$40 - $50	—	$10 - $20	$10 - $20
Adj. G&A[3] ($MM)	**$185 – $210**	$10 - $15	$195 – $225	**$50 – $56**	$1 - $2	$51 – $58
Total Capital ($MM)	—	—	$185 - $210	—	—	$65 - $81
Adj. Total Capital[4] ($MM)	**$180– $200**	$5 - $10	—	**$60 – $71**	$5 - $10	—
Free Cash Flow[3] ($MM)	**$470 – $510**	($70) – ($90)	$380 - $440	**$50 - $75**	($45) – ($55)	($5) - $30

Other Guidance Items:	FY 2023E Low	FY 2023E High	4Q23E Low	4Q23E High
Marketing of Natural Gas Margin ($MM)	$155	$185	$20	$30
Electricity Margin ($MM)	$80	$110	$10	$15
Transportation Expense ($MM)	$60	$80	$15	$19
ARO Settlement Payments ($MM)	$55	$60	$10	$12
Taxes Other Than on Income ($MM)	$170	$180	$40	$44
Interest and Debt Expense ($MM)	$55	$60	$13	$15
Cash Income Taxes ($MM)	$100	$120	$25	$35
Commodity Realizations:				
Oil - % of Brent:	94%	97%	96%	99%
NGL - % of Brent:	56%	60%	50%	60%
Natural Gas - % of NYMEX:	275%	325%	165%	185%

Includes:
~$20MM in new CMB land purchases /easements

2023E Guidance Assumptions ($/Bbl)
2023E Brent Price: $84.16
4Q23E Brent Price: $90.46

Note: please see slide 31 for details on the footnotes on this slide. Current 2023 guidance doesn't include targeted cost reduction initiatives mentioned on page 15 of this deck.

Appendix

Why California Resources Corporation?

A DIFFERENT KIND OF ENERGY COMPANY

CALIFORNIA RESOURCES CORPORATION | CARBON TERRAVAULT | 2045

- LEADING CARBON MANAGEMENT BUSINESS
- PREMIER BALANCE SHEET WITH STRONG FREE CASH FLOW GENERATION
- STRONG SHAREHOLDER RETURNS STRATEGY
- DISCIPLINED CAPITAL ALLOCATION

Executing on our Low Carbon Intensity O&G Operations

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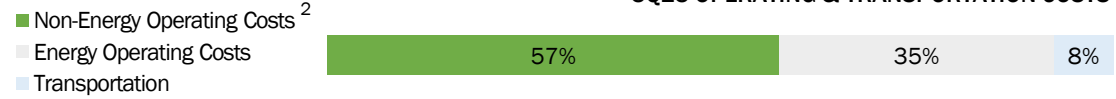
Key Operational Results:

85MBOED
3Q23 NET PRODUCTION

$33MM
3Q23 E&P, CORP, & OTHER ADJ. CAPITAL[1]

$212MM
3Q23 OPERATING & TRANSPORTATION COSTS



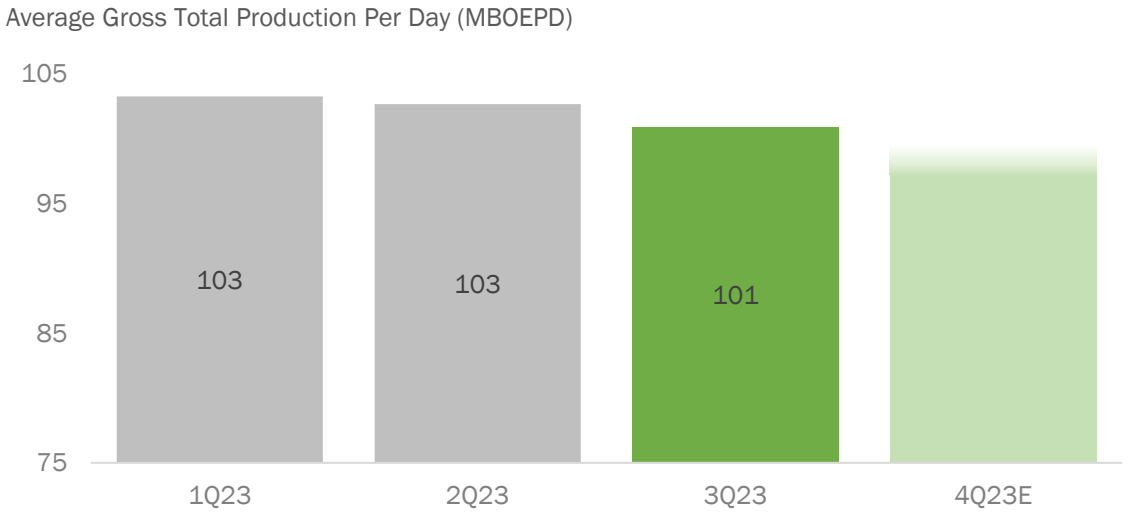
3Q23 OPERATIONAL PERFORMANCE COMMENTARY:

- Continue strong HSE performance above internal goals
- Wells: Drilled[3] 9 wells in 3Q23
- Rig Activity: Exited the quarter with 1 drilling rig in the LA basin and 34 maintenance rigs across CRC's asset base

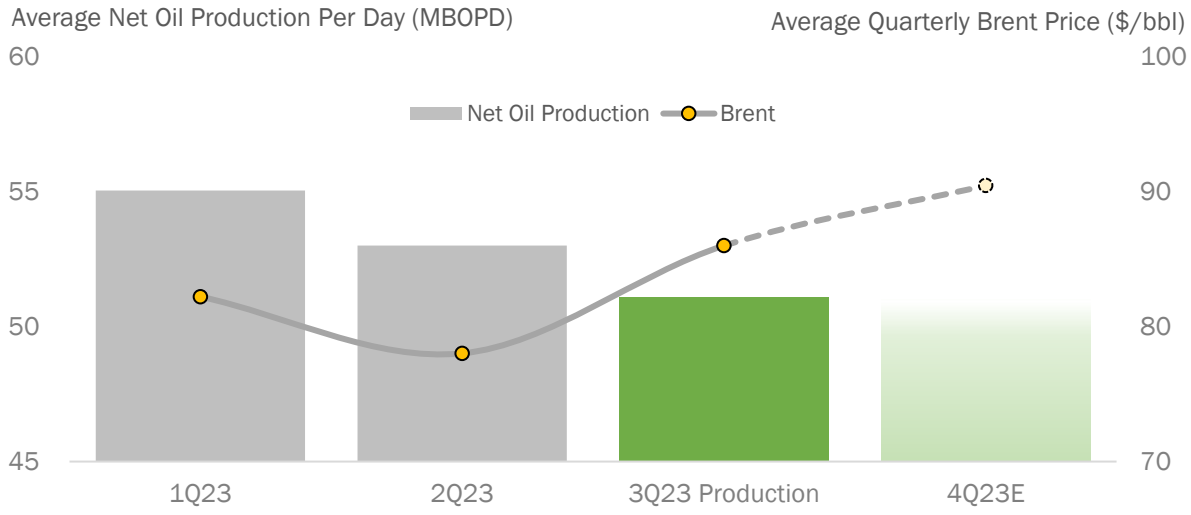
3Q23 PRODUCTION PERFORMANCE COMMENTARY:

- PSC Effects: On a net basis, higher than anticipated Brent prices resulted in a negative quarterly 1.2MBOED of net oil production impact due to PSC effects
- Higher oil prices contributed ~$7MM of higher than planned operating cash flow[4]
- Targeting gross production annual decline rate in line with previously provided 5% to 7% range

RESILIENT ASSET BASE DESPITE LIMITED CAPITAL INVESTMENT



CRC'S NET OIL PRODUCTION



(1) Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. (2) Non-Energy Operating Costs includes gas processing costs. (3) Includes steam injectors and drilled but uncompleted wells, which are not included in the SEC definition of wells drilled. (4) Impact to cash flow after hedges and before changes in working capital.

Wilmington Production Sharing Contracts (PSC) At Higher Commodity Prices

For every $1/BBL increase/decrease in Brent price, we expect a ~90BOD decrease/increase in our net oil production related to PSCs[1]

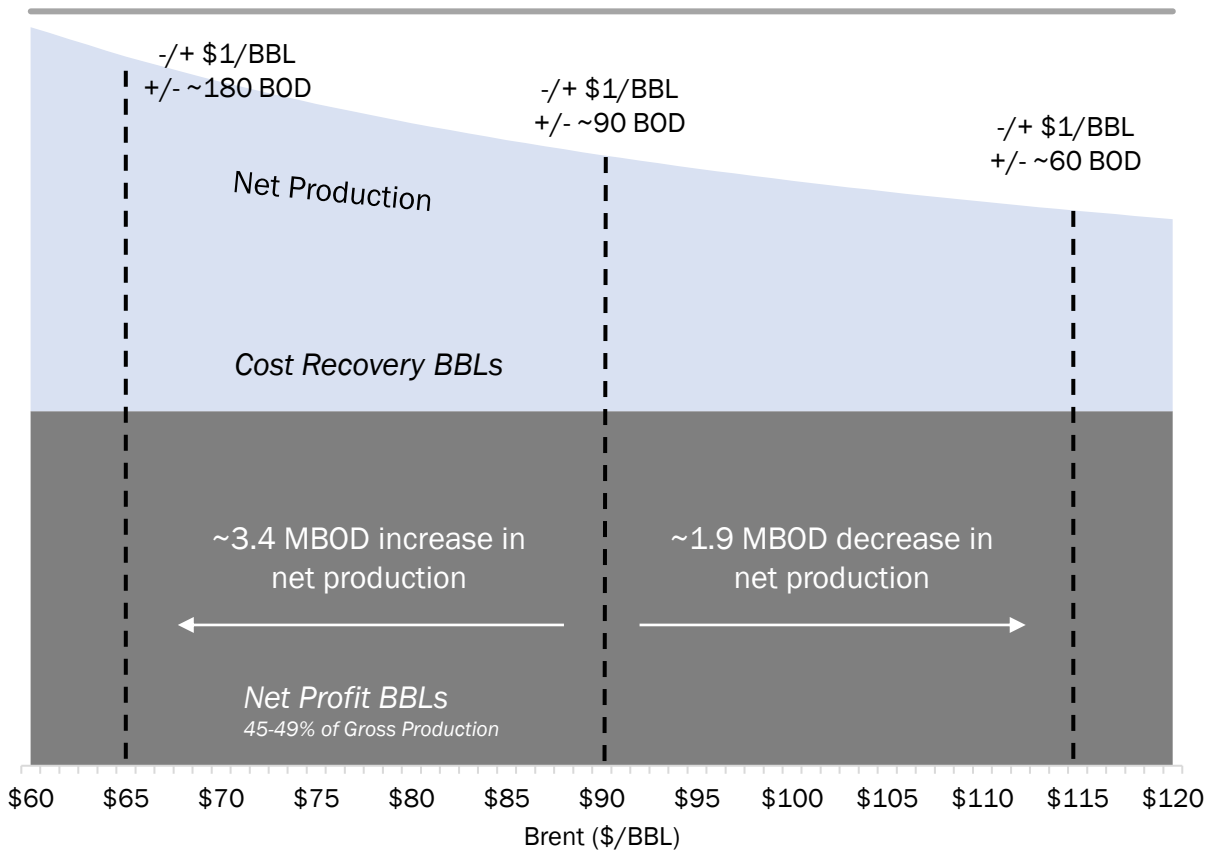
Approximately 30% of CRC's oil production is subject to PSCs Mechanics:

- As operator, CRC pays our partners' share of the Operating and Capital Cost
- CRC recovers our partners' share of operating and capital costs through production sharing, where CRC's cost recovery is reported as revenue
- CRC receives 45-49% of the gross production as "Profit Barrels" after cost recovery
- CRC's net share of production includes cost recovery and profit barrels

As prices rise, fewer barrels are required to recover our partners' portion of the cost

CRC sees a difference of ~5.3MBOD in net oil production between $65/BBL and $115/BBL

EFFECT OF OIL PRICE ON NET PRODUCTION[2]



(1) Based on Brent price of $90 per barrel of oil (2) Net Production from Wilmington field only. Includes the effects of a development program in LA Basin.

Huntington Beach – Asset Optimization & Value Unlock

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1 ACRE PARCEL – FT APACHE

Source: Newmark

- 1810 Pacific Coast Highway, Huntington Beach, CA
- Completed the abandonment of six wells
- In the process of completing surface abandonment
- Targeting call for offers for ~1 acre parcel of land (Fort Apache) by YE23

Over 1 mile of direct access to **Pacific Coast Highway**

~90 ACRES PARCEL – HUNTINGTON BEACH

- Continuing the re-zoning, re-entitlements and due diligence processes
  - Multi year process
- Developing strategy to optimize production and ARO schedule
  - Huntington Beach field 2022 gross production[1] was ~3,000BOD
  - The field is connected to a producing offshore platform Emmy
  - Free cash flow[2] generating asset
- Plugged and abandoned 20 wells year to date
- Targeting to P&A an additional 40 wells in 2024

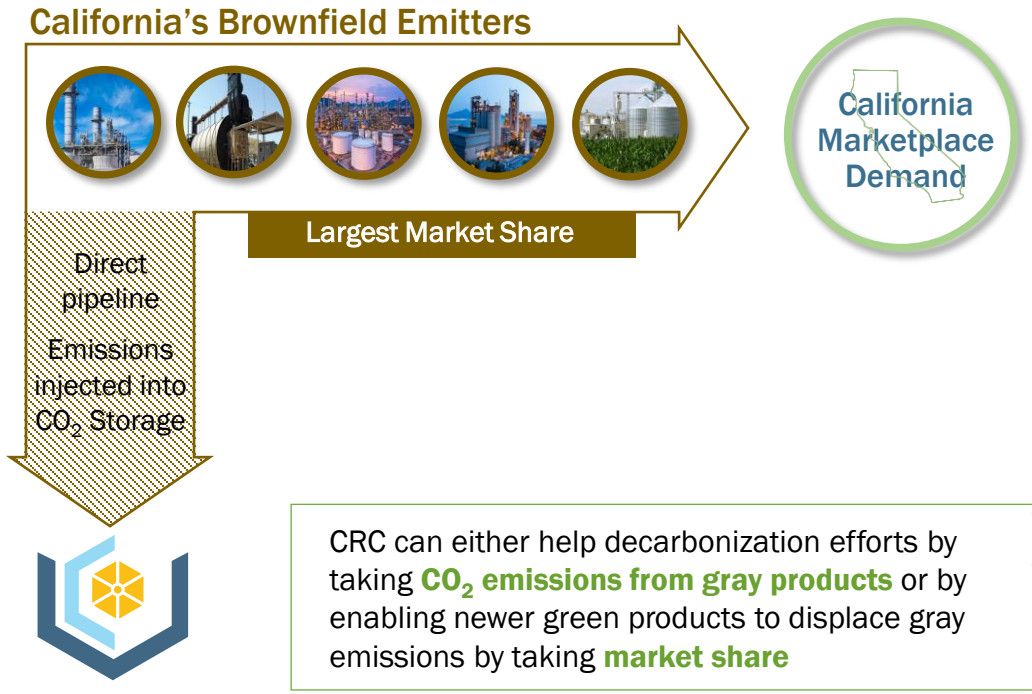
Source: CRC. (1) Source: CalGEM (2) Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. Free cash flow is equal to operating cash flow less total capital requirements.

Multiples Paths to Decarbonize

A DIFFERENT KIND OF ENERGY COMPANY

Conventional Brownfield CCS

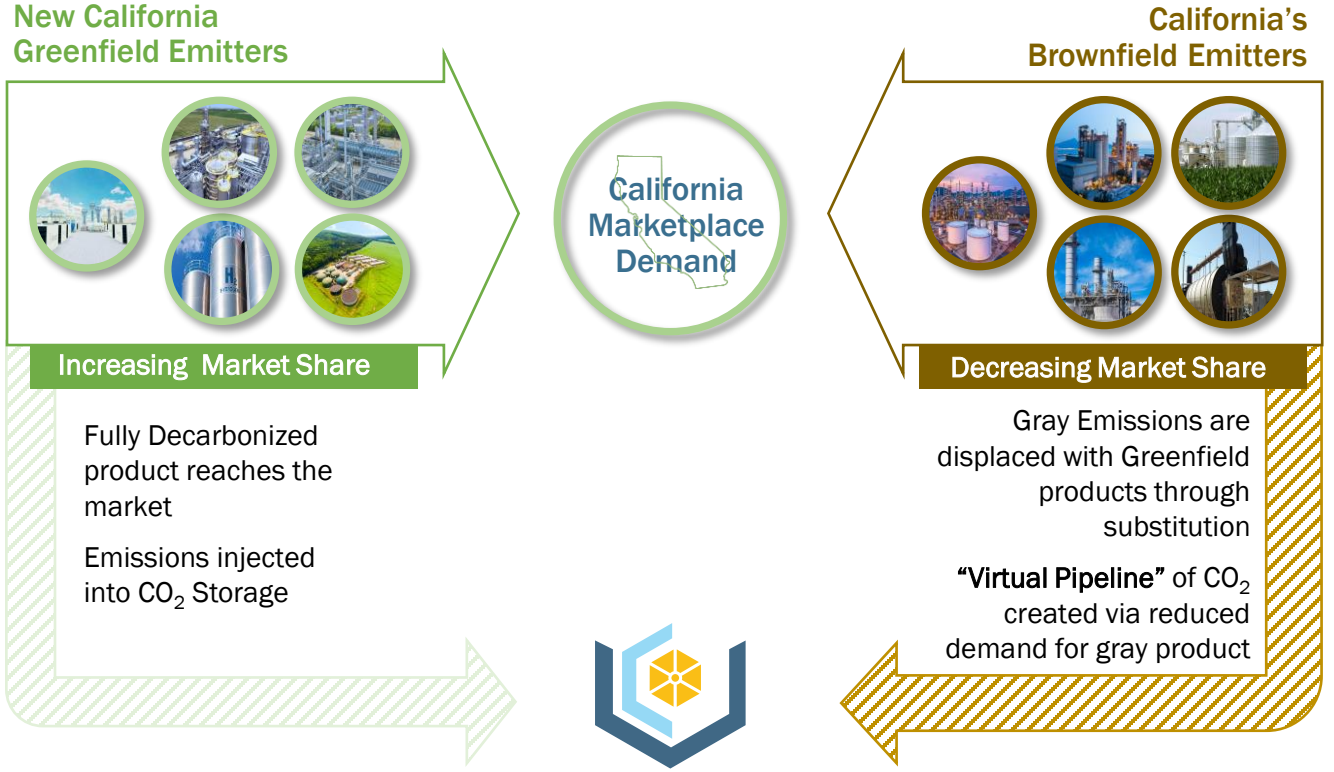
- Brownfield emitters provide a decarbonized product by capturing the CO_2 molecules used in the creation of their products and transporting CO_2 for permanent storage
- This lowers the carbon intensity of their product and the brownfield takes the decarbonized product to market
- Decarbonization enabled by emissions which are transported by physical pipe



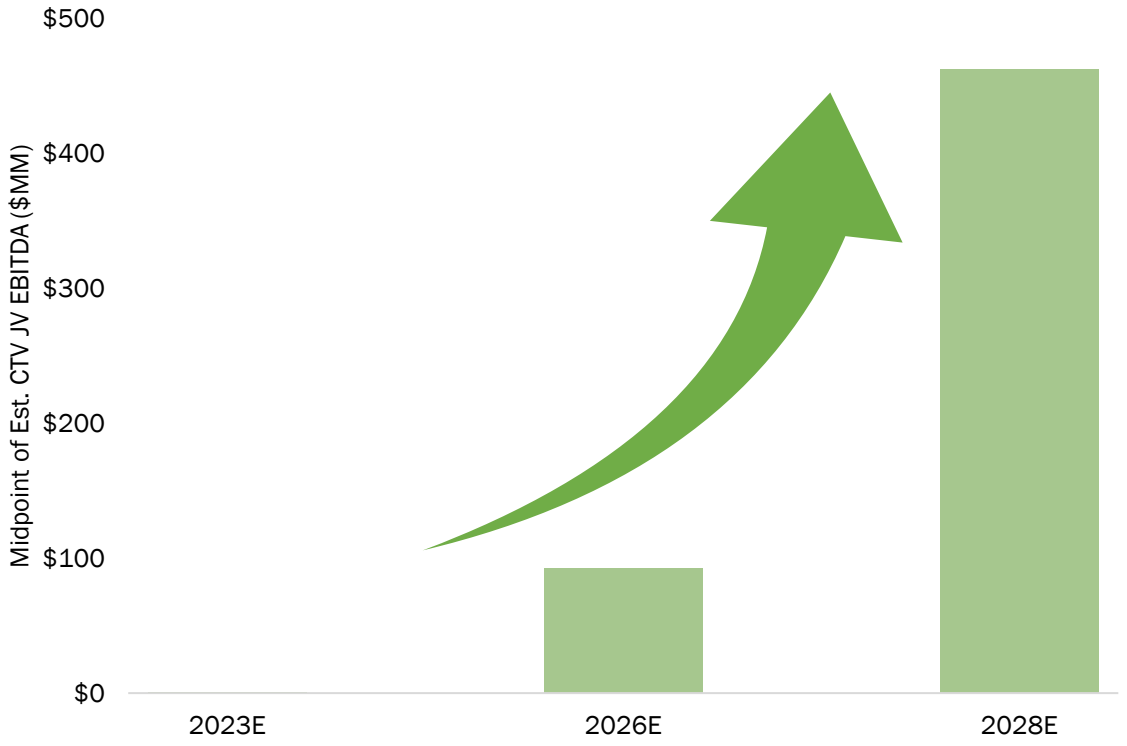
CRC can either help decarbonization efforts by taking **CO_2 emissions from gray products** or by enabling newer green products to displace gray emissions by taking **market share**

Greenfield CCS

- Greenfield projects provide product with an inherently lower carbon intensity than gray products
- Greenfield decarbonized product acts as a substitute for gray product and captures market share
- Decarbonization occurs via products which displace higher CI products thus creating a **"Virtual Pipeline"** that takes lower CI products to market rather than taking the CO_2 from gray products



Illustrative CTV JV Type Curve Demonstrates Potential Valuation Upside



First Full Year of Est. Impact	2026E	2028E
Est. CO_2 Injection Rate per Year	1MMTPA	5MMTPA
Est. CTV JV EBITDA ($MM)	$50 - $135	$250 - $675

Example **Strategic Partnership Economics** An average CTV project could generate on average **$50 to $135 of EBITDA per metric ton injected per annum** depending on project structure

EXAMPLE CTV JV PROJECT ECONOMICS – "TYPE CURVE"

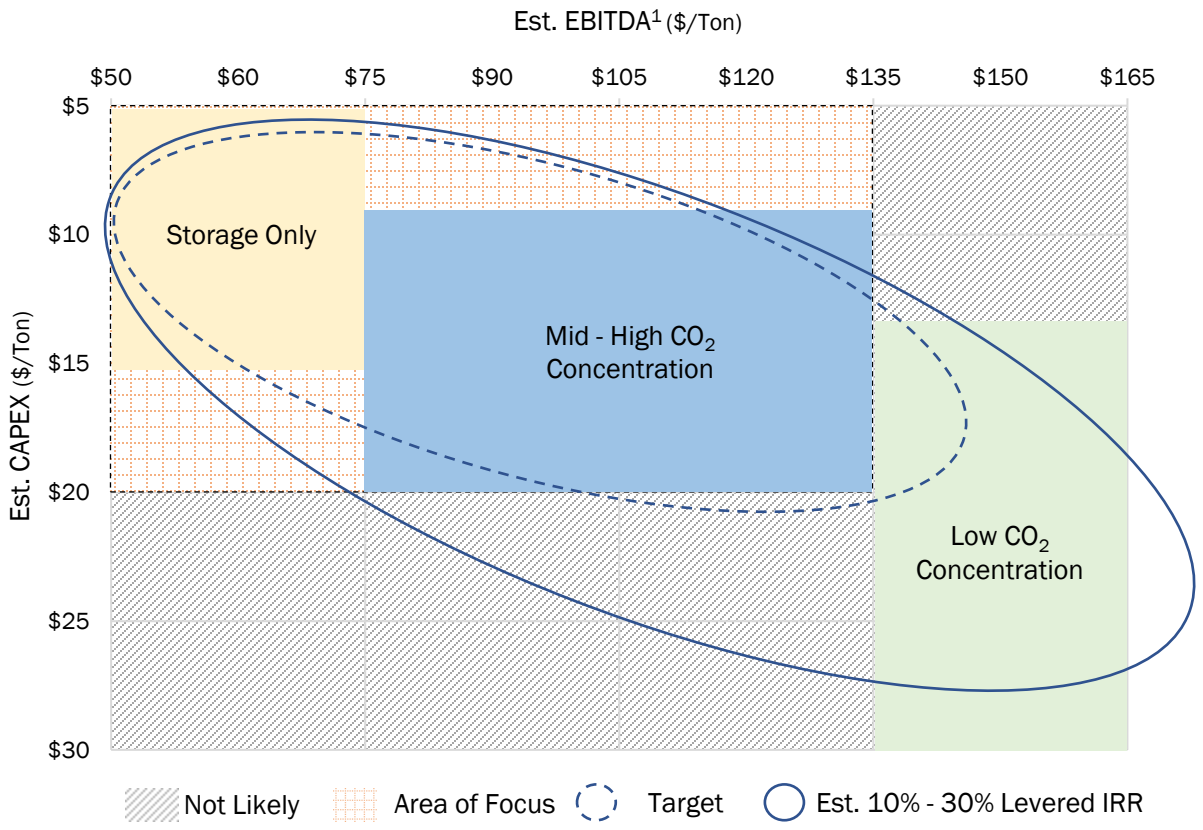
(PER MT OF INJECTED CO_2)

	Unit	Low	High	Notes/Incorporated Assumptions
Total Incentive Potential (LCFS + 45Q)	$/MT	$170	$205	45Q ($/MT): $85, LCFS ($/MT): $85 - $120, 100% LCFS eligibility
Opex	$/MT	$10	$75	Range reflects costs associated with full range of business model possibilities and includes G&A of dedicated staff.
Capex	Avg $/MT	$5	$20	Range of capital includes cost of capture facility and pipeline retrofit. Cost of capture facility depends on CO_2 concentration at source. Pipeline costs depend on distance from source to sink and size of pipe. Pace of capex deployment is expected to be ~5% to ~10% of Total Project Capex in Year 1, ~10% to ~35% in Year 2 and ~55% to ~85% in Year 3. Depending on project structure and location, capex could be lower or higher than range represented.

Note: Please see Slide 31 for important information regarding the assumptions used in the preparation of the information show on this slide. CTV JV economics are shared 51% to CRC and 49% to Brookfield. EBITDA is a non-GAAP measure.

Large Opportunity Set With a Variety of Potential Emitters

ILLUSTRATIVE EBITDA[1] VS CAPEX REQUIREMENTS FOR VARIOUS CO_2 PROJECTS



STORAGE ONLY PROJECTS

- CTV JV is the off-taker of CO_2 at storage site through Storage Co.
- Lower expected capital requirements for project development, including injection and monitoring wells, facilities and compression

MID - HIGH CO_2 CONCENTRATION PROJECTS
(≥15% CO_2 STREAM CONCENTRATION)

- CTV JV controls the entire value chain (capture to storage) and majority of the incentives
- Capital requirements for capture systems, while still significant, are expected to be on the lower end of the capture cost curve due to higher CO_2 concentration of stream
- Project financing more likely vs. storage only and provides opportunity to increase levered returns
- Potential LCFS expansion could provide further EBITDA potential

LOW CO_2 CONCENTRATION PROJECTS
(<15% CO_2 STREAM CONCENTRATION)

- CTV JV controls value chain and incentive but lower expected IRR due to higher costs of capture (*Ex: Natural Gas Combined Cycle Power Plants*)
- Inflation Reduction Act of 2022 expands potential project opportunities
- Advancements in capture technology to play key role in improving project economics
- CARB considering new incentive programs to unlock traditionally hard to decarbonize sectors (e.g. cement)
- CalCapture[2] is an advantaged low CO_2 concentration project given its proximity to storage (insignificant transport capital)

Note: Depicts illustrative examples of expected and estimated IRR, EBITDA and capital expenditure requirements based on internal estimates. Actual results could differ materially. (1) EBITDA is a non-GAAP measure. EBITDA estimates include 45Q tax credits which may change based on further guidance from IRS and other factors and assumes that 45Q wage and apprenticeship requirements are met. (2) CalCapture refers to CRC's project at the Elk Hills Power Plant.

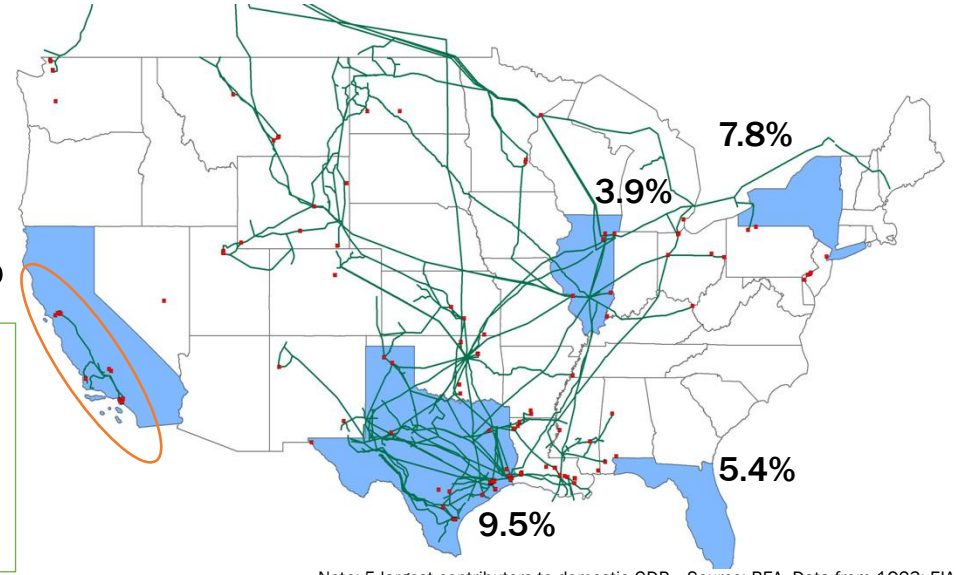
Strong Price Realizations in CA's Unique Market Dynamics

- **Crude:** California crude prices continued move in tandem with the broader market with realizations for 3Q23 firming slightly from 2Q. For the balance of the year, local (permits, refining margins & outages) and geopolitical dynamics (OPEC+, central bank policies, Middle East tensions) remain key determinants as to where prices will trend in California
- **NGLs:** 3Q23 NGL prices across North America continued to weaken driven by seasonal trend and general over-supply. As reflected within 2Q23 realizations - and as projected for the balance of the year - California has been and should remain a premium-priced NGL marketplace
- **Natural Gas:** California 3Q23 natural gas prices increased relative to 2Q23 as storage inventories were replenished. A material increase in Aliso Canyon natural gas storage capacity stands to support prices this Fall while – along with an abundance of hydro generation capacity - limiting the potential for gas price run-ups this winter
- **Power:** As measured on year/year basis, 3Q power prices retreated on the back of record snowpack & hydro output, incremental on-peak solar output, and uncharacteristically mild weather

CRC's commodity realizations continue to trend above domestic WTI averages

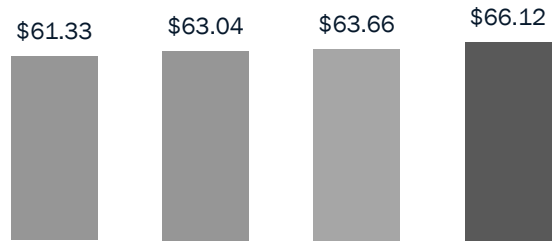
CALIFORNIA IS AN OIL ISLAND AND THE LARGEST U.S. GDP CONTRIBUTOR

(amounts shown as % of U.S. domestic GDP)



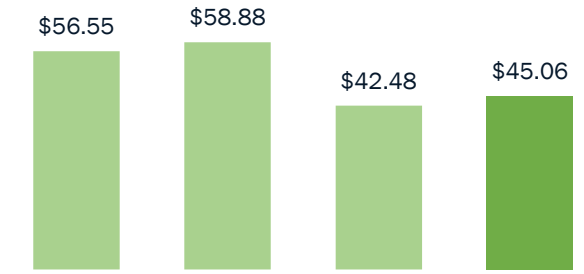
Note: 5 largest contributors to domestic GDP. Source: BEA, Data from 1Q23; EIA

Oil w/ Hedges ($/BBL)



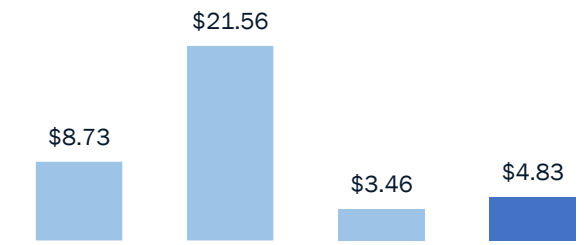
	4Q22	1Q23	2Q23	3Q23
Average Benchmark Prices[1]	$88.60	$82.22	$78.01	$85.95
% of Benchmark[1]	98%	96%	97%	99%
Hedge Settlements	($25.82)	($15.64)	($12.11)	($19.24)
Average Realized Prices[2]	$61.33	$63.04	$63.66	$66.12

NGLs ($/BBL)



	4Q22	1Q23	2Q23	3Q23
	$88.60	$82.22	$78.01	$85.95
	64%	72%	54%	52%
	–	-	-	-
	$56.55	$58.88	$42.48	$44.95

Natural Gas ($/MCF)



	4Q22	1Q23	2Q23	3Q23
	$6.76	$3.42	$2.10	$2.55
	129%	630%	165%	189%
	($0.22)	-	-	-
	$8.51	$21.56	$3.46	$4.83

(1) Benchmark prices are based on Brent for oil and NGLs, and NYMEX average daily price for natural gas. (2) Average realized prices include hedges on oil and natural gas.

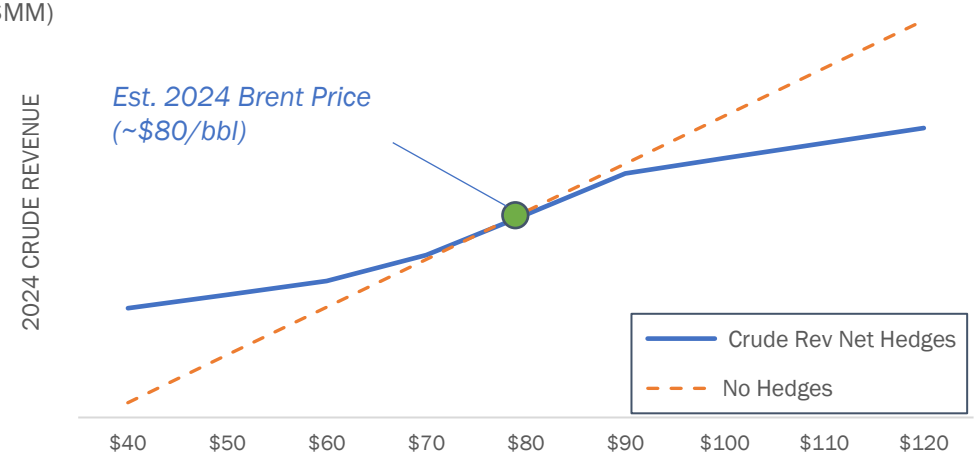
Hedging Program

STRATEGY

CRC's hedging strategy is designed to meet our business objectives should market prices decline and participate should market prices increase

2024 CRUDE REVENUE NET HEDGE SETTLEMENT SENSITIVITY TO BRENT PRICE [1]

($MM)



CRC Realized Price ($/bbl)	$60	$63	$65	$71	$79	$88	$91	$94	$97

OIL HEDGES[2]

As of September 30, 2023

		4Q23	1Q24	2Q24	3Q24	4Q24	2025
SOLD CALLS	Barrels per Day	5,747	23,650	30,000	30,000	29,000	19,748
	Weighted-Average Price per Barrel	$57.06	$90.00	$90.07	$90.07	$90.07	$85.63
SWAPS	Barrels per Day	27,094	9,000	7,750	7,750	5,500	3,374
	Weighted-Average Price per Barrel	$70.73	$79.37	$79.65	$79.64	$77.45	$72.66
NET PURCHASED PUTS[3]	Barrels per Day	5,747	30,584	30,000	30,000	29,000	19,748
	Weighted-Average Price per Barrel	$76.25	$67.27	$65.17	$65.17	$65.17	$60.00

HEDGE CONTRACT SETTLEMENTS EXPECTED TO SIGNIFICANTLY DECREASE IN 4Q23[4] AND BEYOND

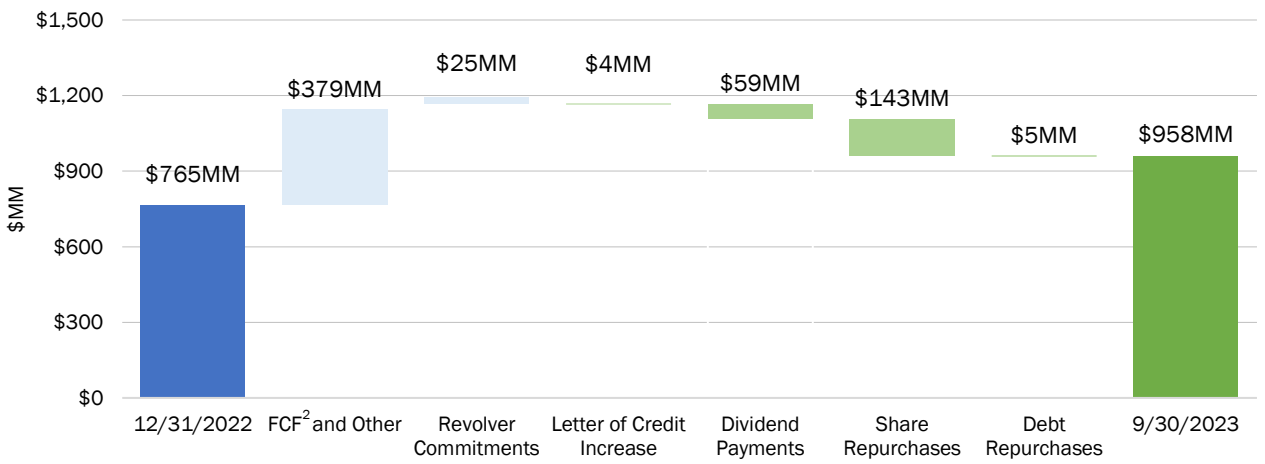
Actual & Estimated Hedge Contract Settlements[5] ($MM)

2021	2022	1Q23	2Q23	3Q23	4Q23E	2023E	2024E	2025E
($319)	($738)	($65)	($63)	($95)	($75)	($300)	($35)	($20)

(1) Hedge position as of September 30, 2023. Includes deferred option premium payment. For the purposes of this example assumes CRC physical sales realize 100% of Brent price. (2) Hedges are based on weighted-average Brent prices per barrel. (3) Purchased and sold puts with the same strike price have been netted together. (4) Assumes forward commodity prices as of September 30, 2023 and assumes a 2023 Brent price of $84.16 per barrel of oil, NGL realizations consistent with prior years and an average daily NYMEX gas price of $2.77 per mcf. (5) Represents estimated net cash settlement payments for derivative contracts as of 9/30/2023, except 2021, 2022, 1Q23, 2Q23 and 3Q23 which are actuals for the year ended on December 31, 2021, the year ended December 31, 2022, the three months ended March 31, 2023, the three months ended June 30, 2023, and the three months ended September 30, 2023 respectively. Historical settlements include natural gas derivatives on production volumes.

Strong Balance Sheet Position, Ample Liquidity and Financial Flexibility

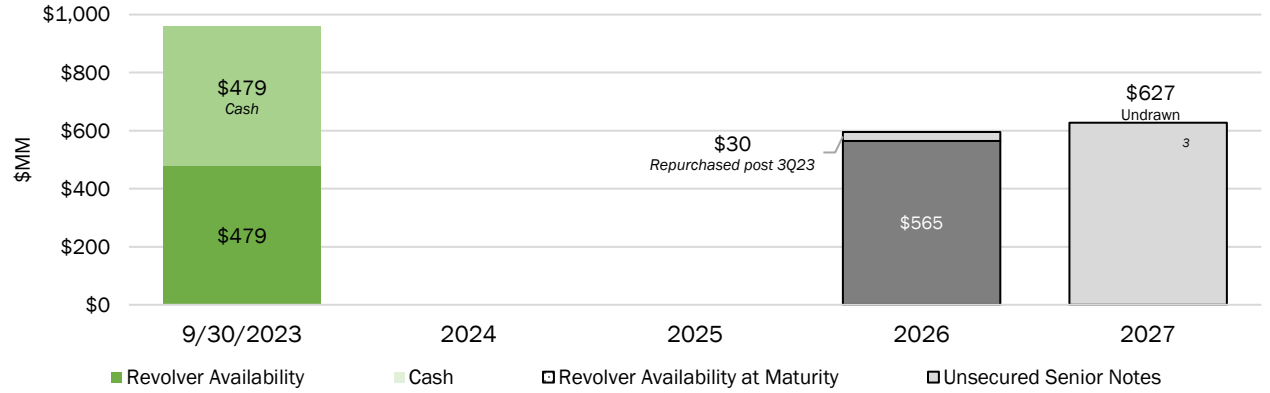
LIQUIDITY ROLL BACK[1]



9/30/23 NET DEBT[2] SNAPSHOT

($MM)	
Revolving Credit Facility (RCF)[3]	$ 0
7.125% Senior Notes	595
Face Value of Debt	**$ 595**
Less Cash & Cash Equivalents	(479)
Net Debt[3]	**$ 116**

NO SIGNIFICANT MATURITIES UNTIL 2026



RECENT CREDIT UPDATES

- Repurchased $5MM of senior notes at par during 3Q23
- Subsequent to quarter end, repurchased an additional $30MM in face value of our senior notes
- S&P Global reaffirmed CRC's 'B+' rating on strong financial metrics and stable outlook despite lower production

MULTIPLES DEMONSTRATE FLEXIBILITY

($MM)	
RCF Borrowing Base	$ 1,200
3Q23 Free Cash Flow[2]	$71
3Q23 Net Debt[2] / LTM Adjusted EBITDAX[2]	0.1x
LTM Adjusted EBITDAX[2] / LTM Interest & Debt Expense, net	15.6x

(1) Liquidity at 9/30/23 calculated as unrestricted cash of $479MM and $627MM capacity on CRC's Revolving Credit Facility less $148MM in outstanding letters of credit. (2) Adj. EBITDAX, Net Debt and Free Cash Flow are non-GAAP measures. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. (3) Undrawn RCF as of September 30, 2023, excluding outstanding letters of credit. Subject to a springing maturity to August 4, 2025, if any of our Senior Notes are outstanding on that date.

Glossary

Term	Definition
Bcf	Billion Cubic Feet
BMT	Billion Metric Tons
CARB	California Air Resources Board
CCS	Carbon Capture and Storage
CCS+	Carbon Capture and Storage + EOR
CDMA	Carbon Dioxide Management Agreement
CEQA	California Environmental Quality Act
CGP	Cryogenic Gas Plant
CI	Carbon Intensity
CMB	Carbon Management Business
CO_2	Carbon Dioxide
CTV	Carbon TerraVault (a subsidiary of CRC)
DAC	Direct Air Capture
D&C	Drilling and Completions
E&P	Exploration and Production
EHPP	Elk Hills Power Plant
EIR	Environmental Impact Report
EOR	Enhanced Oil Recovery
EPA	Environmental Protection Agency
ESG	Environmental, Social and Governance
FCF	Free Cash Flow
FEED	Front End Engineering and Design

Term	Definition
FID	Final Investment Decision
GHG	Greenhouse Gas
IRR	Internal Rate of Return
KMTPA	Thousand Metric Tons Per Annum
LCFS	Low Carbon Fuel Standard
MMT	Million Metric Tons
MMTPA	Million Metric Tons Per Annum
MRV	Monitoring, Reporting and Verification Plan
MT	Metric Tons
MTPA	Metric Tons Per Annum
OCF	Operating Cash Flow
PD	Proved Developed
PUD	Proved Undeveloped
RSG	Responsibly Sourced Gas
ROFL	Right of First Look
R/P	Reserves to Production Ratio
RTC	Round-the-Clock
SFDR	Sustainable Finance Disclosure Regulation
SRP	Share Repurchase Program
SJV	San Joaquin Valley
TBA	To Be Announced
Tcf	Trillion Cubic Feet
WI	Working Interest

Assumptions & Relevant Footnotes:

A DIFFERENT KIND OF ENERGY COMPANY

Slide 3:

- (1) Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. Free cash flow is equal to net cash provided (used) by operating activities less capital investments.
- (2) Dividends are subject to Board approval. Future dividends are expected to be paid quarterly at $0.31 per share of common stock.
- (3) Source: www.epa.gov/uic/current-class-vi-projects-under-review-epa
- (4) Internal estimates. See slide 13 and 14 of this presentation for additional data on natural gas incremental inventory. The SEC prohibits oil and gas companies, in their filings with the SEC, from disclosing estimates of oil or gas resources other than "reserves," as that term is defined by the SEC. This presentation includes estimates of quantities of oil and gas using certain terms, such as "incremental inventory" or other descriptions of volumes of reserves, which terms include quantities of oil and gas that may not meet the SEC's definitions of proved, probable and possible reserves, and which the SEC's guidelines strictly prohibit us from including in filings with the SEC. These estimates are by their nature more speculative than estimates of proved reserves and accordingly are subject to substantially greater risk of being recovered. Readers are urged to consider closely the reserves and other disclosures in our periodic filings with the SEC.

Slide 5:

- (1) 3Q23E guidance assumed a 3Q23 Brent price of $75.28 per barrel of oil, NGL realizations consistent with prior years and an average daily NYMEX gas price of $2.73 per mcf. Generally, CRC's share of production under production-sharing contracts (PSCs) decreases when commodity prices rise and increases when prices decline.
- (2) CMB Expenses includes leasing costs for sequestration easements, advocacy costs, and other startup related costs.
- (3) Represents a non-GAAP measure. For all historical non-GAAP financial measures please see the Investor Relations page at www.crc.com for a reconciliation to the nearest GAAP equivalent and other additional information. Free cash flow is equal to net cash provided (used) by operating activities less capital investments.
- (4) Impact to cash flow after hedges and before changes in working capital.

Slide 6:

- (1) Dividends are subject to Board approval.
- (2) CRC peers include CHRD, DVN, BRY, PXD, EOG, CHK, MUR, APA, FANG, CRC, SM, MRO, EQT, HES, MTDR. Data as of October 27, 2023.

Slide 8:

- (1) Internal estimates.
- (2) Assumes a 12-year project life. See slide 24 and 25 of this deck for the details on the CTV project economic type curve details and project IRRs.
- (3) EPA Class VI draft permit for CTV I expected by YE23 but is subject to EPA approvals and public review. FID subject to permit approvals.
- (4) Earnings before interest, taxes, depreciation and amortization (EBITDA) is a non-GAAP measure. EBITDA estimates include 45Q tax credits which may change based on further guidance from IRS and other factors.

Slide 9:

- (1) CRC's CDMAs frame the anticipated contractual terms between parties and provide a path to reaching final definitive agreements.
- (2) Earnings before interest, taxes, depreciation and amortization (EBITDA) is a non-GAAP measure. EBITDA estimates include 45Q tax credits which may change based on further guidance from IRS and other factors.
- (3) See slides 24 and 25 of this deck for the details on the CTV project economic type curve.

Slide 11:

- Source: Internal estimates. Numbers may not add up due to rounding. SJ Basin implies San Joaquin basin.
- (1) Our CDMAs frame the anticipated contractual terms between parties and provide a path to reaching final definitive agreements.
- (2) Source: CARB 2020.
- (3) Injection rates are average rates based on max permit volumes over life of project using a 40-year basis. Actual volumes and the injection period will vary over time.
- (4) Includes CRC's decarbonization CCS project at Elk Hills gas plant planned to sequester 100KMPTA of CO_2 which is not under CDMA.
- (5) Internal estimates as of October 2023. Represents remaining capacity after taking into account pore space attributable to signed CDMAs and CRC's projects.

Assumptions & Relevant Footnotes (Cont.):

Slide 14:

- (1) Internal estimates. The SEC prohibits oil and gas companies, in their filings with the SEC, from disclosing estimates of oil or gas resources other than "reserves," as that term is defined by the SEC. This presentation includes estimates of quantities of oil and gas using certain terms, such as "incremental inventory" or other descriptions of volumes of reserves, which terms include quantities of oil and gas that may not meet the SEC's definitions of proved, probable and possible reserves, and which the SEC's guidelines strictly prohibit us from including in filings with the SEC. These estimates are by their nature more speculative than estimates of proved reserves and accordingly are subject to substantially greater risk of being recovered. Readers are urged to consider closely the reserves and other disclosures in our periodic filings with the SEC.
- (2) CRC is pursuing a RSG certification for its natural gas assets. This certification depends on many factors which may or may not be achievable.
- (3) Source: ICE forward market price as of October 18, 2023.
- (4) Subject to availability of drilling permits and additional surface infrastructure which may be needed.

Slide 17:

- (1) 2023E guidance assumes a 2023 Brent price of $84.16 per barrel of oil, NGL realizations consistent with prior years and an average daily NYMEX gas price of $2.77 per mcf. 4Q23E guidance assumes a 4Q23 Brent price of $90.46 per barrel of oil, NGL realizations consistent with prior years and an average daily NYMEX gas price of $3.00 per mcf. Generally, CRC's share of production under PSCs decreases when commodity prices rise and increases when prices decline.
- (2) CMB Expenses includes advocacy, and other startup related costs.
- (3) A reconciliation of historical non-GAAP financial measures to the nearest GAAP equivalent and other additional information can be found on the Investor Relations page at www.crc.com. A GAAP reconciliation of forward-looking non-GAAP financial measures can be found in Attachment 3 to the Company's earnings release dated November 1, 2023, also available at www.crc.com.
- (4) Adjusted E&P Capital and Adjusted CMB Capital are Non-GAAP measures. These measures reflect the reclassification of ~$4 million from E&P, Corporate & Other Capital to Adjusted CMB Capital related to investment in facilities to advance carbon sequestration activities.

Slide 24:

The information on slide 24 is an example of project economics for the strategic partnership with Brookfield, which are shared 51% to CRC and 49% to Brookfield. The terms and availability of third-party sources of financing, if needed, could also affect returns and outcomes. The following assumptions were used:

- Assumes that projects are completed and online with no material delays or impediments to the issuance of necessary permits, government approvals, or third party third-party arrangements.
- Assumes development at the mid-point of the CTV JV economic "Type Curve".
- Assumes 1MMT injected per year for 40-year project life unless specified otherwise.
- Assumes Brookfield fully participates in CCS projects up to JV target of 5MMTPA of injection and 200MMT of CO_2 storage.
- EBITDA amounts that are shown as a range assume the top and bottom ranges of the EBITDA assumptions and are multiplied by 1MM and 5MM to represent 1MMTPA of projects and 5MMTPA of projects, respectively. The EBITDA range presented has been reduced by ~20% – 50% to reflect uncertainties related to project structure, financing and ownership.
- EBITDA estimates include 45Q tax credits which may change based on further guidance from IRS and other factors and assumes that 45Q wage and apprenticeship requirements are met. Based on incentives available under current regulatory framework.
- Assumes total incentive potential can be monetized through tax equity brokers and LCFS monetized in the LCFS trading marketplace and recorded as revenue.
- For simplicity, a 5-year accelerated straight line depreciation and amortization is assumed. Assumes no bonus depreciation. which may change based on further guidance from IRS and other factors.
- Assumes that a project is cash flow positive in year 4 with payback period of ~ 4 to 6 years and reflects the midpoint of range estimates. Payback period is defined as total CRC investment / annual cash flow and is specifically for CTV JV project level economics.
- High end of Opex range assumes end-to-end value chain business model and low-end assumes carbon storage business model, both described on slide 23 of CRC's Carbon Storage Update on October 6, 2021.
- Capex range assumes project capital of between $200MM and $800MM for an end-to-end business model. Project/partnership structures where CRC provides storage only could result in capital ranges below stated ranges.

Forward Looking / Cautionary Statements – Certain Terms

This document contains statements that we believe to be "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. All statements other than historical facts are forward-looking statements, and include statements regarding our future financial position, business strategy, projected revenues, earnings, costs, capital expenditures and plans and objectives of management for the future. Words such as "expect," "could," "may," "anticipate," "intend," "plan," "ability," "believe," "seek," "see," "will," "would," "estimate," "forecast," "target," "guidance," "outlook," "opportunity" or "strategy" or similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those expressed in, or implied by, such statements.

Although we believe the expectations and forecasts reflected in our forward-looking statements are reasonable, they are inherently subject to numerous risks and uncertainties, most of which are difficult to predict and many of which are beyond our control. No assurance can be given that such forward-looking statements will be correct or achieved or that the assumptions are accurate or will not change over time. Particular uncertainties that could cause our actual results to be materially different than those expressed in our forward-looking statements include:

- fluctuations in commodity prices, including supply and demand considerations for our products and services;
- decisions as to production levels and/or pricing by OPEC or U.S. producers in future periods;
- government policy, war and political conditions and events, including the wars in Ukraine and Israel and oil sanctions on Russia, Iran and others;
- regulatory actions and changes that affect the oil and gas industry generally and us in particular, including (1) the availability or timing of, or conditions imposed on, permits and approvals necessary for drilling or development activities or our carbon management business; (2) the management of energy, water, land, greenhouse gases (GHGs) or other emissions, (3) the protection of health, safety and the environment, or (4) the transportation, marketing and sale of our products;
- the impact of inflation on future expenses and changes generally in the prices of goods and services;
- changes in business strategy and our capital plan;
- lower-than-expected production or higher-than-expected production decline rates;
- changes to our estimates of reserves and related future cash flows, including changes arising from our inability to develop such reserves in a timely manner, and any inability to replace such reserves;
- the recoverability of resources and unexpected geologic conditions;
- general economic conditions and trends, including conditions in the worldwide financial, trade and credit markets;
- production-sharing contracts' effects on production and operating costs;
- the lack of available equipment, service or labor price inflation;
- limitations on transportation or storage capacity and the need to shut-in wells;
- any failure of risk management;
- results from operations and competition in the industries in which we operate;
- our ability to realize the anticipated benefits from prior or future efforts to reduce costs;
- environmental risks and liability under federal, regional, state, provincial, tribal, local and international environmental laws and regulations (including remedial actions);
- the creditworthiness and performance of our counterparties, including financial institutions, operating partners, CCS project participants and other parties;
- reorganization or restructuring of our operations;
- our ability to claim and utilize tax credits or other incentives in connection with our CCS projects,
- our ability to realize the benefits contemplated by our energy transition strategies and initiatives, including CCS projects and other renewable energy efforts;
- our ability to successfully identify, develop and finance carbon capture and storage projects and other renewable energy efforts, including those in connection with the Carbon TerraVault JV, and our ability to convert our CDMAs to definitive agreements and enter into other offtake agreements;
- our ability to maximize the value of our carbon management business and operate it on a stand alone basis;
- our ability to successfully develop infrastructure projects and enter into third party contracts on contemplated terms;
- uncertainty around the accounting of emissions and our ability to successfully gather and verify emissions data and other environmental impacts;
- changes to our dividend policy and share repurchase program, and our ability to declare future dividends or repurchase shares under our debt agreements;
- limitations on our financial flexibility due to existing and future debt;
- insufficient cash flow to fund our capital plan and other planned investments and return capital to shareholders;
- changes in interest rates;
- our access to and the terms of credit in commercial banking and capital markets, including our ability to refinance our debt or obtain separate financing for our carbon management business;
- changes in state, federal or international tax rates, including our ability to utilize our net operating loss carryforwards to reduce our income tax obligations;
- effects of hedging transactions;
- the effect of our stock price on costs associated with incentive compensation;
- inability to enter into desirable transactions, including joint ventures, divestitures of oil and natural gas properties and real estate, and acquisitions, and our ability to achieve any expected synergies;
- disruptions due to earthquakes, forest fires, floods, extreme weather events or other natural occurrences, accidents, mechanical failures, power outages, transportation or storage constraints, labor difficulties, cybersecurity breaches or attacks or other catastrophic events;
- pandemics, epidemics, outbreaks, or other public health events, such as the COVID-19; and
- other factors discussed in Part I, Item 1A – Risk Factors.

We caution you not to place undue reliance on forward-looking statements contained in this document, which speak only as of the filing date, and we undertake no obligation to update this information. This document may also contain information from third party sources. This data may involve a number of assumptions and limitations, and we have not independently verified them and do not warrant the accuracy or completeness of such third-party information.

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Flaws in EPA's Monitoring and Verification of Carbon Capture Projects

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Carbon capture and sequestration (CCS) is a major focus of President Biden's environmental agenda. The federal government has allocated billions of dollars to subsidize this expensive and controversial technology in an attempt to make it a viable option to combat climate change. In theory, the process captures carbon dioxide (CO_2) from industry and injects it into underground rock formations, permanently removing the gas from the atmosphere. But there are very good reasons to remain skeptical about whether sequestered carbon will remain out of the atmosphere in the long term. One reason is that the laws and regulations governing the technology are still being developed, and the existing framework is too weak to ensure that large-scale sequestration projects – which will be heavily subsidized by taxpayers – will deliver on the carbon reductions they promise.

The Environmental Integrity Project (EIP) examined one central component of carbon capture and sequestration regulation in the U.S.: monitoring, reporting, and verification (MRV) plans required by the EPA's Greenhouse Gas Reporting Program. These plans describe the monitoring strategies in place at each site to validate that the carbon dioxide is securely stored underground and is not leaking or migrating in an unexpected manner. If approved by EPA, the plans can also be used to qualify for tax subsidies. However, the 21 plans that EPA approved as of October 31, 2023, are ambiguous and lack key elements to ensure safe and long-term carbon sequestration. Specifically, these plans:

- **Are not required to include specific monitoring strategies or technologies**, allowing companies to write their own rules.
- **Often contain ambiguous language** that does not commit to explicit monitoring timelines or activities. Several plans lack specific timelines for monitoring and testing, state they will only continue with the monitoring actions described in the plan "if beneficial,"[1] or even promise to "determine the most appropriate method" to quantify leaks in the event a leak occurs,[2] instead of describing quantification strategies within the plan itself.
- **Are difficult to enforce**, with no third-party verification of the data.

This report discusses these weaknesses and the tax incentives at stake. With billions available in grants and tax subsidies, companies have moved quickly to announce additional carbon capture and sequestration projects, especially in the oil and

The Petra Nova carbon capture and storage project, southwest of Houston, is one of the largest in the world. It collects carbon dioxide from the burning of coal at the W. A. Parish power plant and pipes the carbon underground for injection into aging oil fields, to increase oil output. The system restarted in September after being shut down for more than three years.

gas industry. Sixteen of the 21 approved monitoring plans were submitted by oil and gas companies, which stand to benefit the most from the push for carbon sequestration. The expanded tax credit is estimated to result in over $30 billion going from taxpayers to industry by 2032.[3] Before this flood of CCS projects becomes operational, EPA needs to enact strong industry regulations that can protect the environment while combating climate change. EPA must ensure the monitoring plans contain comprehensive and clearly defined monitoring strategies that can adequately detect leaks, prevent environmental harm, and confirm that carbon is successfully stored long-term.

Tax Credits Spurring Additional CCS Project Announcements

Congress created a tax credit for carbon sequestration in 2008. Lawmakers then expanded it in 2018 and again in September 2022 with the Inflation Reduction Act. The expanded tax credit now allows companies that meet certain wage, hiring, and operation date requirements to claim up to $85 per metric ton of geologically sequestered CO_2 and up to $60 per metric ton of CO_2 used with a qualifying method, such as enhanced oil recovery. This increases to $180 per metric ton of CO_2 captured from the atmosphere (direct air capture).[4] According to EPA data, the oil and gas and ethanol industries sequestered nearly 8 million metric tons of CO_2 in 2022,[5] an amount worth an estimated $213 million in tax credits that year.[6] Sequestering the same amount in 2023 could be worth up to $504 million, thanks to a sharp increase in the value of tax credits (Table 1).[7]

Table 1. Estimated Maximum Tax Credits Available to Companies That Sequestered Carbon in 2022

Company	Number of Projects	Project Type	Well Type	Metric Tons of CO_2 Sequestered in 2022	Potential Value of Tax Credits in 2022	Potential Value of Tax Credits in 2023
Occidental Petroleum/Oxy	3	Enhanced Oil Recovery	II	5,894,969	$148,258,470	$353,698,140
Perdure Petroleum/ CapturePoint	2	Enhanced Oil Recovery	II	744,631	$18,727,470	$44,677,860
Archer Daniels Midland Co.	1	Ethanol Plant Long-Term Carbon Storage	VI	428,580	$16,221,753	$36,429,300
ExxonMobil	1	Gas Processing Waste Disposal (Acid Gas)	II	395,332	$14,963,316	$33,603,220
Core Energy	1	Enhanced Oil Recovery	II	311,308	$7,829,396	$18,678,480
Red Trail Energy, LLC	1	Ethanol Plant Long-Term Carbon Storage	VI	81,964	$3,102,337	$6,966,940
Stakeholder Gas Services, LLC	2	Gas Processing Waste Disposal (Acid Gas)	II	89,013	$3,369,142	$7,566,105
Lucid Energy Delaware, LLC	1	Gas Processing Waste Disposal (Acid Gas)	II	23,775	$899,884	$2,020,875
Petra Nova, LLC[8]	1	Enhanced Oil Recovery	II	-16,815	$0	$0
Total	**13**			**7,952,757**	**$213,371,769**	**$503,640,920**

Source: EPA's Facility-Level Information on Greenhouse Gases Tool and the Internal Revenue Service.
Note: Type II wells can be used for enhanced oil recovery and the disposal of gas processing waste. Type VI wells are for long-term carbon sequestration, including by ethanol plants. In 2022, long-term carbon sequestration projects were eligible for up to $37.85 in tax credits per metric ton of CO_2 sequestered, depending on the date the equipment was placed in service. Enhanced oil recovery projects were eligible for up to $25.15 per metric ton. Carbon sequestered from the processing of natural gas (acid gas waste disposal) was assumed to be eligible for the higher credit rate. Please see endnote for more detailed information.[9]

The increased potential pay-out for CCS has spurred a wave of announcements about new carbon capture projects and storage hubs. As of October 31, 2023, EPA had permitted only two wells designed for long-term carbon sequestration (called Class VI wells under EPA's Underground Injection Control Program) and issued draft permits for two more wells.[10] But EPA is also reviewing 58 additional applications for these projects (which include a total of 169 wells.) More than two thirds of these proposed projects were submitted after September 2022, when the IRA became law.[11] These highly complex applications need a thorough review from experts, and in many cases, companies have taken months to submit complete applications or were asked to provide additional information during the technical review. Some of these projects could rack up a lot in tax credits. For example, the proposed Blue Flint ethanol plant in central North Dakota plans to capture and sequester up to 200,000 metric tons of CO_2 annually, making it eligible for up to $17 million in tax credits each year.

Companies can also claim the tax credit for carbon dioxide injected into the ground through wells designed for oil and gas-related underground injection operations (called Class II wells). While Class II wells can be used for a number of purposes, those that can earn tax credits are used for enhanced oil or gas recovery or the disposal of waste from the processing of natural gas (acid gas, which is a mixture of carbon dioxide and hydrogen sulfide). Enhanced recovery facilities employ carbon dioxide injection to dislodge and extract hard-to-reach petroleum from the ground. This process produces both oil and carbon dioxide, but some of the injected carbon dioxide remains underground and is considered sequestered. Acid gas injection facilities inject carbon dioxide along with hydrogen sulfide, a waste product of natural gas processing, as a method of disposal. Many of these facilities have been operating for a long time, especially enhanced oil recovery sites, some of which have been injecting carbon dioxide for decades. Encouraging more of these projects by increasing the tax credits available to them seems unnecessary.

There are many concerns about enhanced oil recovery and acid gas disposal facilities being able to claim the tax credit, especially because it directly subsidizes further oil and gas extraction. Enhanced oil recovery wells are also subject to permits with much less stringent requirements. Unlike carbon waste disposal wells, which have injection permits that specifically regulate carbon sequestration, enhanced oil recovery and acid gas sites are governed by broader permits that regulate "injection related to oil and gas." The number of enhanced oil recovery and acid gas injection projects is expected to increase in the short term. In addition to the projects with approved monitoring plans, there are at least 80 more projects with these permits already injecting carbon dioxide into the ground.[12] If they qualify, they could choose to submit a monitoring plan to EPA and apply for the tax credits.

As mentioned earlier, 13 facilities reported sequestering 8 million metric tons of carbon dioxide to EPA in 2022, roughly equivalent to the greenhouse gas emissions from two coal-fired power plants.[13] This was a fraction of one percent of the 2.7 billion metric tons of greenhouse gases companies reported emitting in the United States in the same year.[14] Of the 13, 11 were of the variety used by the oil and gas industry to produce more fossil fuels or dispose of acid gas (Table 2). About 87 percent of the carbon dioxide was sequestered through enhanced oil recovery. While the tax credits are nominally larger for carbon storage wells, the enhanced oil recovery projects that qualify for the increased tax credits would benefit the most.

Table 2. Geologic Sequestration of Carbon Dioxide Reported to EPA in 2022

Project Type	Number of Projects	Metric Tons of CO_2 Sequestered in 2022
Enhanced Oil Recovery	7	6,934,093
Disposal of Gas Processing Waste (Acid Gas)	4	508,120
Ethanol Plant Long-Term Carbon Sequestration	2	510,544

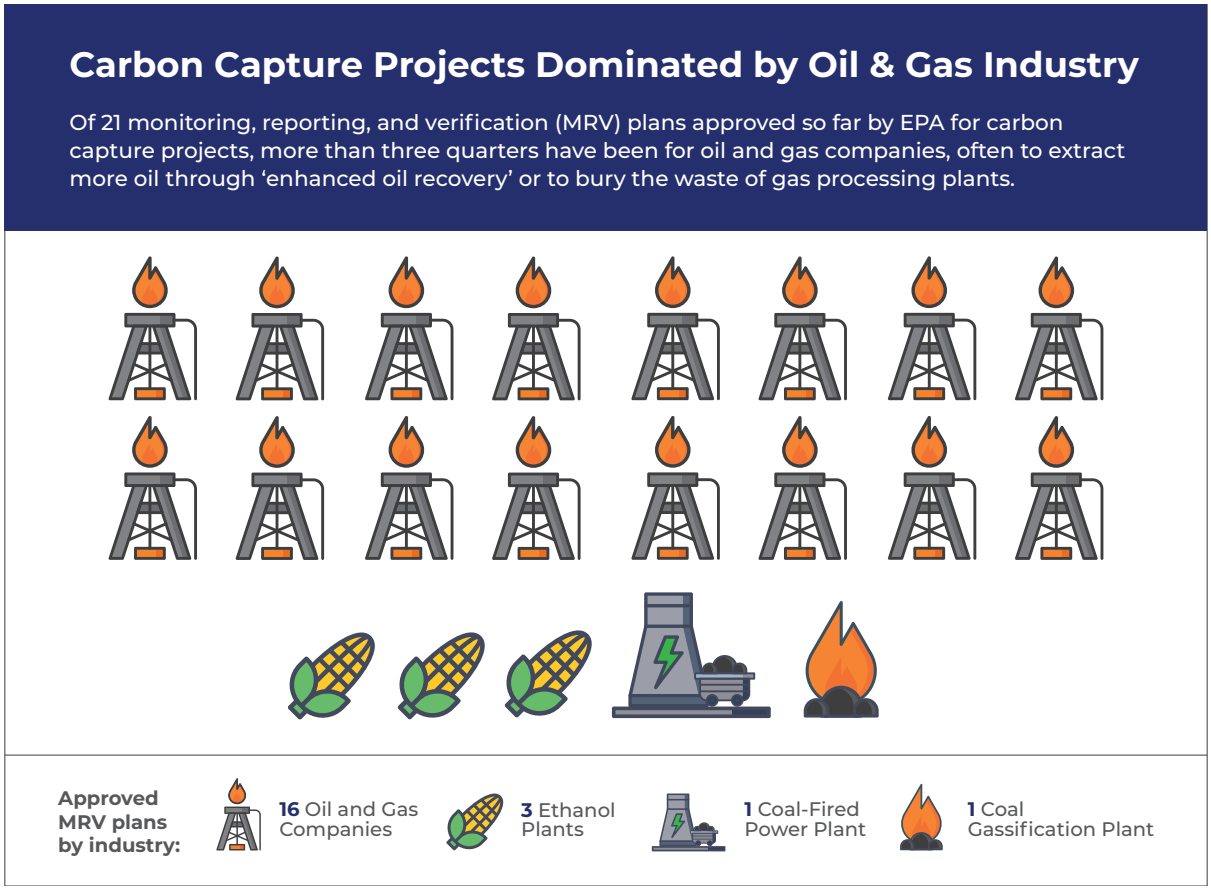
Source: EPA's Facility-Level Information on Greenhouse Gases Tool.

To qualify for the tax credits, companies must have and implement an EPA-approved monitoring, reporting, and verification plan (MRV) or meet an international standard.[15] The plans aim to ensure that companies are accurately accounting for the carbon they inject underground. However, between 2010 and 2019, companies without approved monitoring plans tried to claim nearly $900-million worth of tax credits.[16] Monitoring is critical to accurately account for the amount of carbon sequestered and to prevent its subsequent release into the atmosphere or underground sources of drinking water through either slow and steady leaks or catastrophic releases.

Review of Monitoring, Reporting, and Verification Plans

EPA's Greenhouse Gas Reporting Program requires all carbon storage (Class VI well) permit holders to report data on carbon sequestration each year. To do so, each operator must first submit and have approved a monitoring, reporting, and verification (MRV) plan that demonstrates that the facility is able to accurately report the amount of carbon dioxide sequestered. Enhanced oil recovery or acid gas well (Class II well) permit holders may choose to submit a plan and report data, in addition to their existing reporting requirements, in order to qualify for the tax credit.

In this report, EIP reviewed all 21 monitoring, reporting, and verification plans approved by EPA as of October 31, 2023, which are publicly available on EPA's website.[17] For a spreadsheet with details on all 21 plans, click here. Of these, only five sites are primarily injecting carbon dioxide for long-term geologic sequestration. Ten of the sites are using carbon dioxide for enhanced oil recovery, and six are injecting acid gas to dispose of waste from gas processing plants (see Appendix). Thirteen of these 21 sites have already implemented their monitoring plans and begun reporting to EPA. Four additional facilities are already operating oil recovery fields that will likely begin reporting carbon sequestration data next year, while the rest have not yet started operating.



Regulations Allow Companies to Write Their Own Rules

Monitoring, reporting, and verification (MRV) plans are prepared by Class VI carbon storage permit holders or companies reporting sequestered carbon to the Greenhouse Gas Reporting Program. The plans are submitted to EPA for approval and must contain certain components at a minimum. However, as written in the regulations, these minimum components read as open-ended questions with no right or wrong answers. EPA does not set any minimum monitoring requirements, nor are any specific technologies or methods required. The regulations allow companies to define their own strategies for detecting and quantifying surface leakage of CO_2 and establishing their own baselines for monitoring leakage. Monitoring plans only need to contain a few elements in addition to those strategies, including outlining the monitoring area, identifying, and evaluating potential pathways for CO_2 to leak to the surface, and a list of well identification numbers.[18]

EPA approves each plan through a technical review process. However, these regulations leave considerable room for interpretation, and the approved MRV plans vary quite a bit in how they design and implement monitoring at the site. Companies can also amend the plans at any time, for any reason, and are required to update their plans under certain circumstances.[19]

Inconsistent Monitoring and Testing

Since EPA does not require operators to use any specific monitoring methods or technologies, the monitoring plans vary significantly in how they address potential leaks at a site. These variations may be expected due to differing geological features and monitoring needs, but there needs to be some assurance that the plans will accurately and adequately detect leaks.

Many plans are vague about which monitoring actions will be performed and when. At the Wasson San Andres field in West Texas, for example, mechanical integrity tests will be used to ensure that there are no leaks from the injection well structure, but the monitoring plan does not state how often these tests will be performed.[20] Other sites plan to perform mechanical integrity tests annually, or once every 5 years, which makes a considerable difference in how quickly leaks would be found. Groundwater sampling is another common method used to identify carbon dioxide that may have migrated out of the injection zone. Many companies perform quarterly or annual groundwater sampling, even if the plan states that CO_2 migration into groundwater is unlikely, such as the acid gas injection site at 30-30 Gas Plant in West Texas.[21] However, Camrick Unit, an enhanced oil recovery field on the border between Oklahoma and Texas, claims that there is minimal risk of groundwater contamination at the site, and therefore, there is no need for further groundwater sampling.[22]

Many of the MRV plans claim that there is little to no danger of seismic activity at the storage sites because there are no faults or fractures in the underground formations or earthquakes aren't known to occur in the area. However, oil and gas operations have been known to induce earthquakes, especially from wastewater disposal through produced water disposal wells (also regulated as Class II injection wells).[23] While there are risk factors known to increase the likelihood of induced quakes, there is no way to definitively predict whether injection activities will induce earthquakes.[24] If there is no evidence of induced quakes in the past, that does not mean that continued activity at the site could not lead to one in the future. Monitoring plans need to adequately address seismic activity. But, for example, Blue Flint Sequestration, a carbon sequestration (Class VI) permitted site in central North Dakota, plans to perform seismic surveys of the monitoring area to detect potential leaks caused by seismic activity during the first and fourth years of operation at the site, but will "reevaluate" the timing of the seismic surveys after that.[25]

Monitoring Areas with Thousands of Wells

This need for comprehensive, accurate monitoring is compounded by the large number of old wells present at some of these sites, especially oil fields which have been actively extracting petroleum for decades. These wells present a huge challenge, as they are essentially holes through which CO_2 can leak. While operators promise to comply with applicable regulations for well construction, operation, and abandonment to reduce the risk of surface leakage, this is not always guaranteed, especially for sites which have very old wells that may have been drilled before the

regulations took effect. There are 120,000 documented "orphan" wells in the United States which have not been properly plugged, including over 7,000 in Texas alone, where many existing and proposed carbon capture and storage projects are located.[26] There are even more orphan wells that have not yet been identified; EPA estimates that there are over 3 million abandoned wells in the United States.[27]

The sheer number of documented wells poses a significant challenge for monitoring. The Wasson San Andres Field in West Texas, where oil production has been ongoing for at least 50 years, has nearly 4,700 known wells within the monitoring area, about 1,300 of which are inactive, shut-in, or temporarily or permanently abandoned. The regulations require the company to evaluate these wells as potential leakage pathways in the MRV plan, but Oxy claims the risk of leakage is low, and that they are all in "material compliance" with Texas Railroad Commission rules.[28] Even if all these wells are in compliance at the time of the evaluation, they still need to be monitored for any leaks that may develop.

Oxy uses visual inspections and hydrogen sulfide monitors worn by personnel on site to detect surface leakage. The monitors are used as a proxy for detecting CO_2 leakage, as the injection stream contains an "insignificant" amount of hydrogen sulfide.[29] In some cases, visual inspections could detect the white vapor or ice that often forms when cold carbon dioxide in its supercritical form escapes through pipes and wells. But these methods need to be sensitive enough to detect even small leaks across a huge monitoring area. While the site also continuously monitors injection and wellbore pressures for any abnormalities, these methods must be able to detect small, continuous leaks that may not significantly impact pressure.

Leak Repair

In addition, monitoring plans outline strategies to detect and quantify leaks, but not leak prevention or repair. Some plans do set general time limits for how quickly problems must be fixed. For example, in Texas, the West Seminole San Andres Unit promises to address issues "within days."[30] However, the nearby Seminole San Andres Unit simply promises that leaks will be fixed "in a timely manner."[31] If carbon dioxide is allowed to leak from the storage site for an extended period of time, it defeats the purpose of sequestering the carbon in the first place. This limits the benefits of CCS as a decarbonization strategy, while still taking on all the risks of underground carbon injection.

Monitoring Timelines

Carbon is supposed to be stored long-term, and ideally, permanently. However, the regulations for monitoring plans leave it up to companies to decide how long they want to monitor as long as it's greater than one year.[32] Class VI carbon storage permits require that sequestered carbon stay underground. By default, companies with these permits must monitor the mass of CO_2 sequestered for 50 years, unless they can prove that a shorter timeframe would be sufficient.[33] Monitoring plans from the five Class VI enhanced oil recovery sites EIP reviewed all commit to monitoring the site for 10 years after injection.

Class II enhanced oil recovery or acid gas disposal permits do not have the same requirements. MRV plans from these facilities only promise to continue monitoring until they can establish that the sequestered carbon is not "expected to migrate in the future in a manner likely to result in surface leakage." Many sites claim that this will be possible within two to three years, or even less. West Seminole San Andres Unit expects to be able to demonstrate this "almost immediately" after injection is concluded.[34]

Plans to Make Plans

The plans don't always set specific guidelines for how leaks will be quantified, but instead say that the "most appropriate" method will be chosen depending on the type and variety of leak, with little elaboration. While operators do need flexibility to be able to address problems as they come up, this cannot come at the expense of good methodology. The monitoring plan for Seminole San Andres Unit in Texas states, "In the event CO_2 Surface Leakage is confirmed, the most appropriate methods for quantifying the mass of CO_2 Surface Leakage will be determined, and the information will be reported as part of the required annual Subpart RR submission."[35] In this

case, this "plan" is simply a commitment to develop an actual plan once a leak has occurred. There needs to be some guarantee that the chosen method will be as accurate as possible and will not underestimate emissions. In contrast, the monitoring plan for Barnett RDC #1, a Class II waste disposal well in north Texas, also states that they may use several methods for quantification depending on the nature of the leak but additionally includes examples of potential methods and what kinds of leaks they would be used for.[36]

MRV Plan Enforcement and Verification

For the monitoring plans to have meaning, EPA must have a clear enforcement strategy in place. EPA can pursue enforcement actions against operators who misreport their emissions to its Greenhouse Gas Reporting Program, but it is not clear what actions will be taken to ensure the monitoring plan is being followed and is working to detect and fix leaks. In addition to sequestration data, each operator also must submit annual monitoring reports, which describe all the monitoring actions taken at the site during the reporting year and note any leakage events or monitoring anomalies. These annual monitoring reports are short summaries, usually only a few pages long. EPA should take strict action if a company's monitoring report does not follow through with the monitoring actions outlined in an MRV plan.

Enforcement also becomes even more uncertain when the plans themselves are ambiguous about their monitoring activities. If the monitoring plan itself doesn't define how often a monitoring action will be performed, how can EPA ensure that the monitoring is taking place as planned? For example, at Great Plains Synfuels Plant in North Dakota, one of the methods used to detect leakage from seismicity is a survey method called a vertical seismic profile. Great Plains only commits to performing this survey once, in the first year of injection, and will continue with the profiles "if beneficial."[37] When the plan itself does not commit to continuing with the monitoring actions, how can monitoring be properly enforced?

The data is also all self-reported by operators. While the Greenhouse Gas Reporting Program does not generally require any third-party verification, carbon sequestration is a relatively new field where several projects are being rushed into development, and at great cost to taxpayers. Operators are allowed to devise their own monitoring plans because the sites have unique geologies and requirements. However, EPA and taxpayers need some assurance that the monitoring plan is effective and that any leaks are being detected.

According to EPA data, the oil and gas and ethanol industries sequestered nearly 8 million metric tons of CO_2 in 2022, an amount worth an estimated $213 million in tax credits that year. Pictured above is the Poet ethanol refinery in Chancellor, South Dakota.

EPA Must Strengthen MRV Requirements

If the Federal government wants to wager our tax dollars and climate futures on a costly and energy-intensive technology, at a minimum it must be conducted in a manner protective of human health and the environment. Proper parameters need to be put in place to ensure the carbon is being sequestered safely in the long term. To do that, the monitoring plans need to be specific, enforceable, and comprehensive.

While companies need flexibility to develop appropriate, site-specific monitoring plans, there are ways to allow for flexibility while ensuring the plans are rigorous. EPA could, for example, identify specific types of monitoring that are required (such as atmospheric monitoring, seismicity, etc.), with a list of preferred monitoring methods and technologies for each, similar to the California Air Resources Board's Carbon Capture and Sequestration Protocol.[38] EPA should not accept industry assertions that the carbon dioxide will not leak or migrate. Subsurface studies are not infallible, as shown by an offshore carbon sequestration field in Norway, where, despite conducting pre-operational field assessments and geological studies, carbon dioxide began to migrate in an unexpected direction.[39] Even if companies conclude that CO_2 leakage would be unlikely (as most would, for any proposed carbon sequestration project), they should be required to plan to detect the unexpected and address any leaks immediately.

EPA should also have longer-term monitoring requirements that apply to all plans. Class VI carbon storage wells are already required to continue monitoring the site after injection. EPA's MRV plans should set equivalent requirements for Class II enhanced recovery and acid gas wells, especially if these operations continue to be allowed to claim credit for carbon stored underground. EPA cannot simply accept that the carbon dioxide will not migrate after only two or three years of monitoring. If carbon dioxide escapes from its underground reservoir into the atmosphere years after injection, companies must be able to account for that and report it to the EPA. The monitoring plans should also include some contingency for companies that go out of business or are unable to fulfill longer-term monitoring, reporting, and verification requirements.

Enhanced oil recovery and acid gas projects should not be eligible for tax credits. While these wells should still be required to have and implement an approved monitoring plan to ensure accurate reporting of greenhouse gas emissions, the carbon injection at these sites is secondary to the production of more fossil fuels, which, when used or processed, will emit more carbon dioxide into the atmosphere. This undermines the primary goal of carbon sequestration, which endeavors to reduce carbon dioxide emissions and mitigate climate change.

EPA should also require plan revisions every time monitoring or operational practices change. As is, companies are required to revise their plans if "a material change was made to monitoring and/or operational parameters that was not anticipated in the original MRV plan".[40] This leaves a grey area for companies that plan to reevaluate how often or when specific monitoring actions are performed. Instead, if the company decides that one of their monitoring strategies is not providing any useful information, the company should have to submit a revised plan for EPA approval that explains why this decision was made.

EPA also needs to establish a clear and consistent framework through which companies can be held responsible for monitoring and reporting carbon sequestration data. Companies will also be more likely to prioritize monitoring if the consequences of non-compliance are explicitly stated. Clear expectations help to ensure compliance and accountability.

As is, monitoring, reporting, and verification plans allow for too much leeway that could lead to inadequate monitoring and allow significant carbon leaks to remain undetected and go unaddressed. Accurate and comprehensive monitoring strategies are crucial to evaluating the efficacy and the environmental impacts of carbon sequestration. EPA must address the weaknesses in these monitoring plans before more carbon sequestration projects begin operating.

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Endnotes

[1] Dakota Gasification Company, LLC. "Great Plains CO_2 Sequestration Project Monitoring, Reporting and Verification (MRV) Plan" August 10, 2022. Link: https://www.epa.gov/system/files/documents/2023-01/gpspmrvplan.pdf p. 18

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[3] There is uncertainty about how much of these costs will actually be realized. These budget estimates assume that tax credit claims will increase in the future, but that ultimately depends on how many of the proposed CCS projects become operational. Congressional Research Service. "The Section 45Q Tax Credit for Carbon Sequestration," Updated August 25, 2023. Link: https://sgp.fas.org/crs/misc/IF11455.pdf

[4] Congressional Research Service. "The Section 45Q Tax Credit for Carbon Sequestration," Updated August 25, 2023. Link: https://sgp.fas.org/crs/misc/IF11455.pdf

[5] EPA. "Facility Level Information on Greenhouse Gases Tool (FLIGHT)." Accessed October 31, 2023. Link: https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

[6] This is an estimate of potential tax credit claims based on 2022 data. This calculation assumes that the company meets all the eligibility criteria and completes all the formalities to apply for the credit. See endnote 8. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

[7] This is an estimate of potential tax credit claims based on 2022 data. This calculation assumes that the company meets all the eligibility criteria and completes all the formalities to apply for the credit. See endnote 9. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

[8] Petra Nova, which emitted more carbon than it sequestered in 2022, is not expected to receive any 45Q tax credits in 2022. If the facility received tax credits for carbon sequestration in the past, the company may have to repay some of that amount. This is called credit "recapture." Congressional Research Service. "The Section 45Q Tax Credit for Carbon Sequestration," Updated August 25, 2023. Link: https://sgp.fas.org/crs/misc/IF11455.pdf

[9] These dollar amounts are calculated using 2022 sequestration data and the highest possible tax credit available in the applicable tax year according to the IRS. We assume that that the company meets all the eligibility criteria, including the new hiring, wage, and operation date requirements established by the Inflation Reduction Act, and applies for the tax credit. However, many of the already operating facilities may not meet all the requirements for the expanded tax credit. In 2022, facilities with carbon capture equipment placed in service on or after February 9, 2018 were eligible for $35.85 per metric ton of carbon sequestered and $25.15 per metric ton of carbon utilized in enhanced oil recovery or another qualifying method. If the equipment was placed in service before that date, the rate is reduced to $25.07 and $12.53 respectively. However, placed-in-service dates for the equipment at these facilities are not known, so not all these facilities may qualify for the higher rate. In addition, these calculations do not account for tax credits that may need to be repaid (see endnote 8). The estimated credit amount for 2023 assumes that each company will sequester the same amount of carbon each year. This is also not an exhaustive list of tax credits that could be claimed in 2023; the 2023 tax year has not yet closed, and additional companies may apply for and receive the tax credit in 2023. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

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[14] EPA. "Facility Level Information on Greenhouse Gases Tool (FLIGHT)." Accessed October 31, 2023. Link: https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

[15] The other method to qualify for the tax credit is to comply with geological storage standards set by the International Organization for Standardization, which have been endorsed by the American National Standards Institute (CSA/ANSI ISO 27916:19). This international standard has similar requirements to Subpart RR, but, to receive the tax credit, the documentation must be also certified by a qualified engineer or geologist. Congressional Research Service. "Carbon Storage Requirements in the 45Q Tax Credit," Updated June 28, 2021. Link: https://crsreports.congress.gov/product/pdf/IF/IF11639

[16] J. Russell George, Inspector General for Tax Administration, Department of the Treasury, Memo to Senator Rober Menendez, on April 15, 2020. Link: https://www.menendez.senate.gov/imo/media/doc/TIGTA%20IRC%2045Q%20Response%20Letter%20FINAL%2004-15-2020.pdf

[17] EPA. "Subpart RR – Geologic Sequestration of Carbon Dioxide," Accessed November 2, 2023. Link: https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide#decisions

[18] The regulations also require a start date for data collection and a summary of the considerations used to calculate the reported data elements. 40 CFR 98.448(a)
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Appendix: Summary of Carbon Capture Projects with EPA-Approved Monitoring, Reporting and Verification (MRV) Plans

Project Name	Company	County/ State	Industry	Planned Injection or Storage Volumes (Metric Tons of CO_2 Per Year)*	Operating Status
Wasson San Andres Field (prev. Denver Unit)	OXY USA, INC	Yoakum, Gaines, TX	Oil & Gas	3,500,000 stored	Operating (as Denver Unit)
Seminole San Andres Unit	OXY USA, INC	Gaines, TX	Oil & Gas	5,300,000 stored	Operating (not yet reporting)
Kinder Morgan CCS Complex	Kinder Morgan Permian CCS, LLC	Stonewall, TX	Oil & Gas	Up to 1,200,000 injected	Injection expected to begin June 2024
Barnett RDC Well No. 1	BKV dCarbon Ventures, LLC	Wise, TX	Oil & Gas	Up to 280,000 injected	Injection expected to begin Dec. 2023
Blue Flint CO_2 Storage Project	Blue Flint Sequester Company, LLC	McLean, ND	Biofuels	200,000 injected	Injection expected to begin 2024
Great Plains CO_2 Sequestration Project	Dakota Gasification Company, LLC	Mercer, ND	Coal Gasification	Up to 2,700,000 injected	Not yet operating
Camrick Unit	CapturePoint, LLC	Beaver and Texas (OK), Ochiltree (TX)	Oil & Gas	230,000 stored	Operating (not yet reporting)
30-30 Gas Plant	Stakeholder Gas Services, LLC	Yoakum, TX	Oil & Gas	Up to 2,170,000 injected	Operating
Seminole East Field (SEF)	CapturePoint, LLC	Gaines, TX	Oil & Gas	225,000 stored	Operating (not yet reporting)
Campo Viejo Gas Processing Plant	Stakeholder Gas Services, LLC	Yoakum, TX	Oil & Gas	340,000 injected	Operating
Red Trail Energy, LLC	Red Trail Energy, LLC	Stark, ND	Biofuels	180,000 injected	Operating
Tundra SGS LLC	Minnkota Power Cooperative, LLC	Oliver, ND	Coal Power Plant	4,000,000 injected + 1,200,000 through potential third well	Injection expected to begin 2024-2025
Red Hills Gas Processing Plant	Lucid Energy Delaware, LLC	Lea, NM	Oil & Gas	Up to 500,000 injected	Operating
Petra Nova West Ranch	Petra Nova, LLC	Jackson, TX	Oil & Gas	1,500,000 stored	Operating
Farnsworth Unit CO_2 Flood	Perdure Petroleum, LLC	Ochiltree, TX	Oil & Gas	860,000 injected	Operating
West Seminole San Andres Unit	OXY USA WTP LP	Gaines, TX	Oil & Gas	780,000 injected	Operating
North Burbank Unit	Perdure Petroleum, LLC	Osage, OK	Oil & Gas	800,000 stored	Operating
Shute Creek Facility	ExxonMobil	Lincoln, WY	Oil & Gas	1,925,000 stored	Operating
Core Energy Otsego County EOR Operations	Core Energy	Otsego, MI	Oil & Gas	100,000 injected	Operating
Illinois Industrial Carbon Capture and Sequestration Project	Archer Daniels Midland Co.	Macon, IL	Biofuels	1,100,000 injected	Operating
Hobbs Field	Occidental Permian Ltd, Occidental Petroleum Corporation, and affiliates	Lea, NM	Oil & Gas	1,200,000 stored	Operating

Source. EPA Subpart RR Final Decisions as of October 1, 2023.

*These values are estimates based on project forecasts, historical operating levels, and permit capacities as discussed in the relevant MRV plans. For permit capacities expressed in standard cubic feet, the proportion of CO_2 in the injection stream was assumed to be constant. For project forecasts or previous operational data that estimated an amount sequestered over a period of several years, the average annual injection or storage rate was calculated.

Statement: Offsets Don’t Stop Climate Change

amazonwatch.org/news/2021/1006-statement-offsets-dont-stop-climate-change

October 7, 2021

Press Release
October 6, 2021 | Statement

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Climate-driven wildfires, flooding, droughts and other extreme weather events daily impact every corner of the globe.

Yet the fossil fuel industry, big utilities, big agriculture, big finance — and their political allies — are pushing carbon offset schemes to allow them to continue releasing the greenhouse gases driving the climate crisis, harming Indigenous, Black, and other already-marginalized

communities, and undermining sustainable farming and forestry practices.

The science is clear: we need to rapidly phase out fossil fuels and emissions-intensive agricultural practices like factory farming, while protecting forests, wetlands, and other natural carbon sinks. Every delay means greater impacts on our climate and more pollution in historically overburdened communities.

We call on leaders around the world to join us in rejecting offset schemes because these pay-to-pollute practices are nothing more than false and harmful solutions to the climate crisis.

- **Nature-based offsets cannot "offset" fossil fuel combustion.** While fossil fuel companies and other polluters would like fossil carbon and biological carbon to be fully interchangeable, this has no scientific basis. Fossil carbon emissions are effectively permanent, coming from reservoirs deep in the earth where they have been stored for millions of years. When burned, the carbon pollution remains in the atmosphere for hundreds to thousands of years. In contrast, crops, soils, oceans, and forests are "fast-exchange" carbon reservoirs that have limited carbon storage capacity and can re-release carbon back into the atmosphere over the course of a few decades, or sometimes even over a few days. Offsets confuse this basic science by wrongly treating the Earth's biosphere as an endless source of potential storage for fossil carbon emissions.
- **Offsets of any kind perpetuate environmental injustice.** Greenhouse gas emitting industries are disproportionately sited in poor communities and communities of color, causing them to bear the brunt of pollution. Offset schemes increase pollution in these communities, worsening environmental injustice. Furthermore, by allowing pollution to continue in exchange for land grabs elsewhere, offsets often shift the burden of reducing emissions from the Global North to the Global South.
- **The use of offsets is likely to increase greenhouse gas emissions.** Polluters frequently purchase offsets for emissions-reducing practices by one entity, so that their own emissions can continue. In this case, emissions are still added to the atmosphere, so global warming continues. Polluters also purchase offsets for practices that could pull carbon out of the atmosphere, such as by planting forests or protecting existing forests. However, carbon storage in natural ecosystems is inherently temporary and highly reversible, as has been seen so clearly in the tragic forest fires in the U.S. west in the past few years. All that carbon can be released very quickly back into the atmosphere, again increasing emissions.
- **Offsets can result in violations of the rights of Indigenous and tribal peoples.** Satisfying market demands for offsets will require access to huge expanses of land and forest, lands already occupied by Indigenous Peoples, peasants, and local communities. As such, Indigenous lands are increasingly targeted by forest offset project developers, creating pressure and division in Indigenous communities.

- **Offsets undermine sustainable farming and increase consolidation in agriculture.** Carbon offset programs give additional leverage to already powerful corporations, including agribusinesses and factory farms, that have long squeezed farm income and drained rural economies, while increasing environmental pollution. Corporations and large landowners are best-positioned to develop offset projects, which further entrenches the factory farm and corn/soybean monocultural model at the expense of small farmers, including Black and Indigenous farmers and Tribal Nations. Instead of allowing the industrial, extractive model of agriculture to further prosper by selling offsets to industrial polluters, policy makers should support traditional and ecologically regenerative agricultural practices.
- **Offsets markets create more conditions for fraud and gambling than for climate action.** Existing offset schemes have already proven to be easily open to fraud. Yet the speculative trading of offsets derivatives and other financial products has already begun, prioritizing profit-seeking traders and speculators over economic and climate justice.

We call on global policy makers to reject offset schemes and embrace real climate solutions that will keep fossil fuels in the ground, support sustainable food systems, and end deforestation, while eliminating pollution in frontline communities.

Co-signers

To add your organization as a co-signer, please email roshan@amazonwatch.org.

INTERNATIONAL

Amazon Watch
Amazon Frontlines
BankTrack
Biofuelwatch
Forest Peoples Programme
Global Alliance for the Rights of Nature
Global Forest Coalition
Global Justice Ecology Project
Global Witness
International Marine Mammal Project of Earth Island Institute
International Rights of Nature Tribunal
MADRE
Maryknoll Office for Global Concerns
Profundo
Public Justice
Rainforest Action Network
SEED

Stand.earth
Water Climate Trust
Women's Earth and Climate Action Network – WECAN

AFRICA

groundWork, Friends of the Earth South Africa (South Africa)
Justica Ambiental – JA! Friends of the Earth Mozambique (Mozambique)
Nipe Fagio (Tanzania)

ASIA

Aid Organization (Bangladesh)
Environics Trust (India)
Sahabat Alam Malaysia – SAM (Malaysia)
Wahana Lingkungan Hidup Indonesia – WALHI (Indonesia)
World Animal Protection (Thailand)

AUSTRALIA

Australian Forests and Climate Alliance (Australia)

EUROPE

Action for World Solidarity – ASW (Germany)
Amigos de la Tierra España (Spain)
Association of Ethical Shareholders Germany (Germany)
Campaign against Climate Change (United Kingdom)
CCFD – Terre Solidaire (France)
Climáximo (Portugal)
Corporate Europe Observatory (Europe)
Counter Balance (Belgium)
Eco Action Families (Brighton, United Kingdom)
Emergenza Climatica (Italy)
Feedback (United Kingdom)
Fern (Austria)
Fridays for Future Exeter (Devon, United Kingdom)
Just Finance International (Denmark)
London Mining Network (London, United Kingdom)
Movimento No TAP/SNAM Provincia di Brindisi (Italy)
New Weather Institute (United Kingdom)
Per il Clima Fuori dal Fossile (Italy)
Termoli Bene Comune-Rete della Sinistra (Italy)
Water Justice and Gender (Netherlands)

SOUTH AMERICA

350.org América Latina (Latin America)
Acción Ecológica (Ecuador)
Aliança RECOs – Redes de Cooperação Comunitária Sem Fronteiras (São Paulo, Brazil)
CEDENMA (Ecuador)
Colectivo Voces Ecológicas – COVEC (Panamá)
Convergencia de Saberes y Acción Territorial (Cundinamarca, Colombia)
CooperAcción (Perú)
Coordinación Nacional de Pueblos Indígenas – CONPI (Colombia)
FASE – Solidariedade e Educação (Brazil)
Fórum Mudanças Climáticas e Justiça Socioambiental – FMCJS (Brazil)
Fundación Alejandro Labaka (Ecuador)
Fundación Alianza Ceibo (Ecuador)
Fundación Dignidad (Ecuador)
Instituto Madeira Vivo (Rondônia, Brazil)
LAGERI (Brazil)
Movimento Mulheres pela P@Z! (Brazil)
Somos Agua (Ecuador)

NORTH AMERICA

198 Methods (United States)
350 Conejo / San Fernando Valley (California, United States)
350 Eastside (Washington, United States)
350 Eugene (Oregon, United States)
350 Mass (Massachusetts, United States)
350 New Orleans (Louisiana, United States)
350 Seattle (Washington, United States)
350 Hawaii (United States)
350NYC (New York, United States)
A Well-Fed World (United States)
Action Center on Race and the Economy (United States)
ActionAid USA (United States)
Atmos (United States)
Between the Waters (Ohio, United States)
CatholicNetwork US (United States)
Alternatives for Community & Environment – ACE (Massachusetts, United States)
Blue Mountains Biodiversity Project (Oregon, United States)
Businesses for a Livable Climate (United States)
California Communities Against Toxics (California, United States)
Call to Action Colorado (Colorado, United States)
Center for International Environmental Law (United States)

Church Women United in New York State (New York, United States)
Climate Crisis Policy (New York, United States)
Climate Justice Alliance (United States)
Coalition Against the Pilgrim Pipeline (New Jersey, United States)
Coalition to Protect New York (New York, United States)
CODEPINK (United States)
Compressor Free Franklin (New York, United States)
Connecticut Citizen Action Group – CCAG (Connecticut, United States)
Coordinadora de Pueblos y Organizaciones del Oriente del Estado de México en Defensa de la Tierra, el Agua y su Cultura – CPOOEM (Valle de México, México)
Don't Gas the Meadowlands Coalition (New Jersey, United States)
Earth Action, Inc. (United States)
Earthworks (United States)
Eco-Poetry.org (New Jersey, United States)
Environmentalists Against War (United States)
Extinction Rebellion San Francisco Bay Area (California, United States)
Family Farm Defenders (United States)
Food and Water Watch (United States)
FrackBustersNy (New York, United States)
FreshWater Accountability Project (Ohio, United States)
Fridays for Future U.S. (United States)
Friends for Clean Water (New York, United States)
Friends of the Earth U.S. (United States)
Gas Free Seneca (New York, United States)
Global Exchange (United States)
Grand(m)others Act to Save the Planet – GASP (Canada)
Green State Solutions (Iowa, United States)
Greenpeace USA (United States)
Gulf Coast Center for Law & Policy (United States)
Harford County Climate Action (Maryland, United States)
I-70/Vasquez Blvd. Superfund CAG (Colorado, United States)
Idle No More SF Bay (California, United States)
Indigenous Environmental Network (United States)
Institute for Agriculture and Trade Policy (United States)
Institute for Policy Studies Climate Policy Program (United States)
Jóvenes Por El Planeta Mich (Michoacán, México)
Kickapoo Peace Circle (Wisconsin, United States)
Local Clean Energy Alliance (California, United States)
Mid-Ohio Valley Climate Action (Ohio, United States)
Montbello Neighborhood Improvement Association (Colorado, United States)
Nassau Hiking & Outdoor Club (New York, United States)
National Family Farm Coalition (United States)

New Mexico Climate Justice (New Mexico, United States)
NJ State Industrial Union Council (New Jersey, United States)
North American Climate, Conservation and Environment – NACCE (New York, United States)
North Range Concerned Citizens (Colorado, United States)
Northeast Organic Farming Association – Interstate Council (United States)
Nuclear Information and Resource Service (United States)
Oil and Gas Action Network (United States)
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People for a Healthy Environment (New York, United States)
Physicians for Social Responsibility, Arizona Chapter (Arizona, United States)
People's Climate Movement, Toronto and the GTA (Canada)
Power Past Fracked Gas (United States)
Progressive Democrats of America – Tucson Chapter (Arizona, United States)
Protecting Our Waters (United States)
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ReCommon (United States)
Revolving Door Project (United States)
River Guardian Foundation (North Carolina, United States)
Rivers without Boundaries International Coalition (United States)
SanDiego350 (California, United States)
Seeding Sovereignty (United States)
Seneca Lake Guardian, A Waterkeeper Alliance Affiliate (New York, United States)
Sisters of St. Francis, Rochester, MN (Minnesota, United States)
Small Business Alliance (United States)
South Shore Audubon Society (New York, United States)
Spirit of the Sun (Colorado, United States)
Stop the Algonquin Pipeline Expansion (United States)
Sunflower Alliance (California, United States)
Sunrise Movement (United States)
System Change Not Climate Change (United States)
Texas Campaign for the Environment (Texas, United States)
The Climate Mobilization (United States)
The Green House Connection Center (Colorado, United States)
The People's Justice Council (Alabama, United States)
TIAA-Divest! from Climate Destruction (United States)
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Undoing Equivalence: Rethinking Carbon Accounting for Just Carbon Removal

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Concerns are increasingly raised over the centrality of carbon removal in climate policy, particularly in the guise of "net-zero" targets. Most significantly perhaps, treating emissions and removals as equivalent obscures emission reductions, resulting in "mitigation deterrence." Yet the conflation of emission reductions and removals is only one among several implicit equivalences in carbon removal accounting. Here, we examine three other forms—carbon, geographical, and temporal equivalence—and discuss their implications for climate justice and the environmental risks with carbon removal. We conclude that "undoing" these equivalences would further a just response to the climate crisis and tentatively explore what such undoing might look like in practice.

Keywords: carbon removal, negative emissions, equivalence, carbon accounting, climate justice, net-zero

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INTRODUCTION

Carbon removal is steadily making its way into mainstream climate governance. As countries and corporations embrace net-zero emission goals, the ambition to remove large amounts of carbon from the atmosphere is becoming an implied if not always outspoken pillar of mitigation policies. This development raises a number of, by now, well-known concerns about the feasibility of proposed "negative emission technologies" (Low and Schäfer, 2020; Waller et al., 2020) and the likely environmental and social justice impacts of their implementation (Dooley and Kartha, 2018; Doelman et al., 2020). These concerns remain largely invisible in the modeled pathways that assume large-scale deployment of negative emissions later in this century (Larkin et al., 2017; Beck and Mahony, 2018). Apprehensions are also voiced about the likely "moral hazard" or "mitigation deterrence" effects that promises of future carbon removal have on current emission reduction efforts (Anderson and Peters, 2016; McLaren, 2020; McLaren and Markusson, 2020).

To address some of these issues, McLaren et al. (2019) propose to disaggregate net-zero targets into separate objectives for carbon removal and emission reductions. Doing so, they argue, would "expose interests and politics" in the formulation of emission targets and "reveal both where negative emissions investment and development is inadequate, and where negative emissions (or future promises thereof) could undermine emissions reduction" (p. 4). McLaren et al.'s proposal reflects a long-standing social science critique of carbon accounting as an often misguided exercise in "making things the same" (MacKenzie, 2009).

This critique asserts that common carbon accounting practices are rendering disparate technologies, socioeconomic contexts, and climate change temporalities equivalent, while concerns for climate justice and environmental integrity demand that they are kept separate (Lohmann, 2009, 2011). It fundamentally questions the idea that a ton of CO_2 should be treated as functionally

equivalent irrespective of how, where or when it is avoided, removed, or stored. While "a ton is a ton" might be a useful abstraction for creating and apportioning carbon budgets, the argument goes, it is a poor guide in the design of climate policy, where different options for mitigation and their distribution in time and space correspond to radically different values, socioeconomic effects, and risk profiles (Lövbrand, 2009; Corbera and Brown, 2010; Leach and Scoones, 2015; Turnhout et al., 2015). Hence, while carbon accounting fulfills an important function to create consistency and unity in assessing progress toward identified targets, the specific forms it takes are not neutral and require close consideration.

Seen in this light, the conflation of removals and emission reductions that McLaren et al. are concerned with, is one among several implicit equivalences in carbon accounting. In this perspective piece, we critically examine the social and environmental implications of three other equivalences. We argue that these too must be undone as part of a movement toward ensuring socially and environmentally just carbon removal and mitigation policies—which require that states with greater capability take the lead on climate action and that the needs of the most vulnerable are protected against the effects of climate change and of measures taken to limit it (Shue, 2019; Dooley et al., 2021). While concerns over the equivalences that we examine have long been raised in the social science literature on e.g., carbon accounting and carbon markets (Lohmann, 2009; Carton et al., 2020), they are now resurfacing under the guise of a rapidly evolving carbon removal agenda, and therefore warrant being discussed and scrutinized as part of this new conversation.

UNDOING EQUIVALENCE

We describe three common forms of equivalence in carbon accounting and discuss their implications for climate justice concerns and risks with respect to carbon removal. We then suggest what "undoing" these equivalences might look like in practice.

Carbon Equivalence

Carbon accounting often renders fossil and biotic forms of carbon, i.e., from fossil fuels vs. land use, land use change, and forestry, equivalent. Both categories of carbon are commonly included under the same climate targets, which allows fossil fuel emissions to be "offset" by increases in biological carbon sequestration. The European Union's new 2030 "net-emissions" target, for instance, now includes forests and land use within the bloc's overall mitigation target, which though constrained by accounting rules introduces a degree of flexibility between fossil and land sector emissions (Kulovesi and Oberthür, 2020). Such accounting practices are responding to political rather than scientific considerations and involve a number of risks and complexities (Lövbrand, 2004; Höhne et al., 2007), raising concerns about the weakening of targets (Climate Action Tracker, 2020). While the technical accounting difficulties with making fossil and biotic carbon equivalent have long been recognized, the social, environmental, and climate implications often remain obscured (Fogel, 2005; Dooley and Gupta, 2017).

A key concern with this equivalence pertains to the different timescales involved: fossil carbon sinks are essentially permanent (or inert) if left unused, while biotic carbon is part of the short-term (or active) carbon cycle. While accounting systems try to deal with the risk of reversal from biotic sinks in various ways, for example through temporary crediting, these solutions do not take away the long-term uncertainties involved (Brander et al., 2021). The different temporal characteristics of fossil vs. biotic carbon represent a fundamental barrier to equivalence.

Mackey et al. (2013) explain why using carbon sinks on land as a means to "offset" emissions from burning fossil fuels is scientifically flawed. Current terrestrial removal and storage potential primarily reflects the depletion of carbon sinks due to past land use. Since the capacity of forests and other ecosystems to sequester carbon is finite, increasing carbon in terrestrial sinks simply replaces carbon that has been lost to the atmosphere over past centuries. Fossil carbon, on the other hand, is permanently locked away. Thus, burning fossil fuels moves carbon from permanent storage into the active carbon cycle, causing an aggregate increase in land, ocean, and atmospheric carbon. Once added, this additional carbon cannot be removed through natural sinks on time-scales relevant to climate mitigation, leading to increased warming (Steffen et al., 2016).

Rendering biotic and fossil carbon equivalent also conflates the drivers of climate change. It obscures whether mitigation is achieved through reduced fossil emissions or increased biotic sequestration (Dooley and Gupta, 2017), suggesting that full decarbonization of the energy sector can be avoided (or delayed) by sufficient "greening" in the land sector. However, the technological, social, and economic transitions required in these sectors differ significantly, as do their relative contributions to climate change. Considering them fully fungible therefore has considerable social and environmental implications. Bioenergy with carbon capture and storage (BECCS), for example, is promoted as a biotic carbon removal solution that largely overcomes the permanence issue by geologically sequestering the carbon captured from bioenergy combustion. Yet treating BECCS as a solution to continued fossil fuel emissions implicitly shifts the burden of mitigation from energy, industry, and transport to the land use sector, with ramifications for distributional justice and ecosystem functioning (Buck, 2016; DeCicco and Schlesinger, 2018; Seddon et al., 2020).

A similar suite of issues arises from the establishment of equivalence across different biotic systems. The quality, integrity, and stability of biotic carbon stocks differs between different land-uses. Ecosystem integrity and function, including carbon storage, depends on biodiversity (Labrière et al., 2016), with diverse intact natural ecosystems known to be more resilient and stable than monocultures of non-native species (Seddon et al., 2019). Yet, carbon accounting systems do not differentiate between the "quality" of terrestrial carbon stocks on the basis of ecosystem health or diversity (Keith et al., 2021).

A just framing of carbon removal would require separate accounting and policy agendas on biotic and fossil fuel emissions. Such separation was already recommended several decades ago (WGBU, 1998) and has recently reappeared in the academic and political debate (NewClimate Institute, 2020; Skelton et al.,

2020; Smith, 2021). Separation would help avoid the substitution of fossil fuel emission reductions for land-based actions that risk exacerbating climate injustices through environmental and social impacts. Rather than using biotic carbon removals to compensate for past, ongoing, or residual fossil emissions, restricting removals on a sectoral basis (e.g., land-based removals for land-based emissions) would encourage improved agricultural practices, minimize reliance on land sequestration, and force a faster transformation of sectors reliant on fossil fuels (Upton, 2019).

A further step should be to separate different land-based efforts, recognizing that these come with very different social and ecological implications. A further undoing of equivalences within the "biotic carbon" category is therefore necessary. Actions that minimize problems of impermanence through geological storage (such as BECCS) or create equivalences between terrestrial carbon stocks of different quality (such as between diverse forest ecosystems and monoculture plantations) need to be assessed for their impacts and risks related to *both* social impacts *and* biodiversity, ecosystems, and mitigation effectiveness. Taken together, this means that research and policy agendas need to distinguish between emissions avoided or removed in the land sector; the difference in quality of carbon stocks between different land-uses and ecosystems; and mitigation action in sectors reliant on fossil fuels.

Geographical Equivalence

A second equivalence embedded in carbon accounting is between carbon emissions and removals across different geographies, i.e., across locations that differ widely in terms of their biophysical and socio-political characteristics.

Climate change is commonly construed as a global problem where the spatial location of emissions and removals is irrelevant. It is also widely seen as a problem that should be mitigated at the lowest possible cost, a principle that is written into the U.N. Framework Convention on Climate Change (Article 3.3) (Boyd et al., 2009). This combination of factors makes the idea of geographical equivalence intuitively appealing. From a neoclassical economics perspective, differences in the marginal costs of mitigation efforts across the world derive from comparative advantage premised on different innate abilities and preferences, i.e., some places provide better conditions for carbon removal than others and some people prefer low-carbon lifestyles over others. This logic has given rise to a variety of mechanisms to facilitate the international exchange of mitigation responsibilities, allowing countries and corporations to finance climate action elsewhere to meet their targets. The use of carbon removal within such mechanisms is already common practice on the voluntary carbon market and is actively discussed in the context of a future trading mechanism under the Paris Agreement (Mace et al., 2021).

Carbon removal and storage does come with specific geo- and biophysical conditions that lend support to geographical equivalence and the international exchange of removal responsibilities. Geological storage capacity, for instance, is unevenly distributed across space, implying that some countries will be unable to store captured CO_2 within their jurisdictions (Kelemen et al., 2019; Wei et al., 2021). Similarly, higher biological sequestration rates in the tropics favors them as locations for afforestation/reforestation and bioenergy production in global estimates of mitigation potentials (Griscom et al., 2017). Yet prioritizing such geo- and biophysical conditions in global carbon removal estimates tends to disregard important social and political factors that put these estimates in question (Creutzig et al., 2021), and that caution against the adoption of geographical equivalence. Studies that identify "available" locations for land-based carbon removal (Griscom et al., 2017; Bastin et al., 2019; Pozo et al., 2020), for instance, commonly disregard the existing uses and users (such as pastoralists) of these areas. This amounts to a discursive marginalization of certain land uses and users and may implicitly legitimate processes of "green grabbing" (Fairhead et al., 2012).

Similarly, the notion of comparative advantage, which underpins the alleged mutual benefits of exchanging mitigation responsibilities, has been repeatedly criticized for disregarding global inequality and power structures (Sheppard, 2012; McAfee, 2016). Critics point out that the differences allowing for market exchange reflect uneven capacities and opportunities within a structurally unequal world, and are predicated on historical and present exploitation and unequal power relations (Smith, 2008). Focusing on cost-effectiveness as the driving criterion for the location of carbon removal efforts will therefore, inter alia, tend to reproduce climate injustices (Fairhead et al., 2012).

We currently see rapid growth in the use of offsetting to offer "climate neutral" products and services and/or to make good on corporate and country-level net-zero pledges (Gross, 2020; NewClimate Institute, 2020). Many of these promises build on geographical equivalence, where offsetting occurs through carbon removal—often in the form of afforestation projects—in countries in the global South. This incentivizes delay—by providing cheap alternatives to difficult or inconvenient emission reductions—and deepens climate injustice in several ways. First, by depriving poor nations and regions of "cheap" carbon removal options, making their path toward the coveted "net-zero" harder, while giving wealthy nations and regions an easier path toward realizing the same goal (Rogelj et al., 2021). Second, by limiting the livelihood opportunities afforded to poor (mostly rural) people so that a wealthy global elite can continue its ways (Shue, 2017; Gore et al., 2020). Third, by facilitating the continued release of fossil carbon into the atmosphere (Pearse and Böhm, 2014; Green, 2021), thereby contributing to future demand for carbon removal rollout as well as inflicting more severe climate damages that will shape the lives of poor and vulnerable people in the global South the most [Intergovernmental Panel on Climate Change (IPCC), 2014a].

Just climate policy requires that we abandon the notion of geographical equivalence. Undoing the equivalence between biotic and fossil carbon would contribute toward undoing geographical equivalence in practice, because much of the offsetting done by global North corporations occurs via forest offsets. However, further efforts are necessary to avoid the deepening of climate injustices entailed by global carbon markets. This involves a stronger prioritization of domestic or at least regional mitigation efforts, and a move away from global market

mechanisms that neglect differentiated social and economic capabilities. Efforts to reform such mechanisms have so far failed to curb their negative social fallout as well as concerns related to additionality and leakage, among others (Asiyanbi and Lund, 2020; Cullenward and Victor, 2020; West et al., 2020). Current discussions surrounding voluntary market standards and a possible global compliance market under the Paris Agreement do not indicate a substantial break with failures of the past (Timperley, 2019; Harvey, 2021), hence offer little hope that markets can be reformed to the extent needed. Rather than relying on the principle of geographical equivalence, shared responsibility for carbon removal must start from an acknowledgment of wealthy nations' historical responsibility for climate change and a moral imperative that mandates against shifting the burden and risks associated with removal to poor and vulnerable parts of the world. Ultimately, this means decoupling support for mitigation and adaptation efforts in the global South from any trade in carbon removal claims.

Temporal Equivalence

A third prominent equivalence in discussions on carbon removal is between present (and near-term) mitigation actions, and those projected to occur in the more distant future. This temporal equivalence underpins much of the current discourse on large-scale removal but raises a number of concerns.

Proposals for large-scale removal derive from modeled pathways that seek to stay within 1.5 or 2°C warming limits. In the majority of these pathways carbon removal compensates for a temporary overshoot of the temperature target [Intergovernmental Panel on Climate Change (IPCC), 2014b, 2018]. For instance, more than 80% of scenarios in the IPCC's Special Report on 1.5°C overshoot the 1.5°C temperature threshold before returning to these levels using large-scale carbon removal in the second half of the twenty-first century [Intergovernmental Panel on Climate Change (IPCC), 2018; Rogelj et al., 2019]. This use of temperature overshoot and subsequent decline suggests that it does not matter when, over the next 80 years, mitigation actions occur, as long as the end-result by 2100 stays within agreed-upon temperature targets. It assumes substitutability between emission reductions in the near-term and further-off removals, a notion that is rapidly being institutionalized in net-zero targets. It is this equivalence that most directly lies behind concerns with "mitigation deterrence," because if it does not matter *when* we balance the carbon budget, then there might be incentives to push uncomfortable and difficult decisions and investments into the future.

The idea that future actions can straightforwardly be substituted for present ones is however problematic. For one, as Anderson and Peters (2016) point out, it neglects the different risk profiles that characterize different time horizons: we know what can be done in the present and what technologies are available, and can therefore reasonably assess their risks, flaws, and economic and political feasibility. Future removals on the other hand often rely on technologies that are hypothetical at scale and their roll-out is therefore inherently more difficult to assess. Second, significant uncertainties remain concerning future climate feedback processes and tipping points (Tokarska and Zickfeld, 2015; Lenton et al., 2019; Creutzig et al., 2021), which could affect the effectiveness of carbon removal to reduce temperatures (Rogelj et al., 2018, p. 127). If increased warming weakens natural carbon sinks (Hubau et al., 2020; Li et al., 2020; Wang et al., 2020; Duffy et al., 2021) or turns them into sources of carbon emissions (Wang et al., 2018), then assumptions about our ability to bring down atmospheric CO_2 concentrations in the second half of the century might prove overly optimistic.

Third, equating present with future actions ignores potentially important differences in the climate damages and mitigation burdens that occur as a result of different peak CO_2 concentrations. While the geophysical implications of temporary temperature overshoot remain unclear (Geden and Löschel, 2017), an increasing amount of research points to levels of sea level rise, changes in ocean circulation, and changes in other aspects of the cryosphere that exceed those under straightforward temperature stabilization scenarios and that would be difficult to reverse (Palter et al., 2018; ICCINET, 2019). In other words, while temperature overshoots might be reversible, this is not necessarily the case for other climate and geophysical dynamics. Fourth, the more societies push actions into the future, the greater the scale at which removals will need to happen, and the larger the social and economic burdens associated with mitigation [Intergovernmental Panel on Climate Change (IPCC), 2018]. Rapid short-term emission reductions also entail a significant burden, but there are clear societal co-benefits from transitioning to a renewable energy-oriented transport and industry system, and from making agricultural systems more sustainable. That is not necessarily the case with large-scale carbon removal. Technologies such as Direct Air Capture would likely be a pure cost to society, while in the case of "natural climate solutions" any co-benefits are highly dependent on the form and scale they end up taking [Intergovernmental Panel on Climate Change (IPCC), 2019; Fyson et al., 2020].

Cutting across these different concerns are the uneven intergenerational effects of temporal equivalence. As Shue (2017) notes, the conflation of present with future climate actions entails a risk-transfer to future generations, in which the people deciding that future removal is a reasonable strategy to pursue are different from those that will need to deal with any of the consequences arising should that strategy fail. Substituting near-term mitigation for future removals "sentences young people to either a massive, implausible cleanup or growing deleterious climate impacts or both' (Hansen et al., 2016, p. 578). This occurs against a background where any costs of mitigating climate change in the face of insufficient removal will be significantly larger than today, and where those costs and consequences are likely to disproportionately fall on the poorest.

A commitment to climate justice therefore demands a clear distinction between actions in the present, and more hypothetical, future promises of mitigation (mostly in the form of carbon removal). It demands the introduction of barriers to substitution, for example by moving away from the use of high discount rates in models, which value future generations less than present ones (Stanton et al., 2009) and hence facilitate substitution and bias results in favor of future removals (Emmerling et al., 2019). Foregrounding justice considerations also requires constraints on the use of overshoot scenarios (Geden and Löschel, 2017) and a carbon accounting system that

internalizes the considerable added risks of delaying mitigation, for instance by institutionalizing a risk premium in mitigation pathways. For policy makers, minimizing risk transfer means much stronger prioritization of ambitious near-term actions over distant mitigation targets and open acknowledgment of the important differences between the two. This would guarantee that a majority of the mitigation burden is borne by those most responsible for the problem.

CONCLUSION

In sum, we argue that a just research and policy agenda on carbon removal needs to, first, distinguish between removals in the land use sector, and emissions from the use of fossil fuels in energy production, industry and transport. The purpose here should be to question the logic that allows biotic carbon sinks to be used as offsets for fossil fuel emissions, while also problematizing substitution between biotic sinks without regard for ecosystem quality or justice effects. Second, it needs to resist the temptations of global markets in carbon removal, where the domestic climate obligations of corporations or countries are substituted for removals in distant, often less affluent places. Such cost-shifting perpetuates existing inequalities by outsourcing the responsibility for climate action on economic grounds. Third, it needs to take a cautionary approach to tipping points, climate feedbacks, and the reversibility of climate impacts so as to avoid shifting the risks of climate change onto future generations. Taking these risks seriously would significantly constrain the use of future carbon removal as a way to compensate for continued emissions, and allow an open discussion on when such strategy might be justified, and when it is not.

In practice, the three equivalences that we have discussed are difficult to keep apart. They do not stand side by side but in numerous ways overlap and intersect with each other, and with the "net" equivalence that McLaren et al. (2019) problematize. Attention to these interrelations highlights that the problems and perverse incentives characterizing the carbon removal conversation run deeper than the conflation of removals and emission reductions alone—acknowledgment of which might help overcome some of the criticisms raised against a proposed undoing of the "net" equivalence (see Smith, 2021). Indeed, our discussion here does not exhaust the full range of concerns pervading the construction of equivalence in climate research and policy (Lohmann, 2011). Other equivalences are worthy of renewed scrutiny as well, including for example the conflation of different greenhouse gas emissions under a single CO_2 equivalent metric (see e.g., MacKenzie, 2009; Cooper, 2015). In this article, we merely sought to illustrate how common approaches to carbon accounting tend to disregard important social, environmental, and geophysical differences—among others—between different sources and sinks of greenhouse gas emissions. This accounting logic serves the interest of simplicity, substitutability, and economic flexibility but introduces important social and environmental concerns that undermine climate justice. It is time to acknowledge that carbon accounting equivalences are political choices fulfilling political functions, with important consequences for climate policy. If researchers and policy makers are serious about incorporating social and environmental justice considerations into their climate mitigation work, then models and accounting frameworks must make explicit, and indeed actively minimize, the risks involved in the creation of multiple equivalences.

Beyond separate targets for emission reductions and removals, we also need differentiated targets and policies that separate land-use from fossil fuel emissions, and that prioritize and incentivize near-term domestic actions, using existing technologies, over distant net-zero targets. This would help to direct wealthy corporations and nations—those mainly responsible for climate change and most capable of mitigating it—toward ambitious emissions reductions and just forms of carbon removal, putting us on a path toward stabilizing the climate.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

WC conceived of the article idea and drafted the introduction, the section on temporal equivalence, and the conclusion. JL drafted the section on geographical equivalence. KD drafted the section on carbon equivalence. All authors helped conceptualize the argument and contributed to extensive editing and revising of the text.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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VIEWPOINT

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Gambling With the Climate: How Risky of a Bet Are Natural Climate Solutions?

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This article is a companion to Coffield et al. (2021), https://doi.org/10.1029/2021AV000384.

Key Points:

- Forests may help climate mitigation if they can store carbon for centuries
- Climate-driven disturbances may greatly undermine these aims in California
- Multi-disciplinary and open research is urgently needed to inform policy

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There is widespread and growing interest in using forests and, more broadly "natural and working lands," as nature-based climate solutions (NCS) to mitigate human-caused climate change. NCS frequently bring an array of potential co-benefits, including to biodiversity and conservation, and thus make an attractive potential tool to tackle climate change (Griscom et al., 2017). Crucially, to function as climate mitigation, NCS efforts must meet several fundamental criteria including: (a) providing additional carbon storage beyond what would have occurred otherwise, (b) accounting for emissions that shift elsewhere due to NCS activities (termed "leakage"), (c) having a net cooling effect on the climate by integrating the central biophysical and biogeochemical impacts of ecosystem changes, and finally (d) achieving a level of carbon storage "permanence" over long periods of time (typically considered to be 100 years or longer) (Figure 1) (Anderegg et al., 2020; Anderson et al., 2011; Hurteau et al., 2013; Ruseva et al., 2017). If climate change drives losses of carbon storage in forests, that would dramatically undermine the role and potential of NCS in climate goals and policy (Baldocchi & Penuelas, 2019; Anderegg et al., 2020). Thus, cutting-edge science to evaluate the permanence of forest carbon storage in the 21st century is critically important to a wide array of stakeholders from governments to corporations to non-governmental organizations.

The State of California has set an ambitious suite of climate goals that aim to leverage forest-based NCS strategies through several key avenues. Forest carbon offsets are currently widely used as part of the cap-and-trade carbon market and the State's Natural and Working Lands Climate Change Implementation Plan aims to broadly leverage California landscapes to contribute to carbon sequestration goals. In light of these ambitious and rapidly developing efforts, Coffield and colleagues draw upon four complimentary and widely used empirical approaches to quantify and project future carbon storage of California forests across a wide range of climate models and future scenarios (Coffield et al., 2021). This study is incredibly timely, exemplifies science that is important and directly applicable to policy and planning, and provides one of the most thorough and rigorous studies to date examining California's carbon sequestration projections in natural lands.

The two most important findings of the study are that rising temperatures are projected on average to drive declines in forest biomass and carbon storage in California's forests across the 21st century in all emissions scenarios and that the declines are most dramatic in high emissions scenarios. Precipitation strongly regulates projected biomass, but consistent with much other work (e.g., Cayan et al., 2008; Polade et al., 2017), there is large uncertainty of future precipitation changes across climate models at regional scales, including in California. Differences among climate scenarios highlight that NCS efforts are most likely to be potentially useful for climate mitigation if they are paired with aggressive reductions of greenhouse gas emissions from human sources. However, net losses of carbon over the 21st century even in the lower emissions scenario reveal that NCS efforts are a risky gamble that might not actually contribute to climate change mitigation in highly climate-sensitive regions like California.

Two other central findings of Coffield et al. are important to note. First, the climate risks to forest offset projects located in California are remarkably high and substantially underestimated in current versions of voluntary and compliance markets' forest offset protocols (Anderegg et al., 2020). Second, the authors find consistent spatial patterns of vulnerability with higher climate losses of carbon projected at low elevations and in the coastal and northern areas of California's conifer forests. The spatial patterns in climate-driven biomass loss are also consistent with where widespread drought- and insect-driven tree mortality was observed in the 2011–2017 severe drought in California (Goulden & Bales, 2019; Young et al., 2017).

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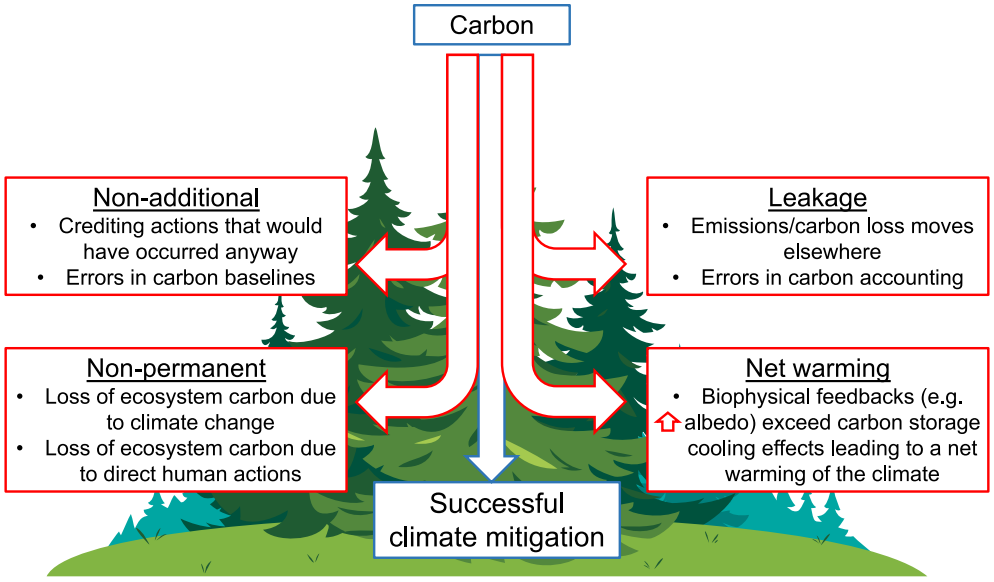

Figure 1. Key requirements for making forest-based natural climate solutions successful for climate mitigation. Prominent examples of potential pitfalls are provided under each category. Improved evidence and science is urgently needed in all of these categories.

Several key uncertainties and limitations in this work provide crucial avenues for future research to inform NCS policies and efforts. First, this study uses an array of empirical or statistical models, which have strengths in the data required, computational demands, and feasibility, but more mechanistic vegetation model simulations are urgently needed as well. Mechanistic vegetation models have the potential to more directly capture important climate-sensitive disturbances, such as fire and drought, and also incorporate other key ecological dynamics such as effects of forest age and demography, land use legacies and management, and the effects of rising atmospheric CO_2 concentrations, which were not directly considered in this study. Mechanistic vegetation models have limitations and large uncertainties as well, such as structural uncertainty in process representation such as wildfires or drought-induced tree mortality (Hantson et al., 2020; Trugman et al., 2021; Venturas et al., 2021), but combinations of both approaches would more fully capture future risk profiles and the uncertainty around them. There are also common, long-standing uncertainties to both empirical and mechanistic approaches, including tree species' migration rates, future precipitation projections from climate models, role of land management in historical biomass patterns and in mediating future changes. Coffield et al. did include a method to examine migration rates and found large uncertainties across different migration scenarios. The study focuses only on forests and shrublands, as well, and thus does not look at potential changes in carbon storage in grasslands (Dass et al., 2018) or human-dominated landscapes.

Finally, NCS efforts broadly represent a clarion call to Earth Scientists and Ecologists where more research is urgently needed. The fundamental and longstanding questions about carbon balance of ecosystems and future climate impacts have an increasingly urgent policy need and audience. The scientific community and funding agencies can and must provide as much guidance as possible about when and where the climate risks are highest, how land management might influence carbon storage potential and risk patterns, co-benefits and trade-offs to different NCS approaches, environmental justice implications of NCS deployment, and whether and where forest-based NCS efforts are a win for both ecosystems and the climate or a risky gamble that could go up in flames.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

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Review of the San Joaquin Valley Air Pollution Control District Emission Reduction Credit System

June 2020

Enforcement Division
California Air Resources Board

Executive Summary

On January 24th, 2019, the California Air Resources Board (CARB) directed staff to conduct a review of the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) Emission Reduction Credit (ERC) program. This report provides our analysis, results, findings, and recommendations. The goal of this project was to review the SJVAPCD ERC system, including the equivalency determination, and explain it in the context of the broader District program for reducing emissions from stationary sources including New Source Review (NSR), permitting, and regulatory requirements.

CARB staff has shared the findings of its review with the District management and discussed with the District leadership the need to update the Districts ERC program and processes to address the following overarching findings.

- The program needs to be more transparent to the public and industry and more rigorous.
- Implementation procedures and policies need to be upgraded.
- Assumptions in the equivalency demonstration need to be reviewed and revised as needed.

In response to these overarching findings, the District has committed to take the following specific steps.

- Develop a new equivalency tracking database, including associated documentation.
- Conduct a public workshop each year, beginning with the 2020 equivalency demonstration, to present the results of the annual equivalency demonstration prior to taking the report to the District's Governing Board.
- Enhance the annual demonstration report to make the report more understandable beginning with the 2020 equivalency demonstration, including more fully characterizing adjustments made to year-to-year carry-overs to ensure the public can better understand all adjustments effective in a tracking year.
- Convene a public advisory working group consisting of affected stakeholders, including regulated Valley businesses, Valley residents, and federal, state, and local public agencies, to assist in developing solutions related to the District's offset equivalency system, as needed to maintain an effective permitting system that allows for strong economic growth and protection of public health.
- Adjust calculated emission reductions from all affected AG-ICE projects to reflect the appropriate load-factor, and incorporate these adjustments into the 2020 equivalency demonstration. The District will include a discussion of the analysis and adjustments in the 2020 report.

- Analyze the orphan shutdowns projects identified by CARB, and make adjustments, as appropriate, for inclusion in the 2020 equivalency demonstration. The District will include a discussion of the analysis and adjustments in the 2020 report.
- Update the District's policies that pertain to the quantification of emissions reductions from orphan shutdowns, and ensure procedures and associated staff training maintain consistency with District NSR criteria for creditability of emissions reductions.

CARB staff plans to work with the district as it implements the above commitments as well as periodically update its Board on progress.

The SJVAPCD was formed in 1992 by the unification of eight individual county districts. Prior to unification, each county had independent rules and requirements, and made their own permitting decisions. With unification, the District developed a single set of rules and regulations, including those governing its NSR and ERC programs. While new ERCs issued after unification were developed in a consistent manner, older ERCs generated prior to unification needed to be carried over. These ERCs exist today and may be available to offset new emissions. About half of all NOx and VOC ERCs were generated prior to unification.

The District adopted its NSR rule in 1991. The rule established BACT requirements, offset thresholds, and offset requirements that when originally put in place applied to more sources, and applied a much greater level of stringency to those sources than required under federal and state law. The rule also diverged from federal requirements in one important respect: under the District rules, the value of an ERC is calculated when the ERC is issued and retains this value over the life of the ERC. This is referred to as "time of issuance" value, and was supported by CARB at the time.

Federal law requires an ERC to be valued at time-of-use, meaning that if a regulation would have reduced emissions from a source granted an ERC, that ERC must be discounted when used as an offset to reflect emissions after required controls from the regulation. The value of an ERC will always be the same or lower at time-of-use than time of issuance. The federal Clean Air Act allows local NSR programs to differ from federal NSR so long as the local program is at least as stringent as federal NSR. In order to demonstrate that the District's NSR program is at least as stringent as federal NSR, in 1999 U.S. EPA and SJVAPCD entered into an agreement requiring the District to implement an annual federal offset equivalency tracking system. U.S. EPA required this agreement as a condition of approving the District's amended NSR rule for incorporation into the State Implementation Plan.

From the time the tracking system was adopted in August 2001 until present, SJVAPCD has never failed to show equivalency based on its annual demonstration to U.S. EPA. However, in 2010, the San Joaquin Valley's federal non-attainment ozone

classification was bumped up from severe to extreme. As a result, the federal major source and major modification thresholds for ozone precursors dropped to levels that were equivalent to emissions thresholds established in the District's NSR rule. This effectively eliminated the primary advantage SJVAPCD's NSR program had in offset stringency over the federal NSR program for NOx, VOC, and CO. Once the District's offset threshold was no longer lower than the federally required threshold, in most cases more offsets are required for major sources under federal requirements than under District rules.

The current SJVAPCD ERC bank contains nearly 11 million pounds per year of NOx ERCs when valued at time of issuance, more than 80% of which were generated more than 20 years ago. However, over the years, the District's regulatory program has become more stringent, and the District estimated in 2016 that these NOx ERCs, when valued at time-of-use, were worth about 18% of the time of issuance value. This reduction in time of issuance value is directly related to the stringency of the District's regulatory program. In effect, as the District increases the stringency in its regulatory program, it also reduces the time-of-use value in its ERC bank, which makes achieving equivalency more difficult.

To demonstrate equivalency, the District has been increasingly relying on the carry-over of past mitigations and reductions, including past unbanked reductions from orphan shutdowns and electrification projects. These emission reductions are not generated as part of the ERC system, but are used to demonstrate offset equivalency between the District program and federal requirements. Between 2010 and 2018, half of all VOC reductions, and 75% of all NOx reductions included in the District's equivalency demonstrations were provided by orphan shutdowns and electrification projects, with the remaining value provided by ERCs.

CARB's review identifies three areas of findings. First, many of the District's engineering evaluations of ERC and permit applications, and the District's equivalency database system, can both be more transparent, and rigorous. These documents could be improved by including supporting explanation or documentation. Without this information, the public and industry cannot verify or fully review the District's actions. Staff also identified calculation discrepancies in electrification projects and orphan[1] shutdowns used for offset equivalency. These issues could be avoided through stronger review procedures.

Second, the District should make adjustments to how it implements its rule for the timeliness of ERC application submittals, and could be more rigorous in its determination of surplus reductions in individual ERCs. For example, in 15 of the 52 ERC projects reviewed, the District granted ERCs, generated by facility shutdowns, in

[1] Orphan shutdowns are unclaimed emission reductions from a facility surrendering all their operating permits.

which emissions ceased more than 180 days before submission of the ERC application. This is consistent with the District's long-standing policy, CARB staff interpret the District's rule as requiring an ERC application to be submitted within 180 days of the shutdown, and that it defines shutdown as the earlier of the permanent cessation of emissions, or the surrender of the operating permit. In addition, in four of the 52 ERC projects reviewed, CARB determined that it is unclear whether the emission reductions were surplus of every federal, State, or district law, rule, order, permit, or regulation. This benefitted the applicant by providing a greater face value to the ERC. But, as a result, the District had to find additional reductions to cover the non-surplus ERCs.

In the third set of findings, staff identified issues in the District's equivalency demonstration. The District relies on electrification projects, generated through the Agricultural Internal Combustion Engine (AG-ICE) incentive program, to demonstrate NOx equivalency with federal requirements. In calculating and claiming credit for these projects, the District used an incorrect load factor, resulting in an overvaluing of reductions in the equivalency demonstration. While the reductions are real, they were not sufficiently documented to have resulted from a permitting action nor could CARB staff identify documentation showing that they were permanent and enforceable. CARB staff also concluded that potentially half of the credited projects appeared to be funded in part through the Carl Moyer program.

The issues identified in this report are substantial and complex, potentially impacting a wide array of stakeholders in the San Joaquin Valley including residents of the Valley, industries that rely on offsets and ERCs in order to expand or build new business, environmental organizations who advocate for cleaner air, and community groups representing those living near stationary and mobile sources who are impacted the most by emissions at the local level.

The Valley has always faced substantial air quality challenges due to its geography, meteorology, and climate. The SJVAPCD has over 150 rules applicable to specific types of equipment (e.g., turbines, internal combustion engines, boilers), to specific industries (e.g., confined animal facilities, oil production, composting), and to all sources (e.g., nuisance, visible emissions). As technologies have improved, the District has continued to improve the stringency of its regulations. The Valley's stationary source emissions have been reduced because of source-specific regulations and now represent 15% of total NOx emissions in the Valley. Despite these successes, the San Joaquin Valley continues to face major air quality challenges. Air pollution concentrations of ozone and particulate are often above standards, and the District continues to experience some of the worst air quality in the United States. Further improvements in air quality will require both stationary and mobile source emissions to be minimized.

Many of the findings in this report - regarding the issuance of individual ERCs, the time of issuance valuation of ERCs, the use of electrification projects from the AG-ICE program, and others - relate to decisions made decades ago. Since these decisions were made, conditions have changed. Air quality has improved substantially, but ambient air quality standards have increased in stringency. Even though these decisions were made decades ago, they generate implications for air quality today. Consistent with the staff recommendations as well as the District commitments the primary focus of this report is on improvements to the district's ERC program moving forward. This report identifies potential improvements in the District's ERC program, which will help in ensuring an effective permitting program that protects public health and supports economic growth and development, which in turn strengthens the District's overall regulatory program.

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

June 4, 2020

Richard Corey, Executive Officer
California Air Resources Board
P.O. Box 2815
Sacramento, California 95812

Re: California Air Resource Board's Review of San Joaquin Valley Air Pollution Control District Emission Reduction Credit System

Dear Mr. Corey,

The San Joaquin Valley Air Pollution Control District (District) has received the California Air Resources Board's (CARB) report titled *Review of San Joaquin Valley Air Pollution Control District Emission Reduction Credit System.* The District staff would like to thank CARB for the opportunity to review and comment on the recommendations of this review. District staff and CARB have worked cooperatively over the past year-and-a-half during this review to evaluate the District's Emission Reduction Credit (ERC) program and identify opportunities to enhance the District's ERC program moving forward in a manner that will help to ensure an effective permitting program that protects public health and supports economic growth and development in the Valley. Furthermore, the District is committed to working closely and collaboratively with CARB and Valley stakeholders to address the recommendations in the report and implement the District's commitments contained in this letter. Additionally, the District is appreciative of CARB's general recognition of the stringency of the District's air quality control program and of the success in reducing stationary source emissions in the Valley.

Both federal and state law mandate New and Modified Stationary Source Review (NSR) permitting programs that contain offsetting and ERC banking provisions. ERCs are intended by both federal and state law to be only one part of a comprehensive NSR permitting program that has been specifically designed by Congress and the state legislature to allow for industrial growth while tightly regulating any emissions increases. Additionally, any emission increases due to growth are accounted for in State Implementation Plans that demonstrate how the District's overall air quality control program will require sufficient emissions reductions to attain national ambient air quality standards, despite that growth.

While it is mentioned in the report, the District feels that it is important to reiterate that, despite a seemingly common misconception, ERCs cannot be used in lieu of meeting

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other air pollution control requirements, such as through market-based systems that other agencies may have in place. Instead, ERCs are required in addition to, and only after, establishing that the new emissions are controlled with the best available control technology (BACT) and will not cause a health risk to surrounding communities. The San Joaquin Valley's NSR permitting program, including the accompanying ERC program, ensures that new emissions are controlled with the best technologies, prevents the permitting of any operation that will cause a significant health impact, demonstrates on a project-by-project basis and in each attainment plan that attainment is not endangered, and has historically been found by the state and federal governments to comply with state and federal laws governing NSR/ERC programs.

Businesses can only generate ERCs by voluntarily reducing emissions to levels below those required by any rule or regulation, and then applying to the District to have those reductions recognized in the form of an ERC banking certificate. Because the District's air quality regulations are among the most stringent requirements in the nation, it is exceedingly difficult and expensive for businesses to reduce emissions beyond rule requirements to generate ERCs. In fact, as more effective controls are developed, they are generally required through regulatory action by the District, limiting the time that new and innovative techniques can be used to generate ERCs. Reductions beyond the level required by those regulations generally involve innovative or untested control techniques, which entail considerable financial risk to develop and implement. The opportunity to bank ERCs for reductions that result from these types of extraordinary and voluntary efforts, and then to be able to sell them on the open market, encourages innovation in emissions control technologies.

The difficulty in the ability to generate and rely on new ERCs for future permitting projects underscores the challenges faced by businesses, especially in extreme ozone non-attainment areas, which even after installing the best available control technology must still provide ERCs to offset emission increases. Without sufficient ERCs, new and modifying businesses and essential public services including, but not limited to, hospitals, waste-water treatment facilities, and composting facilities may not be able to obtain necessary operating permits to serve Valley communities.

While the District and CARB agree on many of the areas identified in the report and on a general path moving forward, there are areas where the District and CARB have differing opinions, especially as it relates to the interpretation and application of certain provisions of District rules and regulations as they pertain to the ERC program. This is not uncommon in a review of this complexity and scale, and the District does not believe that these points of contention undermine the overall cooperative process and ultimate agreement by CARB and the District on a path to move forward relying on the recommendations of CARB and commitments by the District.

In completing this comprehensive review, CARB reached three overarching findings to which the District will respond in turn. The findings as detailed in the report are as follows:

- *The [ERC] program needs to be more transparent to the public and industry and more rigorous.*
- *Implementation procedures and policies need to be upgraded.*
- *Assumptions in the equivalency demonstration need to be reviewed and revised as needed.*

The program needs to be more transparent to the public and industry and more rigorous

Consistent with the District's core values of continuous improvement and open and transparent public processes, the District respects CARB's recommendations which identify opportunities to enhance transparency as it relates to the District's equivalency database system and specific engineering evaluations of ERC and permit applications. It is important, however, to consider these opportunities in the larger context of the existing transparency measures that the District employs in its permitting program.

For years, the District has provided bilingual notice of all significant proposed permitting projects and ERC transactions on our public website. The complete engineering and compliance evaluations are posted with the associated public notice documentation. Furthermore, any interested parties are provided the opportunity to receive, by email, this same set of documents. They can sign up to receive notices for all projects issued by the District, they can sign up to receive notices for all projects in a specific region of the Valley, or they can sign up to receive all notices associated with an individual facility. Through this process, the public receives direct access to the same exact documents that we send to CARB and EPA for their review. All comments received on the District's preliminary analyses are addressed and responded to in writing before finalizing any ERC issuance or permitting project, and all associated documents, including the District's final analysis and final public notice, are also posted to the District website. Similarly, the District's written analyses and preliminary and final public notices of permitting projects that are required to surrender ERCs to obtain a permit are posted to the District's public website for the same review and comment process.

Specific permitting and ERC projects that have been reviewed contemporaneously by CARB, EPA, and the public without comment on the lack of transparency, are now being highlighted when reviewed under this review. While the District believes that CARB's recommendations highlight opportunities to further enhance transparency, we believe it is important to view the recommendations in a larger context so it is clear they should be interpreted through the lens of continuous improvement.

Regarding the District's equivalency database system and annual offset equivalency report, each year the District makes publicly available the equivalency report and accepts comments on the report and its findings up through the public hearing by the District's Governing Board. Additionally, this report is also sent to U.S. EPA and CARB every year. While we believe that the database and report contain the information necessary to demonstrate that the District's ERC system is equivalent to the federal system, we agree that the database system could benefit from modernization and the annual report could be made more consumable to a reviewer that may not possess a comprehensive understanding of complex NSR and offset equivalency concepts.

Implementation procedures and policies need to be upgraded

As recognized in the report, the rules and regulations that implement NSR and ERC banking programs are very complex and require a deep understanding of policy, regulations, and decisions that have been made at the federal, state, and local level over the past 40 years. As a best practice, the District believes that it is prudent to revisit and update, as necessary, policies and procedures that implement District rules and regulations. In the review, CARB questions the District's interpretation of rule provisions relating to the timeliness of ERC applications and the determination of what are considered surplus emission reductions at the time of ERC banking. While the District recognizes the complexity associated with these issues identified in the review, it is important to note that the District has adopted and follows policies and procedures to ensure consistent, fair, and reasonable application of its rules. Furthermore, the areas in question are local requirements of the District's NSR and ERC banking programs, and are beyond any requirements in state or federal law relating to ERCs.

Assumptions in the equivalency demonstration need to be reviewed and revised as needed

Consistent with the District's offset equivalency agreement with the federal EPA and with the provisions of the District's NSR rule, the District utilizes the surplus value of emission reductions across various categories to demonstrate equivalency with federal offsetting requirements on an annual basis. As detailed in the report, there was an inconsistency in the District's methodology for calculating emission reductions from agricultural engine electrification projects associated with the AG-ICE program relative to the Moyer methodology. The District is committed to adjusting the calculated emission reductions from all affected AG-ICE projects to reflect the appropriate emission reductions, and incorporate these adjustments into the 2020 equivalency demonstration.

Another category of emission reductions used in equivalency are those from unbanked facility shutdowns ("orphan shutdowns"). Each orphan shutdown

presents a unique set of circumstances that determines the amount of credit that can be claimed. CARB's review identified some inconsistency in the crediting of emission reductions from certain orphan shutdown projects. The District is committed to analyzing the orphan shutdowns projects identified by CARB, and making adjustments, as appropriate, for inclusion in the 2020 equivalency demonstration. Furthermore, District staff intends to review and update as necessary the policies that pertain to the quantification of emissions reductions from orphan shutdowns.

In response to CARB's overarching findings, the District is committed to taking the following specific steps to enhance the ERC program as needed to maintain an effective permitting system that allows for strong economic growth and protection of public health:

- Develop a new equivalency tracking database, including associated documentation.
- Conduct a public workshop each year, beginning with the 2020 equivalency demonstration, to present the results of the annual equivalency demonstration prior to taking the report to the District's Governing Board.
- Enhance the annual demonstration report to make the report more understandable beginning with the 2020 equivalency demonstration, including more fully characterizing adjustments made to year-to-year carry-overs to ensure the public can better understand all adjustments effective in a tracking year.
- Convene a public advisory working group consisting of affected stakeholders, including regulated Valley businesses, Valley residents, and federal, state, and local public agencies, to assist in developing solutions related to the District's offset equivalency system, as needed to maintain an effective permitting system that allows for strong economic growth and protection of public health.
- Adjust calculated emission reductions from all affected AG-ICE projects to reflect the appropriate load-factor, and incorporate these adjustments into the 2020 equivalency demonstration. The District will include a discussion of the analysis and adjustments in the 2020 report.
- Analyze the orphan shutdowns projects identified by CARB, and make adjustments, as appropriate, for inclusion in the 2020 equivalency demonstration. The District will include a discussion of the analysis and adjustments in the 2020 report.
- Update the District's policies that pertain to the quantification of emissions reductions from orphan shutdowns, and ensure procedures and associated staff training maintain consistency with District NSR criteria for creditability of emissions reductions.

As I stated earlier, the District staff is committed to working closely with CARB and Valley stakeholders to address the recommendations collaboratively to ensure an ERC program that serves our shared goals of public health protection and economic viability in the Valley. Please contact me if you have any questions or wish to discuss any of our comments. I can be reached at 559-230-6036 or via email at samir.sheikh@valleyair.org.

Sincerely,

Samir Sheikh
Executive Director/APCO

List of Acronyms

AG-ICE – Agricultural Internal Combustion Engine incentive program
AIPE – Adjusted Increase in Permitted Emissions
APCO – Air Pollution Control Officer at an Air District
AQMD – Air Quality Management District
ATC – Authority to Construct
BACT – Best Available Control Technology
CAAQS – California Ambient Air Quality Standards
CARB – California Air Resources Board
CARL – Carl Moyer emissions database
CEMS – Continuous Emissions Monitoring System
CNG – Compressed Natural Gas
CO – Carbon Monoxide
DCF – Discounted Cash Flow
DOQ – District Offset Quantity
EACM – Equivalent Annual Cost Method
ERC – Emission Reduction Credit
FCAA – Federal Clean Air Act
FMM – Federal Major Modification
FOQ – Federal Offset Quantity
GHG – Greenhouse Gas
HAP – Hazardous Air Pollutant
HC – Hydrocarbon
hr – Hour
HSC – California Health and Safety Code
lb – Pounds
MMBTU – Million Metric British Thermal Units
MST – Major Source Threshold
NAAQS – National Ambient Air Quality Standard
NMS – New Major Source
NOx – Nitrogen Oxides
NSR – New Source Review
PAS – San Joaquin Valley's Permit Administration System
PG&E – Pacific Gas and Electric Company

PM10 – Particulate Matter 10 microns in size or smaller
PM2.5 – Particulate Matter 2.5 microns in size or smaller
ppm – Parts per Million
ppmv – Parts per Million by Volume
PTE – Potential to Emit
RACT – Reasonably Available Control Technology
SB 288 – Protect California Air Act of 2003, "NSR anti-backsliding"
SCE – Southern California Edison
SIP – State Implementation Plan
SJVAPCD – San Joaquin Valley Air Pollution Control District
SOx – Sulfur Oxides
t/y – tons per year
U.S. EPA – United States Environmental Protection Agency
VOC – Volatile Organic Compound
yr – Year

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I. Review Process

CARB conducted this review consistent with State law, including as defined in sections 41500 et seq. of the California Health and Safety Code (HSC). State law defines CARB's important role in reviewing district attainment plans, rules, regulations, and enforcement practices. CARB's role includes programmatic reviews, such as this one, and day-to-day review of individual district actions, such as permits for major sources and major modifications, issuance of ERCs, adoption of rules, and granting of variances.

For the past decade, CARB has reduced its focus on air district stationary source permitting programs due to demands associated with developing, implementing, and enforcing an unprecedented number of mobile source related regulations, many of which focus on reducing emission of diesel particulate matter. As we have implemented these regulations we have also sought to analyze and improve them, including programmatic improvements, regulatory updates, and in some cases new laws to support implementation and enforcement. This iterative approach has generated improvements in both the regulations and implementation. CARB staff is taking a similar approach with stationary sources, re-engaging in district permitting programs and working as a constructive partner with the districts and federal government to ensure existing programs are as successful as possible. In doing so, as evidenced in this review, CARB hopes to provide answers to questions posed by stakeholders and provide assurance that District programs are effective and consistent with underlying regulations.

CARB staff has worked extensively with SJVAPCD staff and executive management to conduct this review. Through data and information requests from CARB, the District provided electronic copies of hundreds of documents related to over 50 ERC projects, 30 Authority to Construct permits, and the federal offset equivalency tracking system. The documents include SJVAPCD and Kern County Air Pollution Control District NSR and banking rules, SJVAPCD policies and guidance documents related to ERC banking, ERC applications and supporting documents related to CARB-selected ERC projects, SJVAPCD engineering evaluations supporting the decision to issue the ERC certificates, and SJVAPCD engineering evaluations and supporting documents related to CARB-selected NSR actions. Information related to Kern County APCD was needed because prior to unification of the San Joaquin Valley Air District in 1991, Kern County had an independent permitting program, which banked a large number of ERCs that were moved over to the unified air district upon unification.

In addition, SJVAPCD provided CARB staff with electronic access to the SJVAPCD Permits Administration System (PAS). PAS is a comprehensive database where all permitting and ERC related actions are recorded and related documents are stored. From PAS, CARB staff retrieved hundreds of documents including permit applications,

engineering evaluations, ERC transaction histories, emission inventories, source test records, and inspection reports related to the original ERC projects under review.

SJVAPCD also provided CARB staff with access to the federal offset equivalency tracking system at District offices. SJVAPCD shared information about the tracking system, access to database files, and tracking system output.

1. *Public Participation*

In November 2018, Earthworks released the report that helped initiate this review -- *Undeserved Credit: Why emissions banking in California's San Joaquin Valley puts air quality at risk*. The Earthworks report made the following findings and conclusions, among others: "a significant proportion of ERCs in the San Joaquin Valley Air Pollution Control District's bank appear to be invalid"; "CARB should audit the San Joaquin Valley Air District ERC system"; "equivalency should be questioned"; and "CARB should not allow ERCs to last forever."

Further, in a January 9, 2019 letter to Mary Nichols, Chairman of the Board, and in testimony at the January 24, 2019 Board Meeting, a coalition of environmental and health advocacy groups representing the Southern San Joaquin Valley requested that CARB "…conduct a thorough review of the Emission Reduction Credit (ERC) banks administered by the San Joaquin Valley Air Pollution Control District…."

CARB staff has considered input from these and other stakeholders in planning and executing this review. CARB staff has also taken steps to ensure this review is an open, public process. Staff held three workshops: in April and September 2019, and in June 2020. During these workshops, staff presented material and solicited comments. These workshops were hosted at the Bakersfield District office, which was linked to the Fresno and Modesto offices by the District's video teleconference system. The workshops were also webcast through CARB's web site, and translation services were made available at all three District office locations.

CARB staff has also had numerous in person meetings and conference calls with stakeholders regarding this project. Staff maintains a website[2] specifically for this project and an email address (valleyERCs@arb.ca.gov) for project questions. The website includes posting of documents related to the current ERC review, past CARB reviews of the District ERC banking program, and ERC banking in general.

2. *Public Stakeholder Concerns*

Stakeholders have identified a number of issues of potential relevance to CARB's review, including the following concerns:

[2]San Joaquin Valley Emission Reduction Credit Program Review, https://ww2.arb.ca.gov/our-work/programs/san-joaquin-valley-emission-reduction-credit-program-review.

- Validity of Older ERCs

Stakeholders have questioned whether certain ERCs were banked in conformance with legal requirements. Some stakeholders believe that the use of older, improperly issued ERCs could result in a large amount of new emissions in the Valley, which could impact local air quality and regional attainment demonstrations. Other stakeholders are concerned the ERCs they hold may be devalued.

- Impacts on Equivalency

Stakeholders have expressed concerns regarding the District's ability to continually identify additional offsets beyond ERCs to account for the difference between time of issuance valuation (as under the District's NSR program) and time-of-use valuation (as under federal NSR) in order to demonstrate equivalency with the federal program. Additional offsets are needed to demonstrate equivalency because the vast majority of ERCs currently in the bank in the San Joaquin Valley appear to have relatively little value at time-of-use. Many times, the value of an ERC has degraded by the time it is used due to more stringent regulations that are adopted or proposed between the time of issuance and time-of-use.

Stakeholders have expressed concern that the use of a large number of older ERCs could result in a failure to demonstrate federal equivalency. At the same time, some stakeholders believe that the use of a large number of older ERCs could result in a large amount of new emissions in the Valley, which could impact local air quality and regional attainment demonstrations.

- No Net-Increase

Under the District program, offsets are required above certain thresholds, but not below those thresholds. Stakeholders have asked whether this maintains the general goal of no-net-increase in emissions from stationary sources.

- Local Air Quality

Under State and federal law, ERCs are a tradeable commodity, and as such allow emissions to increase at one location while decreasing at another location. Some stakeholders have questioned whether emissions trading is appropriate. Further, while districts have rule provisions intended to protect the public from local increases of criteria pollutant and toxics emissions; such as emissions modeling, health risk assessments, and application of BACT; some stakeholders have questioned the effectiveness of these approaches.

- Transparency

NSR programs are quite complicated. While public documents regarding the SJVAPCD NSR program are available upon request, stakeholders have expressed difficulty in accessing relevant information necessary to understand the program. Stakeholders have expressed difficulty in understanding how to formulate and submit

requests for information to meet the District's requirements. This difficulty may be a result of stakeholders not knowing exactly how to specifically identify or describe the information they need to understand the program, or not being able to ascertain the connections and relevance of the provided information in the larger context of the District's NSR program. There appears to be a desire for stakeholders to understand how permitting and NSR works, and the District has indicated it is willing to offer training to stakeholders upon request.

3. Industry Stakeholder Concerns

- Availability of ERCs and Economic Growth

Some stakeholders expressed concern over possible "invalidation" of some ERCs, which could have an effect on ERC availability and pricing. Because ERCs are the currency of offsets, and offsets are often needed in order to modify or build a new emissions source, ERCs are critical to on-going economic development in the San Joaquin Valley.

Additionally, stakeholders have expressed concern with the permitting impacts associated with a failure to demonstrate equivalency. More specifically, concerns have been expressed regarding the unavailability of surplus at time-of-use ERCs required under permitting actions for federal new major sources and major modifications, particularly given the low major source thresholds in the San Joaquin Valley and large number of major sources across all sectors.

II. Part 1: Explaining the Emission Reduction Credit System

A. Overview of Emission Reduction Credits

The federal Clean Air Act establishes requirements for the permitting of stationary sources. Generally, states have the direct responsibility to meet requirements of the federal Clean Air Act and corresponding federal regulations with respect to permitting. California law, however, allows for delegation of permitting activities to the local and regional air districts. All thirty-five California air districts have taken advantage of the opportunity to implement their own permitting program for stationary sources. In California, maintaining a structure of air districts performing permitting with CARB review has been largely successful. Individual air districts are generally well suited to maintain localized regulations, which has led to improved air quality across the State. CARB has central oversight authority to monitor the performance of district programs and to conduct district functions if the district fails to meet certain responsibilities.

In accordance with the federal Clean Air Act, U.S. EPA sets ambient air quality standards for criteria pollutants. A geographic area that does not meet these standards is called a non-attainment area. The San Joaquin Valley is classified as extreme non-attainment for 8-hour ozone and serious non-attainment for PM2.5. Non-attainment areas must develop State Implementation Plans (SIPs) that either include, or commit to adopt, emission control measures to attain and maintain ambient air quality standards. The local air districts develop and implement portions of the SIP that cover stationary sources through rulemaking, permitting, and enforcement.

Generally, any stationary source that emits or has the potential to emit air pollution is subject to local air district permitting requirements. New or modified sources of air pollution must obtain approval from the local air district in the form of an Authority-to-Construct (ATC) permit. Most ATC permit applications are subject to NSR, and in California NSR is implemented at the district level. The federal Clean Air Act, implementing regulations, and State law establish the minimum requirements for non-attainment NSR permitting programs. U.S. EPA allows implementing authorities to tailor their NSR requirements to address local air quality conditions, provided the local NSR program is at least as stringent as federal standards. Generally speaking, NSR programs require sources exceeding a defined emissions threshold to install best available control technology (BACT) and to offset emission increases which occur after the installation of BACT with emissions reductions. These requirements for mitigating emissions reductions are generally referred to as offsets. NSR programs generally require offsets so that there is no net increase in emissions, on a regional basis, of nonattainment pollutants and their precursors.

NSR rules require either past or contemporaneous emission reductions to be used to counter-balance newly permitted emission increases. Emission reductions above and beyond what is required by rules and regulations, and not immediately used to counter balance new emission increases, can be stored in the form of ERCs. ERCs are the currency of offsets, and are a way of "banking" emission reductions for future use, either at the site they were generated or elsewhere within the air basin (or, in limited circumstances, in a downwind air basin).

Due to the emission-offsetting requirement of NSR, both the federal Clean Air Act and State law require non-attainment areas to have an ERC banking system. To qualify for banking as an ERC, an emission reduction must meet the following criteria:

- Real – the reduction must be in actual emissions not potential, allowed or permitted emissions.
- Quantifiable – the reduction must be calculable based on actual verifiable operational data and the best available emission factors and source test data.
- Surplus – the reduction must go beyond what is required by law, regulation, or SIP commitment at the time the ERC was originally banked.
- Permanent and Enforceable – the reduction must be legally and practically enforceable and permanent through permit conditions and limits, or surrender of the operating permit.

These ERC criteria help ensure the integrity of an ERC program. These criteria are also universal to programs across the United States, and provide the framework CARB staff used in the review of SJVAPCD ERC projects and the equivalency demonstration.

B. Demonstrating Equivalency

The offsetting requirements of the District's NSR rule are different from the offsetting requirements under federal NSR. For example, federal NSR requires offsets from major sources but not from minor sources, whereas the District's NSR rule requires offsets from both major and minor sources if the emissions are calculated to exceed specified offset thresholds. The federal Clean Air Act allows local NSR programs to differ from federal NSR so long as the local program is at least as stringent as federal NSR.

An important caveat to bear in mind when interpreting District and federal offset thresholds is that the District and federal calculation methods that determine "when" offsets are required and "how much" offsets are required are different, especially for modified sources. Thus, even where the pollutant thresholds are the same, the same project will produce different offset quantities for the same pollutant when evaluated under District versus federal NSR.

Other differences exist, which, depending on the facts of a given ATC project, may make either federal NSR or SJVAPCD NSR more stringent regarding offset requirements for a particular project (though the local NSR *program* must remain more stringent overall). Among the most significant difference in offsetting requirements is when the "surplus" value of an ERC is determined. SJVACPD values ERCs at the "time of issuance" whereas federal NSR values ERCs at the "time-of-use."

Specifically, under the SJVAPCD NSR rule, the value of an ERC is calculated when the ERC is issued, and the ERC retains that value throughout its life until it is used. In contrast, under the federal NSR rules, the value of an ERC is calculated first when it is created, and again when it is used. In a 1993 memorandum, entitled "Use of Shutdown Credits for Offsets," U.S. EPA stated that this approach is designed to avoid double counting emission reductions in a SIP. Under the federal approach, each ERC must be re-evaluated based on the rules, regulations, and SIP commitments that apply at the time-of-use. Because many years often elapse between when an ERC is created and when it is used, the adoption of progressively stricter emissions standards can cause the surplus value of an ERC to drop significantly.

For example, if a boiler in compliance with all applicable requirements has actual NOx emissions of 30 ppmv and 1.0 ton per year and ceases operation permanently, the operator could apply to bank the resulting NOx emission reductions as an ERC. Following receipt of an application, the air district verifies the reductions are timely, real, surplus, enforceable, permanent, and quantifiable and issues the operator an ERC with a time of issuance or face value of 1.0 tons per year NOx.[3] Suppose 10 years later the owner of this ERC wishes to use it to offset a new permitted emission increase of NOx, and, in the intervening 10 years, the air district has amended its boiler rule to require a NOx standard of 15 ppmv. Under a surplus-at-time-of-use offset system, the portion of the ERC representing a reduction in NOx from 30 to 15 ppmv is no longer surplus, which leaves the portion from 15 to 0 ppmv as the surplus-at-time-of-use value. Thus, the offset value of the ERC is reduced to 0.5 tons per year NOx[4] because half of the NOx emission reductions represented by the ERC are required by the amended boiler rule. However, under a surplus-at-time-of-issuance offset system, the ERC holds it value of 1.0 tons per year in perpetuity even if new rules are subsequently adopted that require stricter emission standards.

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[3] SJVAPCD would deduct 10% for an air quality improvement deduction (AQID); however, the AQID is omitted in this example for demonstration purposes.

[4] Discount Percentage = [(EF1 – Rule EF) ÷ (EF1 – EF2)] = [(30 – 15) ÷ (15 – 0)] = 0.50
ERC Surplus Value = (Current ERC Value) x (1 – Discount Percentage) = 1 tons per year x (1.0 – 0.50) = 0.5 tons per year
Where: EF1 = Pre-project emission factor used to calculate AER from the original banking action
EF2 = Post project emission factor used to calculate AER from the original banking action
EF Rule = Current emission factor required by a rule or regulation
Source: SJVAPCD Draft Staff Report Annual Offset Equivalency Demonstration (April 19, 2016).

Due to the differences between the federal and District NSR programs, in 1999 U.S. EPA and SJVAPCD entered into an agreement requiring SJVAPCD to implement an annual federal offset equivalency tracking system. U.S. EPA required this agreement as a condition of approving SJVAPCD's amended NSR rule for incorporation into the SIP. The purpose of the equivalency tracking system is to show, on a program-wide basis, that SJVAPCD's NSR rule requires an equal or greater amount of offsets than would be required under the terms of federal NSR. Equivalency is tracked on a pollutant-by-pollutant basis for each of the District's non-attainment pollutants. The District issues an annual offset equivalency report to U.S. EPA. The report is based on the outputs from the District's internal equivalency system.

From the time the tracking system was adopted in August 2001 until present, SJVAPCD has never failed to show equivalency in its annual demonstration report submitted to U.S. EPA. As a result, SJVAPCD has been able to maintain its offsetting system instead of adopting federal offset requirements for new major sources (NMS) and federal major modifications (FMM) to existing major sources. If SJVAPCD were to fail to show equivalency, they would be required, by their existing NSR rule and the agreement with U.S. EPA, to follow federal offsetting standards, including valuing ERCs at time-of-use rather than at time-of-issuance.

C. Role of ERCs under the Federal Clean Air Act

The federal Clean Air Act (FCAA) forms the basis for the national air pollution control effort, including among other elements, national ambient air quality standards for major air pollutants, hazardous air pollutants standards, state attainment plans, stationary source emissions standards and permits, and enforcement provisions. Both the federal government (under the FCAA) and California (under the California Clean Air Act) set air quality standards for clean air. An air quality standard defines the maximum amount of a pollutant averaged over a specified period of time that can be present in outdoor air without harming public health.

The FCAA requires U.S. EPA to set primary National Ambient Air Quality Standards (NAAQS) to protect public health, and secondary NAAQS to protect plants, forests, crops, and materials from damage due to exposure to six air pollutants that are harmful to public health and to the environment. These pollutants include particulate matter (PM 10 and PM 2.5), ozone (O3), nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and lead (Pb).

Federal law requires that all states attain the NAAQS. Geographic areas within each state that do not meet a standard are called non-attainment for that air pollutant. The designation of an area as non-attainment is also important because it triggers the regulatory requirements for banking and use of emission reductions credits. The San Joaquin Valley is one of the non-attainment areas in the State. U.S. EPA classified the San Joaquin Valley as extreme non-attainment for ozone and serious non-attainment

for PM2.5. Non-attainment areas must develop plans, called State Implementation Plans (SIPs), to attain the NAAQS. SIPs are comprehensive plans that describe how an area will attain, or maintain, NAAQS.

The SIPs' main purposes are to demonstrate that the State has the basic air quality management program components in place to implement a new or revised NAAQS, to identify the emissions control requirements the State will rely upon to attain and/or maintain the primary and secondary NAAQS, to prevent air quality deterioration for areas that are in attainment with the NAAQS, and to reduce criteria pollutants emitted in nonattainment areas.

The FCAA Amendments of 1970 also authorize California to set its own separate and stricter-than-federal emissions standards to address California's extraordinary circumstances of population, climate, and topography that pose serious air quality challenges. CARB focuses on California's unique air quality challenges by setting the State's own stricter emissions standards for a range of statewide pollution sources including vehicles, fuels, and consumer products.

The FCAA sets deadlines for attainment based on the severity of an area's air pollution problem. Failure of a state to reach attainment of the NAAQS by the target date can trigger a change in attainment status, new planning, and possibly penalties, including withholding of federal highway funds.

State law makes CARB the lead agency for all purposes related to the California SIP. CARB and local air pollution control districts work together in developing clean air plans to demonstrate how and when California will attain, or maintain, air quality standards established under both the FCAA and the California Clean Air Act. Local air pollution control districts, such as the SJVAPCD, develop plans that describe how the districts will reduce emissions to meet air quality standards by the deadlines, and implement control measures in their areas. These controls primarily affect stationary sources, such as manufacturing and goods processing facilities.

As part of the control strategy at the local level, districts regulate stationary emission sources by adopting control strategies such as district permitting rules and prohibitory rules (prohibitory rules are rules that apply to specific types of equipment or industries). The rules achieve emissions reductions by setting limits and by requiring controls, certifications, or work practices that minimize emissions. Many of these rules have been made stricter over time. The permitting process is the vehicle by which the District implements and enforces rule requirements. An operating permit contains clear, enforceable conditions that spell out each of the rule requirements, and includes associated recordkeeping, monitoring, or testing requirements to ensure that it can be demonstrated that the conditions are being adhered to.

D. Permitting – Federal Requirements

There are two layers of permitting for major sources: 1) federal process and standards; and 2) district process and standards. In many cases, the district will perform both reviews if the district has a SIP-approved program or is delegated authority to implement the federal permitting program. If a district is not delegated such authority, then U.S. EPA will perform the federal permitting and the district will perform its own permitting. Many of the terms used in both federal and local permitting are the same or similar, however some are different, so it is important to distinguish between them.

Major sources of emissions are subject to Title V (of the FCAA), which establishes a federal operating permit program designed to standardize air quality permits and the permitting process for major sources of emissions across the country. Title V only applies to "major sources." U.S. EPA defines a major source as a facility that emits, or has the potential to emit (PTE) any criteria pollutant or hazardous air pollutant (HAP) at levels equal to or greater than federal Major Source Thresholds (MST). The MST for criteria pollutants varies depending on the pollutant and attainment status (e.g., marginal or moderate, serious, severe, and extreme) of the geographic area in which the facility is located.

The FCAA[5] requires NMSs and FMMs to existing major sources of criteria pollutants to undergo a preconstruction review and permitting process conforming to federal law and regulations. In nonattainment areas, the process is called federal "non-attainment new source review" ("NNSR" or simply "NSR"). Existing "major sources" must comply with certain minimum emission reduction requirements and obtain a Title V operating permit. Federal new source review and District new source review differ in several ways, as discussed further below.

E. Permitting – Local Requirements

Air districts issue permits and monitor new and modified sources of air pollutants in accordance with national, State, and local emission standards. A primary purpose of permitting is to ensure that emissions from such sources will not interfere with the attainment and maintenance of ambient air quality standards adopted by CARB and U.S. EPA. Permit requirements apply to individual processes and devices at major sources and to individual processes and devices at facilities that fall below major source thresholds. Local air district permitting activity falls into two broad categories. The districts must approve any new or modified source that has the potential to emit air pollution before it is constructed. This is called an ATC permit for the source. Most ATC permit approvals are subject to NSR. Once a district inspects a source and

[5] CAA 172(c)(5).

finds that the source complies with its ATC permit, the district will issue a permit to operate (PTO). The operating permits of major facilities must include federal Title V requirements in addition to local district requirements.

F. New Source Review

New Source Review (NSR) is the title applied to programs regulating the new construction of, and/or modifications to, industrial sources, that have the potential to emit, or will emit, air pollutants. NSR programs establish standards for the construction of new stationary sources and the modification of existing stationary sources such as power plants, refineries, and incinerators. State and federal law mandate requirements for NSR, including offset requirements for new and expanding stationary sources. There are two types of NSR in California: federal and local.

The requirements of NSR must be met before a district will issue an ATC. The minimum requirements of NSR are specified in federal and State laws, but in California NSR is implemented at the local level. The local air districts incorporate the applicable state and federal requirements in their own local NSR rule(s). In addition, the districts may include more stringent requirements in their NSR rule(s). Emissions offsetting and ERCs are required components of NSR in non-attainment areas, such as the San Joaquin Valley.

The California Clean Air Act sets basic requirements for NSR programs in the State. Specific to NSR, each district is to include in its attainment plan, a stationary source control program designed to achieve no net increase in emissions of nonattainment pollutants or their precursors for all new or modified sources that exceed particular emission thresholds.[6]

Each of the 35 districts in California has its own NSR program and issues its own ATCs and PTOs. Each district has adopted its own NSR rules and regulations to comply with state and federal laws. These regulations usually incorporate both the California and federal regulations into one or more rules. Two of the key components of NSR in each of the districts are Best Available Control Technology (BACT) and offsets.

1. Best Available Control Technology

Depending on the type and quantity of emissions of air pollutants that will be emitted from the source and the area designation for that pollutant, the new or modified source may be required to install BACT. In general terms, BACT means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation, emitted from, or which results from any major emitting facility. The SJVAPCD defines BACT as follows:

[6] HSC 40918 – 40920.5.

> [T]he most stringent emission limitation or control technique of the following:
>
> Achieved in practice for such category and class of source;
>
> Contained in any State Implementation Plan approved by the Environmental Protection Agency for such category and class of source. A specific limitation or control technique shall not apply if the owner of the proposed emissions unit demonstrates to the satisfaction of the APCO that such a limitation or control technique is not presently achievable; or
>
> Contained in an applicable federal New Source Performance Standard; or
>
> Any other emission limitation or control technique, including process and equipment changes of basic or control equipment, found by the APCO to be cost effective and technologically feasible for such class or category of sources or for a specific source.

At a minimum, a specific limitation or control technique must be proposed as BACT if it has been achieved in practice on the same type of equipment, anywhere. Even more stringent emission limitation or control techniques are required, including alternative basic equipment or process or changes of control equipment, if found by the APCO to be technologically feasible for such class or category of sources or for a specific source, and cost effective, even if such a control has never been achieved before.

2. *Offsets*

The California and federal Clean Air Acts each require offsets as an element of air quality attainment plans. State law specifies that each non-attainment area's attainment plan contain a stationary source control program designed to achieve no net increase in emissions of non-attainment pollutants from all new or modified stationary sources. Under California law, a new or modified facility at, or above, a certain threshold must mitigate all emission increases so that the result is no net increase in emissions.

Therefore, new and/or modified sources in California may be required, depending on the type and quantity of pollutants emitted, to mitigate or "offset" the increases in emissions that result from the project, even after installation of BACT. The concept behind offsets is that new and expanding stationary sources of air pollution mitigate, or "offset," new emissions with reductions in air pollution at existing sources. The system is designed to accommodate new emissions so that industrial growth can continue in areas not meeting NAAQS (or CAAQS) while not undermining progress toward achieving clean air mandates.

An offset threshold refers to the level of emissions from a new or modified stationary source above which the source is required to provide offsets to mitigate a new emissions increase. Offset requirements are triggered on a pollutant-by-pollutant basis. For example if the offset threshold for VOC in a given district is 10 tons per year, and a new or modified source is projected to emit 8 tons per year, then the source would not be required to provide offsets to mitigate the 8 ton emission increase. However, if the source is projected to emit 12 tons of VOC, then the source would be required to provide offsets.

Once offsets are triggered, a source must provide ERCs to offset either all or a portion of the permitted emissions. Each district's NSR program differs in whether a source must offset the entire permitted amount of emissions, or only down to the offset threshold. Meaning, in the case described above, where the source is permitted to emit 12 tons of VOC, some districts require the source to offset 12 tons of VOC, where others only require the source to offset 2 tons of VOC down to the 10 ton offset threshold. SJVAPCD requires offsetting down to the offset threshold.

G. The San Joaquin Valley Air Pollution Control District ERC System

This section provides an overview of how the SJVAPCD implements the ERC element of its NSR program.

The history of the SJVAPCD is important for understanding the current ERC program. The SJVAPCD was formed in 1992 by the unification of eight individual county districts. Prior to unification of the District, the eight counties each had independent air quality management programs. Each county had its own set of rules and requirements and thus each county made its own permitting decisions. While each county was subject to essentially the same State and federal requirements pertaining to air quality, there were differences in the way counties made permitting and ERC approval decisions.

The unification of these county programs through the formation of the SJVAPCD created a consistent air quality program Valley-wide. Prior to unification, some counties, such as Kern, had fully developed rules for granting ERCs while other counties had more informal procedures for recognizing ERCs. While permits issued under the new unified District were consistent, it was recognized that the ERCs generated by the individual counties before unification needed to be carried over to the unified District. The SJVAPCD NSR and ERC rules facilitated this by creating procedures and timelines for recognizing and carrying over ERCs created in the individual counties. Thus old ERCs generated by county air districts prior to unification became unified District recognized ERCs. These ERCs still exist today, comprise roughly half of available NOx and VOC ERCs, and may be available to offset new emissions.

Following unification, the District established its own requirements for ERC banking, as further detailed below.

1. The SJVAPCD New Source Review Program

The SJVAPCD operates its NSR program to meet federal and State legal requirements. Elements of the program have been approved by CARB and U.S. EPA through the SIP approval process.

Rule 2201 is the District's NSR rule. First adopted in 1991, the District has updated and amended the rule sixteen times, most recently in August 2019. The rule establishes BACT requirements, offset thresholds, and offset requirements. Key elements of the rule include:

- BACT Requirements

BACT requirements are triggered on a pollutant-by-pollutant basis and on an emissions unit-by-emissions unit basis. Under Rule 2201, a BACT analysis is required (unless exempted) on (a) any new emissions unit or relocation from one Stationary Source to another of an existing emissions unit with a Potential to Emit exceeding 2.0 pounds in any one day; (b) modifications to an existing emissions unit with a valid Permit to Operate resulting in an Adjusted Increase in Permitted Emissions (AIPE) exceeding 2.0 pounds in any one day; and (c) any new or modified emissions unit, in a stationary source project, which results in an SB 288 Major Modification[7] or a FMM.

- Emissions Offset Threshold

Offset requirements are triggered on a pollutant-by-pollutant basis. Unless exempted, offsets are required if the post-project Stationary Source Potential to Emit (SSPE2) equals or exceeds the following offset threshold levels: VOC and NOx – 20,000 pounds per year; CO – 200,000 pounds per year; SOx – 54,750 pounds per year; PM10 – 29,200 pounds per year. SJVAPCD requires offsets down to the offset threshold.

- Offset Ratios

Rule 2201 establishes distance offsets designed to require additional offsets where the original location of emissions offsets is 15 miles or more away from the source under review. For NMSs and FMMs involving VOC or NOx, and for sources more than 15 miles away from the offset source, the ratio is 1.5. This means that every 1 pound of emissions increase must be offset by 1.5 pounds of emission decrease.

[7] The SB 288 Major Modification calculation procedure is included in Rule 2201 to comply with the requirements of California SB288 which prohibited air district's from relaxing requirements for Federal new source review (as they existed on 12/19/02) as a result of Federal NSR reform.

- Air Quality Improvement Deduction Requirements

New ERCs are discounted by 10% prior to banking, which is called an air quality improvement deduction. For example, if an emission reduction of 10 TPY qualifies for ERCs, then a certificate would be issued to the applicant for 9 TPY, and 1 TPY would be permanently retired by the District. This requirement is designed to help ensure that the implementation of the ERC program results in an overall air quality benefit within the boundaries of the air district.

- Calculation Requirements

Rule 2201 defines calculation methods for applying the NSR rule, including for baseline periods, daily emissions limits, historical actual emissions, and potential to emit. These definitions and requirements apply to both permit engineering review calculations, and to the equivalency demonstration. There are several important calculation differences between the SJVAPCD's rule and the federal program.

The most important distinction for purposes of this review concerns whether ERCs are discounted when they are used. Under federal NSR rules, the value of an ERC is discounted at the time-of-use. Under this approach, each ERC must be re-evaluated based on the rules, regulations, and SIP commitments that apply at the time-of-use. Because many years often elapse between when an ERC is created and when it is used, the adoption of progressively stricter emissions standards can cause the surplus value of an ERC to drop significantly.

Under the SJVAPCD rules, the value of an ERC is calculated when the ERC is issued, and the ERC retains this value for the life of the ERC. This is referred to as "time-of-issuance" value. This means the District grants ERCs based on the "surplus" (in excess of any rules, requirements or plans on the books) value at the time of banking. If at some point in the future a rule is adopted that would have reduced emissions from the banked source, the rule has no effect on the ERC. CARB supported this approach at the time it was originally adopted. In a 1993 letter to U.S. EPA, CARB expressed its view that this approach created incentives for companies to produce and use ERCs, "no company exercising good business judgment would ever purchase ERCs which could become worthless within an unforeseeable future time. This would also tend to discourage modernization, since a valuable ERC would be rendered useless on the open market."

A second calculation difference between SJVAPCD NSR and federal NSR is how an emissions increase is calculated to determine the offset quantity for FMMs. For modified sources that qualify as "clean emissions units,"[8] the emissions increase under SJVAPCD NSR is calculated as the difference between the pre-project PTE and the post-project PTE, i.e. a potential-to-potential basis (for all sources). In contrast, under

[8] Clean emissions units are emissions units equipped with emissions controls 95% efficient or meeting achieved-in-practice Best Available Control Technology requirements in the previous 5 years.

federal NSR (for new major sources and federal major modifications), the emission increase is calculated as the difference between the pre-project actual emissions and the post-project PTE, i.e. an actual-to-potential basis. An actual-to-potential basis (as under federal NSR) will always produce an emissions increase that is equal to or greater than an emission increase determined on a potential-to-potential basis (as under SJVAPCD NSR). Thus, the actual-to-potential calculation is more stringent. Districts differ in terms of the emissions increase calculation for their particular NSR rule. Some, including SJVAPCD, use a potential to potential calculation, while others use an actual to potential calculation, which results in a larger number of offsets required.

Due to the differences between the federal and District NSR programs, in 1999 U.S. EPA and SJVAPCD entered into an agreement requiring SJVAPCD to implement an annual federal offset equivalency tracking system. U.S. EPA required this agreement as a condition of approving SJVAPCD's amended NSR rule for incorporation into the SIP. The purpose of the tracking system is to show, on a program-wide basis, that SJVAPCD's NSR rule requires an equal or greater amount of offsets than would be required under the terms of federal NSR. This is the "equivalency determination" that a major section of this review discusses below.

The District's NSR Rule contains language that describes how the district would modify its program if it were to fail to show equivalency. From the time the tracking system was adopted in August 2001 until present, SJVAPCD has never failed to show equivalency based on its annual demonstration to U.S. EPA. As a result, SJVAPCD has been able to maintain its offsetting system instead of adopting federal offset requirements for NMSs and FMMs to existing major sources. If SJVAPCD were to fail to show equivalency, they would be required, by their existing NSR rule and the agreement with U.S. EPA, to follow federal offsetting standards.

2. The SJVAPCD ERC Bank

The District publishes on its website[9] a daily summary of the available (or currently valid) ERCs. Table 1 provides an example of the daily summary from August 1, 2019. The summary reports the ERCs by the region in which the ERCs were banked, however an ERC from one region may be used (retired) to mitigate emission increases in any other region. In 2016, the District estimated[10] that approximately 18% of its NOx ERCs were surplus as of that the time, if evaluated and discounted under a "surplus-at-time-of use" assumption.

[9] http://www.valleyair.org/busind/pto/erc.htm

[10] http://www.valleyair.org/Workshops/postings/2016/05-11-16_OEI/DRAFT-Staff-Report.pdf

Table 1. Available Annual ERCs in the San Joaquin Valley by Region (August 2019)

Pollutant (lbs/yr)	Northern Region	Central Region	Southern Region	Total District
VOC	748,373	589,690	8,847,980	10,186,043
NOx	2,005,863	740,185	8,242,410	10,988,458
CO	1,691,911	1,011,453	51,328,838	54,032,202
PM10	739,839	980,277	962,531	2,681,897
SOx	1,654,602	664,580	3,914,109	6,233,291
Acetone	71,826	2,695	None	74,521
Ethane	None	14,134	1,879,617	1,893,751
Hydrogen Sulfide	None	107	45,005	45,112
PM2.5	None	None	3,218	3,218
Sulfate Particulate	None	None	191,193	191,193
-	-	-	-	-
CO2E (MMT/yr)	2,444	259,575	636,315	636,315

Figures 1 and 2 below show the percentage of available VOC and NOx ERCs in the bank according to the age (grouped by decade) of the emission reductions that created them. The charts show that the majority of VOC (89%) and NOx (85%) ERCs remaining in the bank unused are based on emission reductions that occurred more than 20 years ago.[11]

[11] Note that the ERC totals (lb/yr) for VOC and NOx in the charts below will not equal the VOC and NOx totals in Table 1 above because the charts only represent banking actions through 2018, whereas Table 1 is current as of August 1, 2019.

Figure 1. Age of VOC ERCs Available in the SJVAPCD Bank

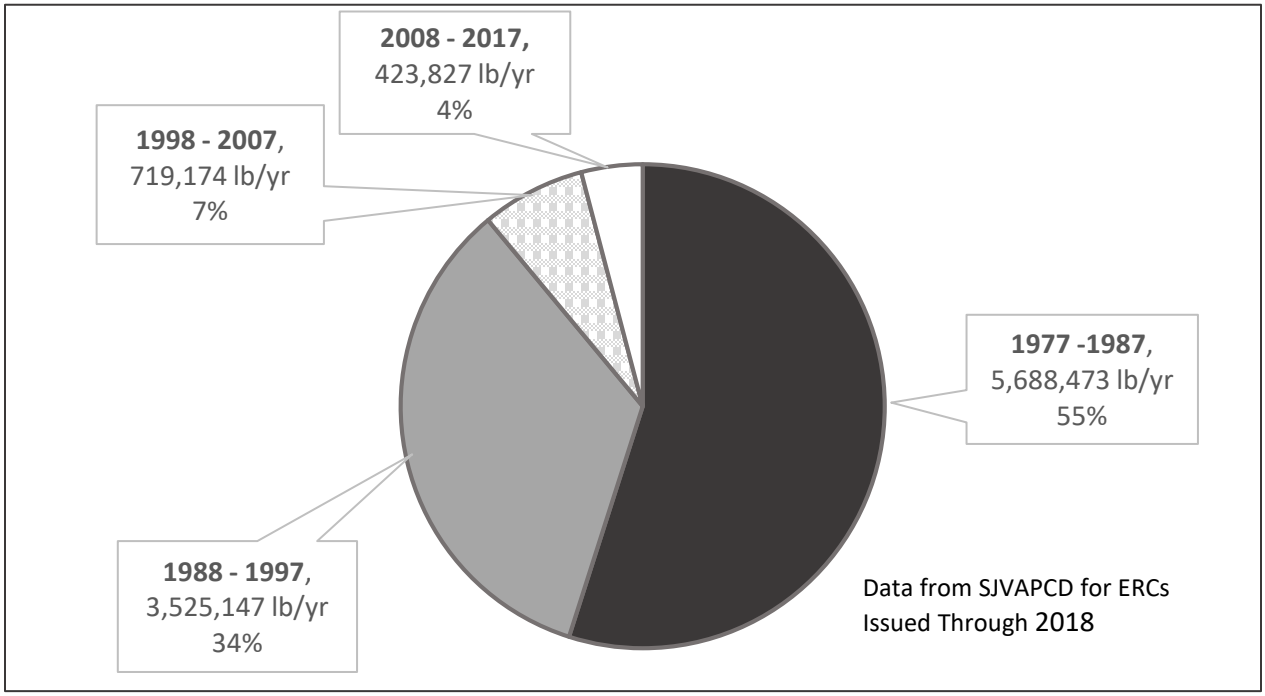
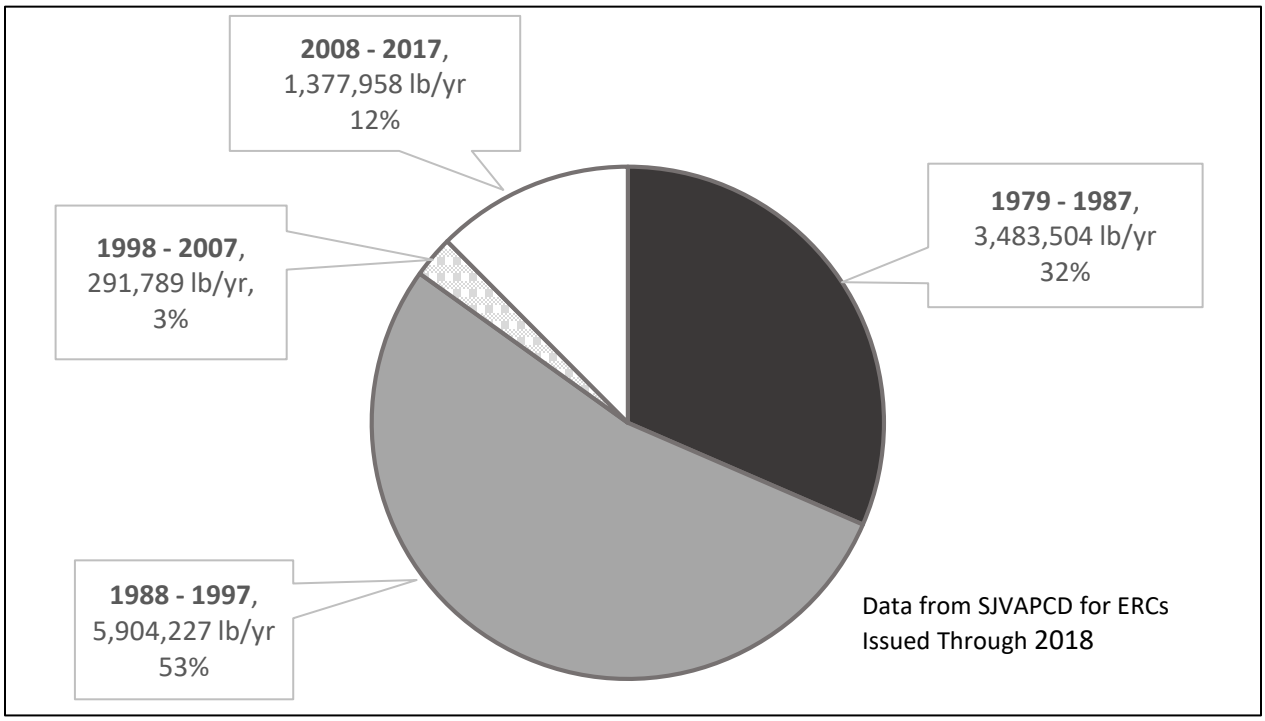


Figure 2. Age of NOx ERCs Available in the SJVAPCD Bank



3. Demonstrating Equivalency

When originally established, the District's NSR program required more offsets than the federal NSR program, primarily because District emissions offset thresholds and offset ratios were more stringent compared to federal NSR. However, in 2010, the San Joaquin Valley's federal non-attainment ozone classification was bumped up from severe to extreme. As a result, the federal major source and major modification thresholds for ozone precursors dropped to levels that eliminated the primary advantage SJVAPCD's NSR program had in offset stringency over the federal NSR program for NOx, VOC, and CO.

Since the reclassification to extreme non-attainment for ozone in 2010, SJVAPCD's tracking system frequently relies on the carry-over of past mitigations and reductions. To demonstrate equivalency for NOx and VOC the District has relied heavily on past, unbanked reductions from orphan shutdowns and electrification projects (i.e., reductions not used for ATC projects). For example, between 2010 and 2018, half of all VOC reductions, and 75% of all NOx reductions included in the District's equivalency demonstrations were provided by orphan shutdowns and electrification projects, with the remaining value provided by ERCs.

Figures 3 and 4 below display the emissions reductions claimed by source type by the District to demonstrate federal offset equivalency between 2010 and 2018. For NOx, electrification projects comprised the majority of offsets used to demonstrate equivalency, and for VOC both ERCs and orphan shutdowns were used to demonstrate equivalency.

Part 3 of this report provides further discussion and analysis of the District's equivalency program.

Figure 3. Surplus at Time-of-use Equivalency: NOx Mitigation by Source

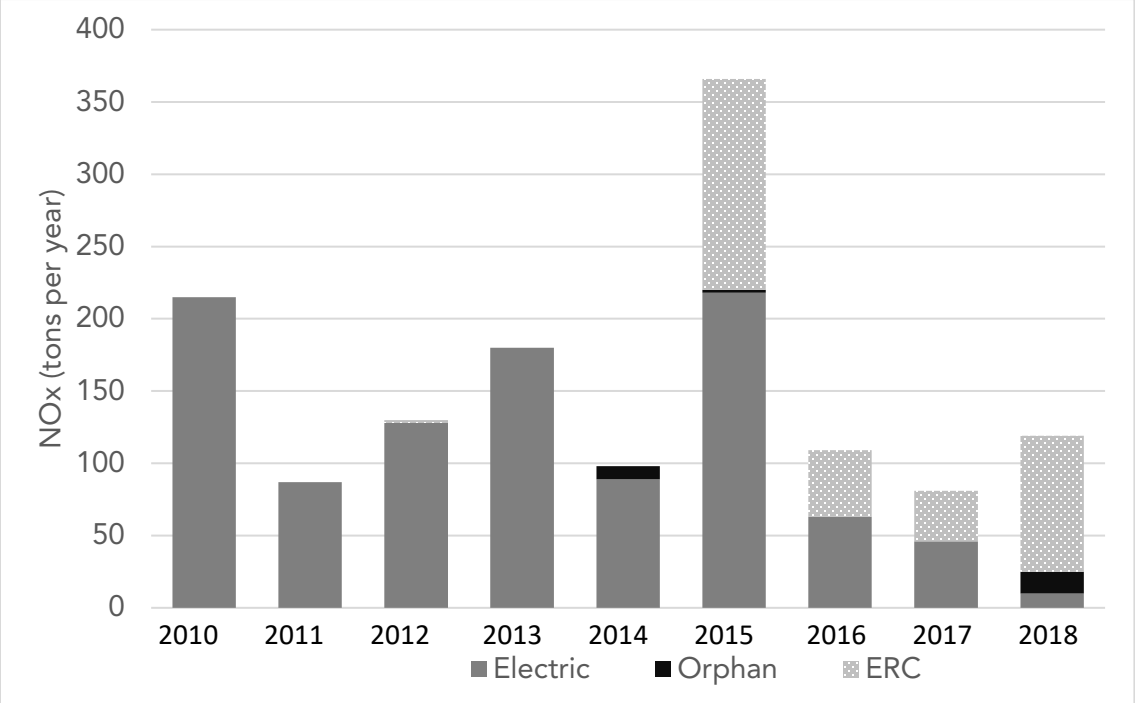
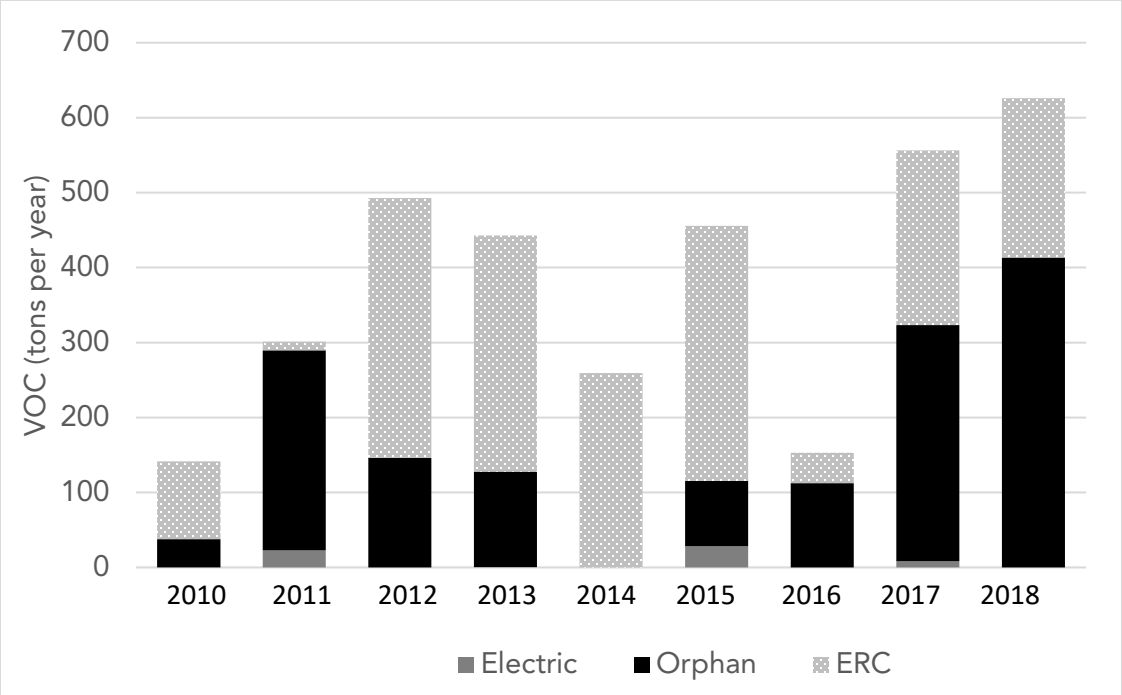


Figure 4. Surplus at Time-of-use Equivalency: VOC Mitigation by Source



H. Summary of Findings for Part 1

The current SJVAPCD ERC bank contains nearly 11 million pounds per year of NOx ERCs when valued at time-of-issuance, more than 80% of which were generated more than 20 years ago. However, over the years, the District's regulatory program has become more stringent, and the District estimated in 2016 that these NOx ERCs, when valued at time-of-use, were worth about 18% of the time-of-issuance value.[12] This reduction in time-of-issuance value is directly related to the stringency of the District's regulatory program. In effect, as the District increases the stringency in its regulatory program, it also reduces the time-of-use value in its ERC bank, which makes achieving equivalency more difficult. By way of example, when a business uses a 100 TPY ERC to offset a 100 TPY emissions increase, the business gets full use of the 100 TYP face value of the ERC. However, when the District accounts for the use of the same 100 TPY ERC in the context of the equivalency determination, its surplus-at-time-of-use value may be much less. In the case of NOx, on average, the 100 TPY NOx ERC would only be able to "offset" 18 TPY in the equivalency determination calculation.

At the same time, the District's NSR program, once significantly more stringent than federal requirements no longer is for NOx and VOC because of the District's reclassification to extreme non-attainment status for ozone in 2010. Prior to reclassification, the District's offsets thresholds for major sources were below the federal offset threshold and therefore the District required a greater use of offsets to mitigate emissions increases than what was federally required. However, upon reclassification, the District's offset threshold was no longer lower than the federally required threshold, which created a situation in which more offsets are generally required for major sources under federal requirements than under district rules. This change has been exacerbated by the fact that there generally are not sufficient reductions from the application of the NSR ERC program to offset the difference between time-of-issuance and time-of-use value of ERCs. The District uses orphan shutdowns and electrification projects to provide additional emissions reductions that are needed to demonstrate equivalency because the remaining portions of the program do not appear to provide sufficient additional offsets. These emission reductions are not generated as part of the ERC system, but are used to demonstrate offset equivalency between the District program and federal requirements. On the other hand, the District has not to date incorporated other eligible and more stringent requirements of their NSR rule into the offset equivalency demonstration, such as the application of BACT requirements to minor sources which is beyond federal requirements.

[12] SJVAPCD Draft Staff Report for Annual Offset Equivalency Determination, April 19, 2016, page 6

III. Part 2: Evaluating ERC Projects

This section discusses Part 2 of the review, in which staff evaluated 52 individual ERC projects, which represents 201 individual ERC banking certificates.[13] Staff's evaluation focused on whether the projects conformed to District rules, as well as federal and State requirements. Staff focused particularly on timeliness of applications; baseline determinations and calculations; and the evaluation criteria (real, quantifiable, surplus, permanent, and enforceable). In addition, staff reviewed emission calculations and engineering evaluations for accuracy and completeness of information. Because the Earthworks Report identified potential issues with specific ERCs, CARB staff included in this review all of the ERCs discussed in the Earthworks Report. To ensure the sample of ERCs in this review provides an adequate representation of the entire ERC program, CARB selected additional ERCs for evaluation using a random selection and representing the following criteria:

- A variety of locations, including varied regions of SJVAPCD;
- A variety of industries;
- A range of magnitude of emissions banked; and
- A range of dates in which the project took place.

To select ERCs for review, staff first identified the full population of projects and ERCs. Staff identified 1,358 projects and 2,101 ERC certificates listed in the District's ERC bank. From this population, staff selected 52 ERC projects representing 201 individual single pollutant ERC certificates, including those addressed in the Earthworks Report and additional projects chosen by CARB staff to provide a representative overview of the program.

Table 2 below lists the ERC project codes associated with the 52 ERC projects selected for review. District staff assign ERC project codes when an ERC application is submitted. The first letter of the project code indicates which region the reduction originated in (N for northern, C for central, and S for southern). The remaining numbers uniquely identify each project. Each ERC project code represents between one and five actual ERC certificates because a unique ERC certificate is issued for each pollutant banked, even if they result from the same project. For each of these projects, staff requested the contents of the project file from the District, and reviewed information available in the District's permitting database, PAS. Key publicly available information which staff used to review these projects can be found on CARB's website at the following address: https://ww2.arb.ca.gov/our-work/programs/san-joaquin-valley-emission-reduction-credit-program-review

[13] An ERC banking action, or "project", can involve a banking of multiple pollutants, and an individual ERC certificate is issued for each pollutant banked in an action or project.

Table 2. List of ERC Projects that CARB Reviewed

ERC Project Number	Date of Issuance	Number Certificates Issued	VOC (tpy)	NOx (tpy)	CO (tpy)	PM10 (tpy)	SOx (tpy)	CO2e (tpy) (metric)
S-851028	7/23/1987	2	2,202.3	-	11,459.8	-	-	-
S-870731	4/14/1988	5	261.3	509.4	4730.2	6.6	295.8	-
S-920255	9/27/1994	23	1,168.0[14]	-	-	-	-	-
S-910706	3/30/1992	5	-	58.7	8.1	20.8[15]	386.4	-
S-920024	12/17/1992	5		3.3	10.4	3.6[16]	126.5	-
S-930509	7/14/1994	4	-	110.9[17]	-	-	-	-
S-950784	12/6/1996	1	103.6	-	-	-	-	-
S-981134	4/12/1999	1	-	9.9	-	-	-	-
S-1010702	12/17/2001	1	-	13.1	-	-	-	-
S-1020219	4/28/2003	1	-	-	-	8.74	-	-
S-1052797	12/6/2006	4	38.2	7.1	20.2	2.6	-	-
S-1075362	5/15/2008	4	11.5	11.8	52.7	0.8	-	-
S-1080067	5/14/2008	4	0.1	0.7	1.3	0.1	-	-
S-1113860	1/19/2012	1	4.5	-	-	-	-	-
S-1120775	2/13/2014	2	-	-	-	-	-	70,788[18]
S-1122749	3/24/2015	1	-	-	-	-	-	12,003
S-1122845	7/14/2014	6	0.5	4.7	3.2	1.7	0.03	30,279
S-1123816	4/19/2017	1	-	-	-	-	-	257,426
C-1130364	10/7/2015	6	0.04	0.1	3.5	0.1	0.002	161
S-1141060	8/26/2015	4	-	42.0	99.6	13.9	9.2	-
S-1144501	7/12/2017	1	1.5	-	-	-	-	-
S-1154368	4/3/2017	3	-	0.1	1.9	0.6	-	-

[14] 1,168.0 tpy is the total of twelve separate VOC ERC certificates issued for this project. In addition, eleven ethane ERC certificates were issued.
[15] A separate ERC for 8.4 tpy sulfates was also issued.
[16] A separate ERC for 1.8 tpy sulfates was also issued.
[17] 110.9 tpy is the total of four separate NOx ERC certificates issued for this project.
[18] 70,788 is the total for two separate CO2e ERC certificates issued for this project.

ERC Project Number	Date of Issuance	Number Certificates Issued	VOC (tpy)	NOx (tpy)	CO (tpy)	PM10 (tpy)	SOx (tpy)	CO2e (tpy) (metric)
S-1171326	3/12/2018	4	-	19.8	6.1	7.8	0.2	-
S-1180895	8/21/2018	5	0.3	0.4	11.1	0.3	0.8	-
C-920318	9/13/1993	5	61.0	11.0	2.7	112.7	0.05	-
C-950579	6/12/1996	3	3.5	22.6	18.2	-	-	-
C-970158	1/7/1999	5	20.7	6.0	31.4	0.7	0.04	-
C-980294	8/18/2003	5	0.7	5.5	74.2	1.1	4.4	-
C-1010009	3/15/2001	5	163.9	1.5	1.4	39.5	0.02	-
C-1011235	7/16/2002	5	1.5	14.6	2.2	0.7	0.2	-
C-1032163	3/29/2004	5	0.01	0.2	0.2	9.9	0.006	-
C-1040561	10/6/2004	5	0.03	0.7	0.1	7.5	0.04	-
C-1063777	4/30/2007	5	0.02	0.4	0.1	9.5	0.003	-
C-1120248	7/9/2012	5	0.4	32.9	32.7	6.8	22.8	-
C-1162473	7/12/2017	5	0.009	0.2	0.03	8.0	0.03	-
C-1162737	1/30/2018	1	5.3	-	-	-	-	-
C-1171943	7/26/2018	6	0.003	0.1	0.01	3.9	0.01	79
C-1172943	7/8/2019	5	0.1	0.9	0.7	2.1	0.01	-
C-1173456	10/11/2018	5	0.003	0.05	0.01	5.5	-	56
N-930450	5/19/1995	4	0.1	45.5	-	1.6	17.5	-
N-950107	5/21/1996	1	-	-	37.9	-	-	-
N-950151	3/4/1996	1	-	163.5	-	-	-	-
N-950288	12/8/1998	5	68.3	79.0	69.3	12.7	6.4	-
N-960487	6/3/1997	5	1.0	36.0	10.8	8.1	0.7	-
N-970384	11/5/1998	5	1.7	243.6	42.1	49.8	341.3	-
N-980337	5/25/2000	5	107.5	14.1	9.4	3.0	0.2	-
N-1000509	10/29/2008	1	-	-	-	6.4	-	-
N-1001257	8/14/2002	5	0.5	55.9	40.7	9.5	28.1	-
N-1061341	2/20/2008	5	2.7	20.8	54.3	0.03	4.3	-

ERC Project Number	Date of Issuance	Number Certificates Issued	VOC (tpy)	NOx (tpy)	CO (tpy)	PM10 (tpy)	SOx (tpy)	CO2e (tpy) (metric)
N-1062909	5/26/2011	2	14.7	-	-	0.6	-	-
N-1101305	12/19/2012	1	32.8	-	-	-	-	-
N-1131840	2/21/2017	1	-	-	-	-	28.3	-

A. Findings

In reviewing the 52 ERC projects, staff identified four areas in which the District's program requires improvement:

1. Transparency
2. Timeliness of Application and Selection of Baseline Periods
3. Real and Permanent Reductions
4. Surplus Reductions

This section provides an overview of each of these areas of concern, with reference to the affected ERC projects.

1. Transparency

In about half of (27 of 52) ERC projects reviewed, the District's project files lacked sufficient supporting documentation that would be necessary to replicate or verify the information used in the District evaluation or provided in the facility application. The ERC projects were missing information such as emissions inventory submittals, choice of baseline period, Continuous Emission Monitoring (CEMS) data, source test data, and other information. The following ERCs lacked sufficient documentation: C-920318, C-920255, C-1010009, C-1032163, C-1130364, C-1162737, C-1172943, C-1173456, N-930450, N-950107, N-950288, N-960487, N-980337, N-1062909, N-1131840, S-851028, S-870731, S-910276, S-920024, S-1020209, S-1075362, S-1113860, S-1122749, S-1122845, S-1123816, S-1141060, and S-1144501.

The ERC process should ensure that the ERC file is complete and transparent, such that a reviewer, or member of the public, can readily replicate the decision made. Three examples of transparency issues found during the review are illustrative of ERCs with similar issues.

- S-1144501: The proposed reduction resulted from shutdown of two floating roof crude oil production tanks. The referenced ERC was issued in 2017. The District's files provide no discussion of the reason the District chose an alternative baseline period for the facility, rather than the two years immediately preceding the date of

application. There is no detail of the quarterly average production data calculations, and using the raw data, the District values cannot be duplicated. In addition, the District relied on the permit surrender date for justification of application timeliness, yet the letter from the applicant surrendering permits is not included in the District's files.

- N-960487: The proposed reduction resulted from the shutdown of a sugar manufacturing facility. The throughput and fuel usage were supplied by a consultant on behalf of the applicant, without any supporting documentation or records. The file did not include any emission inventory submittals, nor any evidence that the District verified the information in the application.
- N-1062909: The proposed reduction resulted from the shutdown of a steel storage system manufacturing facility. The District sent several letters requesting more information from the applicant regarding amount of paint used and VOC contents of paints, but the file contains no resolution of the requests. The project files do not contain final issuance letters. The District took over four years to determine the application was complete, but the file contains no explanation for this delay.

2. Timeliness of Application and Selection of Baseline Period

District's banking rule (Rule 2301) governs the timeline for applications for ERC banking. CARB staff interprets the rule as being clear that the application must be submitted within 180 days of when emission reductions occurred. To interpret Rule 2301, District follows Policy APR 1805 (4/9/1992)[19]. CARB staff believes that Rule 2301 and APR 1805 are inconsistent. The District maintains that the rule and policy are consistent but has committed to making adjustments to reduce the likelihood of future actual or perceived inconsistencies.

In the San Joaquin Valley, most ERCs are generated from the shutdown of a facility or process. In 15 of the 52 projects reviewed, the District granted ERCs for reductions generated by a facility shutdown that occurred more than 180 days before submission of the ERC application following Policy APR 1805. The 15 affected ERC projects are: S-1075362, C1010009, C-950579, C-970158, C-1032163, C-1063777, C-1130364, C-1162473, C-1172943, C-1173456, S-430424, N-1001257, S-870731, S-1080067, S-1122845. For many of these ERCs, the District also selected baseline periods reflecting operation of the facility even though the facility had not operated within 180 days of, and sometimes in years prior to, the ERC application.

District Rule 2301, Sections 4.2 and 4.2.3 states:

[19] https://www.valleyair.org/policies_per/Policies/APR%201805.pdf

4.2 Affected Pollutant Emissions Reductions Occurring After September 19, 1991

For emission reductions occurring after September 19, 1991, the following criteria must be met in order to deem such reductions eligible for banking: …

4.2.3 An application for ERC has been filed no later than 180 days after the emission reductions occurred.

The District does not define the date "emission reductions occurred," however, it is the District's position that the date the "emission reductions occurred" for facilities which are shutting down and applying for ERCs is the date of the "shutdown." The District defines "shutdown" in their regulations, although the term is not used in the timeliness language. Specifically, District regulations define shutdown as *the earlier* of the permanent cessation of emissions from an emitting unit or the surrender of that unit's operating permit. Rule 2301, Section 3.14, defines "shutdown" as:

Shutdown: shall mean either the earlier of the permanent cessation of emissions from an emitting unit or the surrender of that unit's operating permit. If, prior to the surrender of the operating permit, the APCO determines that:

the unit has been removed or fallen into inoperable and unmaintained condition such that startup would require an investment exceeding 50% of the current replacement cost; and

the owner cannot demonstrate to the satisfaction of the APCO that the owner intended to operate again, then the APCO may cancel the permit and deem the source shutdown as of the date of last emissions. Evidence of an intent to operate again may include valid production contracts, orders, other agreements, or any economically based reasons which would require the operation of the emitting unit after initial cessation of emissions.

District Policy APR 1805, Definition of a Shutdown defines shutdown as follows:

For permitted sources, the date of the shutdown shall be the date of the surrender of the operating permit, unless the Control Officer determines that: a) the unit has been removed or has fallen into an inoperable and unmaintained condition such that start-up would require an investment exceeding 50% of the current replacement cost; and, b) the owner cannot demonstrate to the satisfaction of the Control Officer that the owner intended to operate again. Evidence of "intent to operate again" may include valid production contracts, orders, other agreements, or any

economically based reasons which would require the operation of the emissions unit.

Should the Control Officer make determinations a) and b), the date of the shutdown shall be the date of the last emissions from the emissions unit.

District Policy APR 1805 further states "*We further recommend that the definition be changed, by rule amendment, at the first opportunity. The wording of the attached interpretation may be appropriate for such an amendment.*"

By following Policy APR 1805 in reviewing the timeliness of ERC projects, the District is accepting ERC applications submitted more than 180 days after the date emission reductions occurred, which CARB staff interprets as in conflict with the District's Rule. The acceptance of applications more than 180 days after cessation of emissions impacts the selection of the baseline period. District Rule 2201, Section 3.9, defines the baseline period as: "the two consecutive years of operation immediately prior to the submission date of the Complete Application" or "[a]t least two consecutive years within the five years immediately prior to the submission of the complete application if it is determined by the APCO as more representative of normal source operation."[20] In 14 of the 15 ERCs identified as being issued more than 180 days since cessation of emissions, the District defined a baseline period consisting of two years that were not immediately prior to the submission of the application.

While the District's reliance on District Policy APR 1805 with respect to application timeliness appears to have been consistent since 1992, CARB staff concludes that the policy and the rule are not aligned and should be modified accordingly. When coupled with the District's selection of baseline periods, the application of the policy has led to the issuance of ERCs for facility shutdowns that occurred more than 180 days prior to application, with credit for normal levels of activity prior to shutdown. The district has committed to a process to align the policy and the rule.

3. Source Shifting Considerations

In 10 projects (6 criteria pollutant and 4 GHG) of 52 ERC projects reviewed the reductions may not have been real and permanent as the pollution activity and emissions may have shifted to a different facility.[21]

In ERC projects for criteria pollutants, the District may consider the potential for the emissions reductions proposed for banking being shifted to another nearby source or

[20] Different baseline periods apply to sources that have been in operation for less than two years in total. These periods do not apply to the projects staff reviewed.

[21] CARB includes this review of GHG issues in part because non-profit groups raised concerns on this program as well. CARB recognizes that the GHG program is not directly linked to NOx offsets for ozone attainment, but GHG reductions, too, should be properly handled, given the significant public health implications of GHG emissions.

source within the air basin. This "source shifting" consideration is expressed implicitly in Rule 2301, Section 4.4.1 which bans certain source categories such as gasoline stations from banking emission reductions. The rationale for this exclusion is that the shutdown of a gasoline station will not result in any permanent or real emission reductions because the demand for gasoline will remain the same and the activity of refueling will be shifted to another nearby gasoline station. Thus, the air basin will see the same emissions as before the shutdown.

Where an emissions reduction creates a potential for source shifting, it is best practice for the ERC application to address this issue specifically by conducting an analysis to demonstrate source shifting is not occurring or that it is being compensated for in the amount of ERC being issued.

Staff observed that the issue of source-shifting was not explained adequately in some criteria pollutant banking actions where it could be an issue, in particular, in the banking of emissions from cotton gins in projects C-1032163, C-1040561, C-1063777, C-1162473, C-1171943, and C-1173456. While the District explained that cotton production was declining as an industry within the San Joaquin Valley, which CARB staff concurs, the District did not explain how this ensured that the production from one cotton gin shutting down was not being shifted to another nearby gin. In some cases, there was another nearby gin within a few miles. The District could improve its assessments by addressing source shifting more explicitly and comprehensively in its review of ERC applications.

The District considered the issue of source shifting when amending Rule 2301 to allow banking of GHG reductions. In presenting the Rule change, District staff noted certain reductions would be ineligible for banking –including shutdowns where "global demand for product/service does not decrease, product/service will be produced elsewhere (and result in GHG emissions)."[22] While this language was not directly incorporated into the Rule, the stated interpretation is consistent with the requirement that reductions be real and permanent.

Because the effects of GHGs are global, some account of global demand and therefore source shifting, on a global basis, is appropriate to ensure reductions are real and permanent. However, in the analysis of GHG banking projects (S-1122749, S-1123816, S-1122845, and C-1130364) for the shutdown of oil and gas production equipment (pre-Cap and Trade), the District did not apply this global level of scrutiny. The District assumed the GHG reductions would be real and permanent based on documentation of declining oil and gas production in California. However, a global boundary and demonstration of source shifting would have been more appropriate to

[22] http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2012/January/Item11-Rule2301011912presentation.pdf

show the reductions are real and permanent given that oil and gas are global commodities not on a downward trend, many producers are global, and the effects of GHGs are global.

Ultimately, the impact of these GHG ERCs is not clear, as there is no currently authorized use in an NSR context consistent with District rules or in the context of GHG Cap and Trade programs. To CARB's knowledge, none of these GHG ERCs have been used.

4. Surplus Reductions

In four of the 52 ERC applications reviewed (S-1075362; S-981134; S-851028; and C-1010009), it is unclear whether a portion of the reductions issued an ERC were not surplus. These issues are particularly complicated – influenced by federal, state, and local requirements.

For purposes of ERC banking, State law requires:[23]

> *(a) Every district board shall establish by regulation a system by which all reductions in the emission of air contaminants that are to be used to offset certain future increases in the emission of air contaminants shall be banked prior to use to offset future increases in emissions. The system shall provide that only those reductions in the emission of air contaminants that are not otherwise required by any federal, state, or district law, rule, order, permit, or regulation shall be registered, certified, or otherwise approved by the district air pollution control officer before they may be banked and used to offset future increases in the emission of air contaminants.*

Federal law requires:[24]

> *(c) Offsets (2) Emission reductions otherwise required by this chapter shall not be creditable as emissions reductions for purposes of any such offset requirement*

District rules require:[25]

> *3.2.2 To be considered surplus, [actual emissions reductions] shall be in excess, at the time the application for an Emission Reduction Credit or an Authority to Construct authorizing such reductions is deemed complete, of any emissions reduction which:*

[23] California Health and Safety Code 40709.
[24] Clean Air Act Section 173(c)(2).
[25] SJVAPCD Rule 2201, 3.2.2.

3.2.2.1 Is required or encumbered by any laws, rules, regulations, agreements, orders, or

3.2.2.2 Is attributed to a control measure noticed for workshop, or proposed or contained in a State Implementation Plan, or

3.2.2.3 Is proposed in the APCO's adopted air quality plan pursuant to the California Clean Air Act.

CARB recognizes that these rules and requirements are complex. However, all these requirements focus on a careful evaluation of whether an ERC is truly surplus relative to controlling law. This issue is particularly important to reevaluate, as a policy matter, because the time-of-issuance program in San Joaquin can mean ERCs issued under one legal regime are no longer truly surplus at use in light of changes in law since issuance. This becomes more important because the District, not the applicant, must identify sufficient time-of-use reductions in the context of the Equivalency Demonstration.

The four applications where it is unclear as to whether the full value of the ERCs were in fact surplus in light of changes in law.

- ERC S-981134 involved a refinery applying for ERCs for emissions reductions achieved from the required installation of BACT in 1998. The facility received an Authority to Construct (ATC) Permit # S-33-56-11 to increase the firing rate capacities of two heaters on a hydrocracking unit. This modification triggered BACT for NOx, and the District determined BACT for NOx to be a technology capable of meeting a NOx emission rate of 0.036 lb/MMBtu. The District granted an ERC for reductions achieved between the rule requirement and BACT.

  This approach was consistent with District Rule 2201 as adopted in 1995, which required emissions reductions selected for banking to be in excess of any emissions reduction required by any law, rules, regulations, agreements, or orders – except controls required by the District's NSR Rule. However, District Rule 2201 as adopted in 1995 was inconsistent with California Health and Safety Code section 40709 and federal Clean Air Act section 173(c)(2), discussed above, which require banked reductions to be surplus of all requirements including NSR requirements for BACT. The District subsequently amended Rule 2201 in 1998 to remove the language allowing banking of emissions reductions required by installation of BACT in NSR.

- ERC S-851028 involved benzene emissions reductions from the installation of a boiler on a fluid coker at a refinery in 1987. CARB and USEPA appeared to differ with the Kern County Air Pollution Control District on whether or not the reductions were surplus and therefore eligible for banking. EPA and CARB both commented that the reductions had occurred 10 years earlier and were already

accounted for in the non-attainment plan, and RACT at the time of banking was incineration. This ERC was discussed extensively in the Earthworks evaluation, and the record regarding this ERC is not clear. Ultimately, the Kern County Air Pollution Control District issued the ERCs, despite comments from CARB and U.S. EPA at the time which raised issues about the eligibility of the emissions reductions that the Kern County Air Pollution Control District did not fully address.

- ERC C-1010009 involved an ERC application in July 2000 for the shutdown of equipment at an oil mill used for seed processing. The facility continued to operate exclusively as a cottonseed receiving and storage facility. Prior to the ERC application, in May of 2000, the US EPA had published a notice to update a NESHAP (40 CFR Part 63 Subpart GGGG) applicable to the source. The District did not discount the ERC for the proposed NESHAP because it believed its rules did not require it to do so, and finalized the ERC in March 2001. However, US EPA finalized the NESHAP in April 2001, which reduced the time-of-use value of the ERC by 280,000 pounds of VOC per year, a reduction of roughly 80%, just weeks after the ERC was issued. This example highlights why time-of-issuance ERCs can be problematic as a policy matter, given this notable difference in reduction value.
- ERC S-1075362 involved the shutdown of six CNG engines. In this application, the applicant requested ERCs for reductions above the most stringent regulatory internal combustion emissions limit incorporated into a SIP in California – the 36 ppm NOx limit set forth in South Coast AQMD Rule 1110.2 (revised on June 3, 2005). The applicant used South Coast AQMD Rule 1110.2 for the Reasonably Available Control Technology (RACT) adjustment because the 36 ppm NOx limit was more stringent than the emissions limit under SJVAPCD Rule 4702. The application noted that SJVAPCD Rule 4702 had been identified as a further study measure, but no new draft potential emission limits had been published. As a result, the applicant calculated reductions using the 36 ppm NOx emissions limit.

  The District granted the ERC assuming an emissions limit of 65 ppm NOx, rather than the 36 ppm NOx emissions limit proposed by the applicant. This increased the value of the ERC. The District's evaluation did not include an explanation for the decision to use the 65 ppm limit. During this review process, however, the District explained that prior to the issuance of the ERC, the District had consulted with U.S. EPA in relation to a different banking action, and U.S. EPA had advised the District by letter "*actual emission reductions are required to be surplus of any other SIP requirement the source is subject to, not the requirement of other agencies SIPs which do not apply to the source.*"

IV. Part 3: Examining the District's Federal Offset Equivalency Demonstration

This section describes the District's federal offset equivalency demonstration and presents the analysis and findings of staff's review.

Summary of findings:

- The District's equivalency database is not a self-contained, relational database and lacks a complete data dictionary and technical documentation. CARB staff noted a number of stranded records, data-handling discrepancies, and transparency concerns related to these issues.
- The District over-credited the amount of emission reductions claimed for equivalency from PG&E's AG-ICE diesel-to-electric incentive program for agricultural irrigation pumps (Table 13). The over-credit is due to the use of a load factor of 1.0 instead of the Carl Moyer Guidelines' recommended load factor of 0.65 in the calculation of the amount of actual emission reductions creditable from these projects. (Table 11).
- Six of the ten AG-ICE projects reviewed received Carl Moyer co-funding, which, according to California Health and Safety Code section 44281(b) and Carl Moyer Guidelines, call into question their appropriateness for use in the equivalency demonstration. However, CARB staff found no evidence that the emission reductions from the AG-ICE projects were relied on in the California State Implementation Plan (SIP), which indicates the District's use of these reductions likely did not result in double-counting in both the SIP and equivalency demonstration, and found evidence that only a portion of the reductions, and not all of the reductions, were claimed for offset equivalency.
- AG-ICE projects were emission reductions from agricultural sources and not all agricultural sources were/are subject to permitting and NSR. Pursuant to SB 700 (2003, Florez), the District requires permits for agricultural sources (including spark- and compression-ignited irrigation pumps) if their emissions are greater than one-half of the major source emissions threshold. For agricultural sources with emissions less than one-half of the major source emissions threshold, the District issues registrations for spark- and compression-ignited irrigation pumps. It is unclear whether the emission reductions associated with the AG-ICE projects met the enforceability and permanence criteria under Rule 2201 Sections 7.2.2.2 and 7.1.5 in all cases.
- The District over-credited the amount of NOx and VOC emission reductions from some orphan shutdowns claimed for surplus-at-time-of-use equivalency for ten of the eleven projects reviewed (Table 14). Collectively, orphan shutdowns account for nearly 50 percent of the emission reductions the District used to

show surplus-at-time-of-use equivalency for VOC from 2001 – 2018 and over 60 percent of the excess VOC and NOx emission reductions available for use in future equivalency demonstrations at the end of the 2018 reporting period (Table 12).

A. Equivalency Overview

Since 2001, U.S. EPA has required the District to demonstrate program equivalency with federal NSR offset requirements by showing that the emissions reductions generated by SJVAPCD's NSR requirements as a whole are equal to or greater than the reductions that would have been required by federal NSR.[26] U.S. EPA and the District entered into an agreement on August 30, 1999 establishing the requirements for the equivalency demonstration. The District subsequently amended its NSR rule (District Rule 2201), to reflect the requirements of the agreement. The equivalency provisions in Rule 2201 have been incorporated into the SIP, and through that process were subject to CARB review and U.S. EPA approval. The District submits its federal offset equivalency report each November to U.S. EPA and CARB. The reports are available on the District's web site. The reports provide a summary of the reductions the District relies on to demonstrate equivalency, but the full data set underlying the equivalency demonstration is within the District's internal equivalency tracking system, which is not subject to regular review by U.S. EPA or CARB.

The federal offset equivalency demonstration consists of two distinct tests: Test 1 (offset requirement equivalency) and Test 2 (surplus-at-time-of-use equivalency).

Test 1 – offset requirement equivalency – compares the annual quantity of offsets that would have been required under the federal program (i.e., the "Federal offset quantity" or FOQ) to the annual quantity of offsets actually required by the District's program (i.e., the "District offset quantity" or DOQ).[27] This test requires the District to calculate and track the total FOQ and DOQ from all ATC projects it issues each period. To demonstrate equivalency under this test, the total DOQ must be equal to or greater than the total FOQ.

Although the District is required to report this demonstration annually, the report is best understood as an update because the District must demonstrate equivalency since August 20, 2001. In other words, when the District makes an equivalency

[26] Technical Support Document for EPA's Notice of Proposed Rulemaking for the California State Implementation Plan, San Joaquin Valley Unified Air Pollution Control District: Rule 2020, Exemptions Rule 2201, New And Modified Stationary Source Review Rule, p. 15 - 17 (8/30/1999); *see also* August 26, 1999 Letter from David Howekamp, U.S. EPA Region IX Director Air Division to Mark Boese, Deputy APCO, SJVAPCD, enclosing EPA-District NSR Offset Tracking Agreement.

[27] The abbreviations FOQ and DOQ will be used to represent the federal and district offset quantities both for individual ATC projects and the total for all ATC projects during a tracking period. The context will make clear which meaning is intended.

demonstration, it represents federal offset equivalency over the life of the NSR program since 2001. Thus, in Test 1 (the offset requirement equivalency test), any extra DOQ beyond what is needed to show equivalency with the FOQ in the current year's equivalency demonstration may be carried forward and used to show equivalency in future years if the ATC projects issued in that year show a shortfall in DOQ relative to the FOQ.

While Test 1 is focused on the amount of offsets required, Test 2 is focused on the emission reductions used to satisfy the offset requirements.

Test 2 – surplus-at-time-of-use equivalency – requires the District to reserve or retire sufficient surplus-at-time-of-use creditable emission reductions[28] to mitigate the current years' FOQ plus any unmitigated FOQ from prior years.[29] The creditable emission reductions the District uses to mitigate the FOQ can be drawn from any time from August 20, 2001, the start of the tracking system, to the end of the current tracking period. The creditable emission reductions used to satisfy the FOQ have come from three principle sources: (1) ERCs reserved or withdrawn for ATC projects, (2) orphan shutdowns, and (3) electrification of agricultural irrigation pump engines from 2005 – 2008.[30]

Each test has its own accounting rules and different remedies for a failure to demonstrate equivalency. The failure of one test would not necessarily entail failure of the other. Both tests are pollutant specific, meaning equivalency must demonstrated for every pollutant (i.e. NOx, VOC, PM10, PM2.5, CO, and SOx). Because the demonstration represents federal offset equivalency over the life of the program since 2001, both tests permit the District to carry forward any excess or shortfall in credit for use in a future year's equivalency demonstration. The District has an excess margin of credits to draw on to remedy future potential shortfalls for both tests. That substantial margin of excess credits, however, rests on the integrity of the prior credits used for equivalency.

Because almost all NMSs and FMMs in SJVAPCD involve NOx and VOC offsets, CARB's review of SJVAPCD's federal offset equivalency demonstration focused on NOx and VOC.

[28] A creditable emission reduction meets the same integrity criteria as ERCs, i.e. the emission reductions must be real, quantifiable, permanent, enforceable, and surplus.
[29] The District has never had a year where it did not fully mitigate the current tracking year's FOQ based on the data provided in the District's equivalency demonstration reports.
[30] PG&E's Ag-ICE program will be discussed in detail in Part III. C. 3. a. See Tables 13 and 14 for the total amount of reductions claimed for NOx and VOC equivalency by type.

B. Interpreting the District's Federal Offset Equivalency Report

The District must submit to U.S. EPA and CARB its annual federal offset equivalency report by November 20 every year.[31] The District publishes the equivalency reports on its web site.[32] Each report summarizes the offsetting and emissions reduction (i.e. mitigation) activity during the tracking period August 20 of the previous year to August 19 of the current year. The dates coincide with the effective date of the equivalency demonstration requirements in SJVAPCD's NSR Rule 2201 on August 20, 2001. The report summarizes the activity during the tracking period. The determination of equivalency in the report reflects not only that current year's activity, but also the entire history since the beginning of the tracking system in 2001. Table 3 is reproduced from SJVAPCD's 2019 Annual Offset Equivalency Report for the tracking period 8/20/2018 to 8/19/2019 and summarizes the demonstration of equivalency made for Test 1.

Table 3 : Test 1 – Offset Requirement Equivalency (from SJVAPCD 2019 Annual Offset Equivalency Report)

Pollutant	Number of New Federal Major Sources (NMS)	Number of Federal Major Modifications (FMM)	Offsets Required under Federal NSR (FOQ) (tons per year)	Offsets Required under District NSR (DOQ) (tons per year)	Excess or Shortfall This Year (tons per year)	Excess or Shortfall Previous Year (tons per year)	Total Excess or Shortfall (tons per year)
NOx	0	16	83.4	84.4	1.0	4,312.9	4,313.9
VOC	0	19	69.5	43.3	-26.2	733.4	707.2
PM10	0	0	0.0	3.2	3.2	837.5	840.7
PM2.5	0	0	0.0	0.0	0.0	377.7	377.7
CO	0	0	0.0	0.0	0.0	198.1	198.1
SOx	0	0	0.0	47.5	47.5	2,863.6	2,911.1

The equivalency test is performed pollutant-by-pollutant. In 2019, for NOx, there were 16 FMM, which required 83.4 tons per year of NOx reductions under federal requirements. Thus, 83.4 tons per year is the FOQ. The actual quantity of offsets or DOQ required by SJVAPCD for all ATC projects issued during the tracking period was 84.4 tons per year NOx. Therefore, SJVAPCD required 1.0 tons per year more NOx offsets under their NSR rule than they would have required if they were following federal NSR to determine the offset quantity. The extra 1.0 tons per year is added to the accumulated 4,312.9 tons per year of excess NOx accumulated from prior years, and is carried forward for use in future years. As long as the Total Excess (last column of Table 4) is equal to or greater than 0.0 tons per year, SJVAPCD has shown it meets

[31] Rule 2201, 7.3.2 (amended 8/15/19)
[32] http://www.valleyair.org/busind/pto/annual_offset_report/annual_offset_report.htm

Test 1 "offset requirement equivalency" for NOx as of the end of the tracking period. Moreover, the Total Excess NOx (4 313.9 tons per year) is available to use for future Test 1 equivalency demonstrations when the FOQ is larger than the DOQ in a future year.

Table 4 is reproduced from SJVAPCD's 2019 Annual Offset Equivalency Report for the tracking period 8/20/2018 to 8/19/2019 and summarizes the demonstration of equivalency made for Test 2.

Table 4: Test 2 – Surplus at the Time-of-Use Equivalency (from SJVAPCD 2019 Annual Offset Equivalency Report)

Pollutant	Number of New Federal Major Sources	Number of Federal Major Mods	Offsets Required under Federal NSR (FOQ) (tons per year)	Shortfall from previous year (tons per year)	Reduction (surplus at the time of use) used for equivalency this year (tons per year)	Shortfall this year (tons per year)	Reductions eliminated by discounting at the time of use (tons per year)	Unused Carry-over Creditable Reductions (tons per year)
NOx	0	16	83.4	0.0	83.4	0.0	5,559.8	408.0
VOC	0	19	69.5	0.0	69.5	0.0	2,300.3	1,428.0
PM10	0	0	0.0	0.0	0.0	0.0	135.0	1,898.0
PM2.5	0	0	0.0	0.0	0.0	0.0	8.4	1,020.0
CO	0	0	0.0	0.0	0.0	0.0	110.7	763.0
SOx	0	0	0.0	0.0	0.0	0.0	786.6	2,038.0

Similar to Test 1, Test 2 is performed on a pollutant-by-pollutant basis. The first three columns for Test 2 are the same as for Test 1. During the 2019 tracking period, the FOQ was 83.4 tons per year of NOx. The current years' FOQ is added to the shortfall from the previous year (in this case zero) to get the total amount of surplus-at-time-of-use emission reductions the District must reserve, withdraw, or retire to show equivalency. The District mitigated or matched the 83.4 tons per year NOx FOQ with 83.4 tons per year NOx worth of surplus-at-time-of-use reductions as indicated in the column "Reduction (surplus at the time-of-use) used for equivalency this year." The District identifies the amount and source of those reductions in an attachment to the report. The sources of the NOx reductions for 2019 are from ERCs and orphan shutdowns. Since the District was able to match the FOQ with enough surplus-at-time-of-use reductions based on its calculations, the District does not have any shortfall in 2019, which means it has passed Test 2. In the column "Reductions eliminated by discounting at time-of-use," the District presents the sum total since 2001 of reductions required by its NSR program that were not surplus and so were not counted as mitigation in Test 2. Finally, the last column, "Unused carry-over creditable reductions" are the excess reductions still available for use in next year's surplus-at-time-of-use demonstration.

C. Equivalency Review Approach

The District's offset equivalency demonstration is complex and involves large and diverse data sets, covering a nearly 20-year period. CARB staff evaluated the data system functionality, approaches, and calculations in order to evaluate the equivalency determination. Staff reviewed both the data system as a whole and individual projects, selected at random, which were part of the equivalency demonstration. To conduct the evaluation, staff reviewed the District's equivalency database and associated documentation including individual tables, inputs to the database, and outputs from the database. Staff reviewed select reduction types and the underlying source data to determine whether it was correct and accurately input to the database system. The purpose of the evaluation was to determine whether the equivalency database is accurately reporting information and calculating equivalency.

1. Findings Regarding the Equivalency Database

The equivalency database is a system written in Microsoft Access, and originally developed in the mid-2000s. Overall, the database's lack of documentation limits the ability to determine if the system is functioning properly. In addition, the database is not self-contained, meaning that many calculations are conducted external to the database system (e.g., input from spreadsheet files), and not adequately documented in the database. This impedes the ability to assure the quality of the calculations in the demonstration.

To facilitate the review, District staff provided CARB staff with access to the database in the District's Fresno office, along with a manual describing how to operate the system, including copying and clearing data tables, renaming the tables, performing analyses in Microsoft Excel, and inputting data from Excel to Microsoft Access. District staff also provided a partial data dictionary based on specific CARB requests. CARB staff created copies of two summary tables in the database (Track_Master and Track_Allocate). These tables represent the results of core calculations and information tracked and used in the database system. District staff could not provide a complete data dictionary or technical documentation describing the calculations within the system.

The Track_Master table is the parent table for the Track_Allocate table. They are connected through the TrackNum field in each table. Each time a portion of an ERC is allocated (used), a record is put in the Track_Allocate table and the quantity of the ERC used is in the quantity column of the Track_Allocate table. Based on this understanding, there should never be a record in the Track_Allocate table that does not have a parent record in the Track_Master table. Otherwise, referential integrity is not enforced in the database. CARB staff's analysis identified what appear to be orphan records, including 194 NOx and 98 VOC records in Track_Allocate that did not have a record in Track_Master.

The used_NOx and used_VOC fields in Track_Master represent the amount of NOx and VOC used from an ERC (or other creditable reduction) in the surplus-at-time-of-use equivalency demonstration. This amount should always be less than or equal to the total value of the Actual Emission Reductions (AER), which is shown in the aer_NOx and aer_VOC fields. As a result, the used_NOx and used_VOC fields should always be less than or equal to the aer_NOx and aer_VOC fields. CARB's analysis identified 6 records where the used_VOC exceeded the aer_VOC, although the difference was negligible (0.122 t/y VOC).

District staff has investigated and identified the source of most of the discrepancies identified by CARB staff and have committed to making the appropriate corrections immediately. District staff has also conveyed their assurance that none of the orphan records identified above had any effect on the equivalency demonstration. Finally, District staff has indicated a willingness to explore the development of a new database with documentation to reduce the types of issues noted above and improve transparency.

2. Findings Regarding Test 1 – Offset Requirement Equivalency

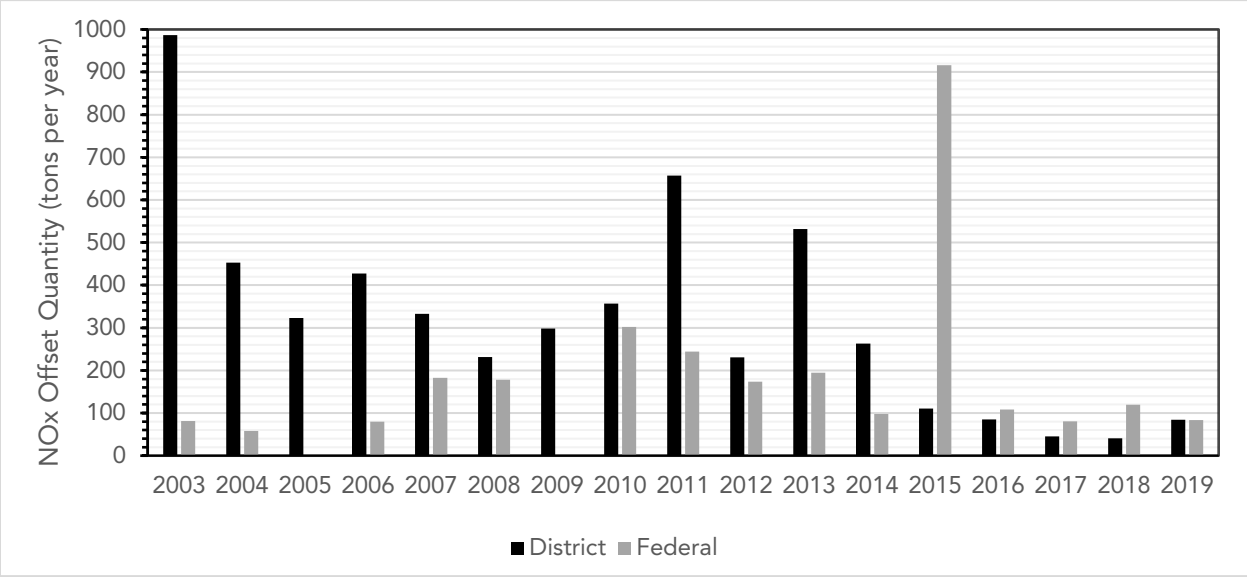
Figures 5 and 6 compare the DOQ to the FOQ for all ATCs issued by tracking year.[33] Between 2001 and 2010, the District's NSR program required more offsets for NOx and VOC than what would have been required by the federal NSR program, primarily because the District required offsets at a lower emissions threshold than federal NSR during that time. However, after the bump-up to extreme non-attainment for ozone in 2010, the FOQ usually tends to be greater than the DOQ for NOx and VOC for the ATCs issued in a given year.

Overall, the database indicates the District has accumulated a significant excess DOQ for every pollutant from previous years' equivalency demonstrations. The most current statement of the amount of excess credits the District has for Test 1 is from the District's 2019 equivalency report, presented in Table 3 in the last column labeled "Total Excess or Shortfall". A positive number indicates an excess, a negative number, a shortfall. The Total Excess DOQ for NOx is 4,313.9 tons per year, for VOC 707.2 tons per year. This will be the starting point for the District's equivalency demonstration in 2020.

CARB identified a transparency issue associated with the equivalency demonstrations each year. In essence, the carryover from year-to-year relies on adjustment terms that are not clearly provided in the tables, and which are difficult to check.

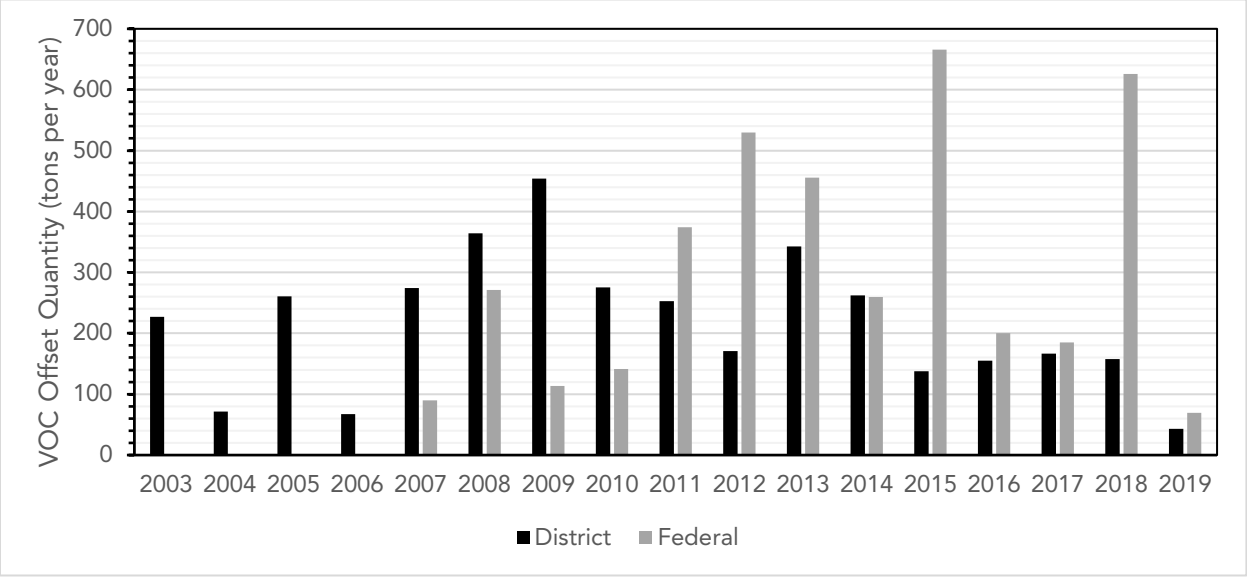
[33] A given tracking period runs from August 20 of one year to August 19 of the following year. The tracking year is the later year in this period. For example, for the tracking period running from August 20, 2015 to August 19, 2016, the tracking year is 2016.

Figure 5. NOx District Offset Quantity and Federal Offset Quantity by Tracking Year



Source: SJVAPCD Equivalency Reports Published on http://www.valleyair.org/busind/pto/annual_offset_report/annual_offset_report.htm

Figure 6. VOC District Offset Quantity and Federal Offset Quantity by Tracking Year



Source: SJVAPCD Equivalency Reports Published on http://www.valleyair.org/busind/pto/annual_offset_report/annual_offset_report.htm

The quantities displayed in Figures 5 and 6 are taken from each individual annual equivalency demonstration. The Total Excess or Shortfall values in the 2019 Report (Table 3) consists of the sum of the DOQs and FOQs from all previous equivalency reports plus adjustments for any projects removed (or sometimes added to) the tracking system each year. Simply adding quantities displayed in Figures 5 and 6 will not equal the Total Excess DOQ, which takes into consideration the annual adjustments related to projects being removed or added to the tracking system. The necessary adjustment is not explicitly stated in the tables but its cumulative effect over all the years is significant.

These adjustments come from ATC projects that previously were included in the tracking system in one year, but for various reasons (usually the ATCs have been cancelled or expired unimplemented), it becomes necessary to remove them. In the annual equivalency reports published by the District since 2011, the District lists the ATC projects that are being removed from the current year's demonstration and provides a reason for the removal. For example, the adjustment taken in the 2019 Equivalency Report is summarized in Table 5.

CARB staff attempted to verify the net adjustment in Table 4 above by summing the net effect from the three ATC projects removed from the 2019 Equivalency Demonstration (Table 5). In Table 5, removal of a project from the tracking system is accompanied by a negative sign in the corresponding DOQ and/or FOQ value. CARB staff found the DOQ and the FOQ from the ATC application reviews of the three projects on the District's public notification web site. The ATC application reviews are the source documents for the DOQ and FOQ that are used for the equivalency demonstration. CARB staff calculated a net adjustment of +0.5 tons per year for NOx and +22.3 tons per year for VOC, compared to the District's adjustment of +35.4 tons per year for NOx and +77.3 tons per year for VOC.

Table 5. Adjustment to Excess DOQ Credit Implied in SJVAPCD 2019 Equivalency Report

	NOx DOQ (tons per year)	**VOC DOQ (tons per year)**
Total Excess from 2018 Report (ending)	4,277.5	656.1
Total Excess from 2019 Report (beginning)	4,312.9	733.4
Net Adjustment	+35.4	+77.3

Table 6. CARB Calculated Adjustment to Excess DOQ Credit from 2019 Project Removed List

Project Number removed	NOx DOQ (tons per year)	NOx FOQ (tons per year)	VOC DOQ (tons per year)	VOC FOQ (tons per year)
C-1133313	0	0	-13.7	-13.7
C-1161110	0	-0.5	0	0
N-1133659	0	0	-41.5	-63.8
Total Adjustments	0	-0.5	-55.2	-77.5
CARB Net Adjustment	+0.5		+22.3	
District Net Adjustment	+35.4		+77.3	
Discrepancy	+34.9		+55.0	

District staff has explained that the source of the NOx difference was related to ATC project N-1161175 from the 2017 – 2018 tracking period, which had a DOQ of 35.0 tons per year NOx. According to District staff, the District included the FOQ for this project during the 2017 – 2018 tracking period, but not the DOQ because the facility had not specifically identified which ERC certificates it was going to use to satisfy the DOQ. The facility did identify which specific NOx ERCs it would use as offsets during the 2018 – 2019 tracking period, at which point the District added the DOQ amount as a 35.0 tons per year NOx adjustment. District staff has indicated verbally a similar explanation for the VOC difference noted in Table 6 above.

In effect, the District delayed counting the DOQ, is conservative and understandable under the circumstances, and had no impact to the outcome of equivalency demonstration. However, this explanation should have been included in the list of projects accounting for the adjustment in the 2018 – 2019 report – so that the report and calculations are more clear to the interested public, CARB, and U.S. EPA.

CARB staff also checked the District's calculations of the DOQ and FOQ by examining the ATC application reviews for the 2016 - 2017 tracking period. The ATC application reviews are the building blocks for the equivalency demonstration. The FOQ and DOQ values provided in the equivalency reports -- on which the determination of equivalency rests -- should be traceable back to the ATC application reviews. CARB staff obtained from the District and the District's web site the application reviews for the ATC projects from the 2017 tracking year (8/20/2016 – 8/19/2017) that were identified as NMS (1 ATC project) or FMM (32 ATC projects). Most ATC projects that had a FOQ also had a DOQ. For example, of the 14 ATC projects that were FMM for NOx, 11 also had a DOQ associated with the project.

Staff spot-checked the emissions increase calculations used to determine the FOQ and the DOQ in the ATC application reviews for all the NMS (1) and FMM (32) projects identified by the District for the 2017 tracking year. All reviewed calculations appeared to have been completed correctly. Staff then summed the FOQ and DOQ from all the ATC application reviews in order to compare to values reported by the District in the 2017 report. These results are summarized in Tables 9 and 10 below.

Table 7 shows a minor discrepancy discovered between the calculated and reported FOQ for VOC. The source of this discrepancy is ATC projects S-1151973 and S-1152366, which were associated with a FOQ of 7.9 tons per year VOC. However, the District entered the FOQ as 5.3 tons per year VOC for these projects (in the ini_i_VOC field of the Track_Master table). This results in a difference in the FOQ of 2.6 tons per year VOC. Thus, CARB staff calculated a FOQ of 187.6 tons per year VOC, while the district reported a FOQ of 185.0 tons per year VOC.

Table 7. Comparison Between CARB Calculated and SJVAPCD Reported Federal Offset Quantities for One New Major Source and 32 FMMs Reported in the 2017 Equivalency Demonstration.

FOQ Calculation Method	NOx (tons per year)	VOC (tons per year)
FOQ calculated using CARB reviews of each NMS and FMM	80.5	187.6
FOQ reported in the 2017 Equivalency Report	80.5	185.0
FOQ calculated in the Equivalency Database Track_Master table.	80.5	185.0

Verification of the DOQ for Test 1 must take account of a different subset of ATC projects because the District can require offsets (DOQ) both from projects that are NMS or FMM and from new minor sources or minor modifications. CARB staff reviewed ATC application reviews for all the NMS (1) and FMM (32) identified by the District for the 2017 tracking year to identify the DOQ. However, staff did not request the ATC application reviews for those projects that had a DOQ but were not NMS or FMM. The DOQ from those projects was taken at face value from Track_Master.

Staff added up the DOQ from FMM, NMS, and minor projects. Table 8 shows the results of this analysis, by comparing differences between the CARB calculated DOQ and District reported DOQ for NOx and VOC from the 2017 Report. CARB staff identified 75.9 tons per year NOx DOQ from FMM and NMS, and 0.8 tons per year from minor projects, for a total of 76.7 tons per year NOx DOQ. However, the District in its 2017 Equivalency Demonstration, presented a DOQ of 45.6 tons per year NOx – a difference of 31.1 tons per year NOx from the CARB value.

CARB staff identified 100.2 tons per year VOC DOQ from FMM and NMS, and 119.2 tons per year VOC DOQ from minor projects for a total of 219.4 tons per year VOC DOQ. However, the District in its 2017 Equivalency Demonstration, presented a DOQ of 166.8 tons per year VOC DOQ – a difference of 52.6 tons per year VOC from the CARB value.

Table 8. Comparison between CARB Calculated and SJVAPCD Reported District Offset Quantities in the 2017 Equivalency Demonstration

DOQ Calculation Method	NOx (tons per year)	VOC (tons per year)
DOQ calculated using CARB reviews of each NMS and FMM	75.9	100.2
DOQ from minor projects in Track_Master	0.8	119.2
Total DOQ	76.7	219.4
DOQ reported in the 2017 Equivalency Report*	45.6	166.8
Possible under-credit of DOQ	31.1	52.6

*The source of the DOQ in the equivalency report is sum of erc_pollutant fields in Track_Master.

CARB staff identified ATC projects whose application reviews identified a DOQ, but had a different value noted in the erc_NOx field in Track_Master (Table 9). The erc_NOx field in Track_Master is the source for the DOQ in the equivalency reports.

Table 9. List of ATC Projects from 2017 Report with a District Offset Quantity for NOx in the Authority to Construct Application Review Different from what is Recorded in the Equivalency Database (as erc_nox)

ATC Project Number	DOQ for NOx (tons per year) in ATC Application Review	erc_NOx (tons per year) from Track_Master*
S-1143503	1.1	0
S-1144548	32.6	33.2**
S-1151973 (and S-1152366)	18.4	0.0000001
S-1162420	8.5	0.0000001
S-1162746	0.3	0.2
S-1170679	0.3	0.2
S-1171052	0.9	0.1
S-1171635	6.9	4.1
Net Difference	+31.2	

* Each ERC certificate reserved or withdrawn for a given ATC project will have its own separate entry (erc_NOx) in the District's Track_Master equivalency database under erc_NOx (or erc_pollutant more generally). The DOQ for each ATC project in Table 9 could represent more than one ERC certificate.

** Both District and CARB staff agree that the erc_nox value for project S-1144548 should be 32.6 tons per year. 33.2 tons per year is the total face value of the NOx ERCs proposed for use as offsets in project S-1144548, not the DOQ.

Finally, CARB staff noted three examples where the DOQ for individual ATC projects appeared to be over-credited because the face value of the ERCs reserved for an ATC project were counted (in erc_nox field of Track_Master) instead of the actual DOQ calculated in the application review. This is shown in Table 10. District staff has acknowledged these issues and assured CARB staff that they would be corrected.

Table 10: ATC projects where the DOQ was Over-credited in the Report Because the Face Value of the ERCs Instead of the DOQ from the ATC Application review was Transferred to erc_nox in Track_Master*

Report year	ATC project	erc_nox from Track_Master (tons per year)	ERC # from ATC application review	Face value of ERC (tons per year)	Amount of NOx offset required in ATC project (tons per year)	Over-credit to DOQ in Test 1 Demonstration [sum of erc_nox – amount of offset required in ATC project]
2017	S-1144548	33.2	S-3208-2	33.2	32.6	0.6
-	-	-	-	-	-	-
2016	S-1151996	5.7	S-4515-2	5.7	7.4	7.6
2016	S-1151996	1.4	S-4514-2	5.8		
2016	S-1151996	0.5	S-4516-2	0.5		
2016	S-1151996	3.7	S-4530-2	3.7		
2016	S-1151996	1.5	N-1302-2	1.5		
2016	S-1151996	2.2	N-1332-2	2.2		
-	-	-	-	-	-	-
2016	S-1153671	0.4	S-3326-2 (?)	0.4	6.8	6.6
2016	S-1153671	1.2	S-3625-2	1.2		
2016	S-1153671	0.7	N-1327-2	0.7		
2016	S-1153671	0.4	N-1329-2 (?)	0.4		
2016	S-1153671	10.7	C-1059-2	4.1 (?)		

Overall, CARB staffs' review of federal offset equivalency identifies issues with the accuracy and transparency of the equivalency demonstration because of the data handling system, which, for reasons noted in the findings on the equivalency database, makes it difficult to ensure the accuracy of the demonstration. The current data handling system may have been adequate when the District began the tracking system in 2001 until 2010 -- when the number of NMS and FMM projects in a tracking period

was between zero to four for every pollutant. However, after the bump-up to extreme non-attainment for ozone in 2010, the number NMS and FMM projects for NOx and VOC together has ranged from 35 to 90 every tracking period, creating a quality assurance challenge in an already complex system. The data handling issues point to a clear need for better quality control and transparency.

3. Findings Regarding Test 2 – Surplus at Time-of-Use Equivalency

The second federal offset equivalency test requires the District to reserve or retire sufficient surplus-at-time-of-use creditable emission reductions to mitigate the current years' FOQ. In other words, the District must demonstrate that it has retired sufficient reductions valued as surplus-at-time-of-use to match the number of reductions that would have been required under federal NSR. The emission reductions used as mitigation may come from any year since the start of the equivalency tracking system in 2001, and, as such, each annual report represents a running-total demonstration of equivalency.

The "surplus-at-time-of-use" federal requirement is based in the Clean Air Act requirements that all creditable emission reductions be surplus to all requirements under the Act. Further, this valuation is necessary to avoid double counting of reductions claimed in the SIP.[34] As U.S. EPA has explained ". . . the State cannot rely on emission reduction credits in its overall attainment plan and rely on the same credits in the issuance of an NSR permit (i.e., no 'double counting')."[35] U.S. EPA requires Test 2 as part of the equivalency demonstration because SJVAPCD relies on surplus-at-time-of-issuance valuation and does not discount the value of ERCs at time-of-use based on additional requirements that have been imposed between issuance and use.[36]

Performing a surplus-at-time-of-use determination for an ERC requires looking back at the original emission reduction, but applying the strictest applicable law or emission standard in effect at the time the ERC is used as an offset for NSR (i.e., at time of ATC issuance). As the emission standards become more stringent, the amount of the

[34] See footnotes 9 and 10.

[35] July 21, 1993 U.S. EPA Memorandum from John Seitz, Director, Office of Air Quality Planning and Standards to Air Branch Chiefs, Regions I-X, et al., "Use of Shutdown Credits for Offsets."; *see also* August 26, 1994 U.S. EPA Memorandum from John Seitz, Director, Office of Air Quality Planning and Standards, to David Howekamp, Director Region IX, Air and Toxics Division: "Response to Request for Guidance on Use of Pre-1990 ERC's and Adjusting for RACT at Time-of-use."

[36] Bay Area AQMD and Ventura County APCD are required to perform similar surplus-at-time-of-use equivalency demonstrations by U.S. EPA because they likewise only require emission reductions banked as ERCs to be surplus-at time-of-issuance. South Coast AQMD also does not discount ERCs for their time-of-use; however, South AQMD discounts emission reductions banked as ERCs to applicable Best Available Control Technology (BACT) levels at time-of-issuance. South Coast AQMD is required by U.S. EPA to make an annual demonstration of federal offset equivalency for emission reductions held in its internal bank per Rule 1315, Federal New Source Review Tracking System.

original emission reduction that is still surplus will be reduced. In aggregate, the requirement that ERC value be determined at time-of-use has a deflationary effect on the offset value of an ERC bank.[37] This is discussed in Part 1, which illustrates that the District's estimate that its NOx ERC bank's time-of-use value (as of 2016) is on average about 18 percent of its time-of-issuance value.

Test 2 requires the District to match or mitigate the federal offset quantity (FOQ) from the current tracking period with an equal amount of surplus-at-time-of-use emission reductions drawn from an "equivalency bank" of creditable emission reductions. These reductions are not formally banked, but rather tracked by the District internally through its equivalency-tracking database. To be "creditable" means an emission reduction is real, surplus,[38] quantifiable, enforceable, and permanent.[39] Rule 2201 further defines the eligibility criteria for use of such reductions in the equivalency demonstration.[40]

In practice, the District has used the following types of creditable emission reductions in its "equivalency bank" for use in the surplus-at-time-of-use equivalency demonstration:

- ERCs reserved or withdrawn for ATC projects,
- Unclaimed reductions from orphan shutdowns (i.e. closed facilities), [41]
- Electrification projects from PG&E's AG-ICE program,
- 10 percent air quality improvement deduction (AQID) from newly banked ERCs, returned credits from unimplemented NMS and FMS,
- ERCs surrendered for non-NSR actions (e.g. CEQA, variance, consent decree),

As with Test 1, Test 2 allows any excess in the amount of surplus-at-time-of-use creditable emission reductions to remain in the equivalency bank and be carried forward to future years for equivalency purposes.

To evaluate Test 2, CARB staff began by spot-checking the emission reduction calculations for the types of reductions that have been the most significant for the surplus-at-time-of-use equivalency demonstration. Table 11 compares the amount of NOx reductions used, and the amount remaining for future use in equivalency demonstrations, over the period 2001-2018. Table 11 shows that electrification

[37] The surplus value of the ERC at time-of-use could vary from 0 to 100 percent of its face value. In a April 19, 2016 draft staff report on its equivalency system, SJVAPCD estimated that approximately 18 percent of its banked NOx ERCs were currently surplus (ref. http://www.valleyair.org/Workshops/postings/2016/05-11-16_OEI/DRAFT-Staff-Report.pdf)
[38] For purposes of Test 2, surplus is understood to mean "at time-of-use," i.e. when the creditable reduction is used for a mitigation.
[39] Rule 2201, section 7.1.5.
[40] Rule 2201, section 7.2.2.2.
[41] The electrification projects discussed later in this review could be classified as a type of orphan reduction that the generator of the reduction did not claim or ceded to the District.

projects have accounted for more than 50 percent of the mitigations used to show surplus-at-time-of-use equivalency for NOx from 2001 to 2018, and were completely used by the end of the 2017 to 2018 tracking period. Table 12 shows orphan shutdowns have accounted for nearly 50 percent of the mitigations used to show surplus-at-time-of-use equivalency for VOC from 2001 to 2018 and comprise over 60 percent of the excess VOC and NOx mitigations available for use at the end of the 2018 reporting period.

Table 11: NOx Reductions Used and Remaining by Type for Surplus-at-Time-of-Use Equivalency 2001 – 2018. (All values are tons per year from Track_Master Table.)

Type of Reduction	Amount Used as Mitigation (used_nox)	Remaining Reductions Available for Future Equivalency Demonstrations (r_nox)
Emission Reduction Credits	720.7	160.6
Electrification Projects	1,210.7	0
Orphan Shutdowns	122.5	273.8
Totals	2,053.9	*434.4

*Unused Carry-Over Reductions in 2018 Report = 434.0 tons per year NOx

Table 12: VOC Reductions Used and Remaining by Type for Surplus-at-Time-of-Use Equivalency 2001 – 2018. (All values are tons per year from Track_Master Table.)

Type of Reduction	Amount Used as Mitigation (used_voc)	Remaining Reductions Available for Future Equivalency Demonstrations (r_voc)
Emission Reduction Credits	1,752.4	466.2
Electrification Projects	61.2	0
Orphan Shutdowns	1,720.4	819.2
Totals	3,534.0	*1,285.4

*Unused Carry-Over Reductions in 2018 Report = 1,286.0 tons per year VOC

The source of the creditable reductions from electrification projects is the Agricultural Internal Combustion Engine or AG-ICE program, which funded replacements of diesel internal combustion engines with utility electricity to power agricultural irrigation pumps from approximately 2005 - 2008. The District's equivalency database shows that 1,210.7 tons per year of surplus NOx reductions from 919 engines were claimed from AG-ICE. The electrification projects comprise 77 percent of the mitigations used to show surplus-at-time-of-use equivalency for NOx from 2008 to 2018.

CARB reviewed data and other background information to determine the amount of creditable emission reductions from a randomly selected sample of 10 electrification projects that were listed in the 2017 Equivalency Report. The diesel internal combustion engines replaced were all Tier 0, Tier 1, or Tier 2.

Because the District claimed the reductions from all 919 diesel-to-electric projects at the same time for use in the equivalency demonstration in 2008, and all the reductions were generated by replacing diesel internal combustion engines with electric motors, the sample of 10 projects appears representative of the emission reduction calculations from all 919 projects.

a. Electrification Projects

There are multiple issues with the use of the electrification projects for equivalency.

- *Issues Regarding Whether Reductions Were Real, Due to Load-Factor Discrepancies*

Emission reductions from the AG-ICE electrification projects involved the replacement of Tier 0, 1, or 2 diesel IC engines with electric motor power. The reductions from AG-ICE were divided into two parts: (a) the replacement of Tier 0, 1, 2 diesel emissions to the equivalent activity with Tier 3 levels of emissions, and (b) the replacement of Tier 3 level of emissions to zero (i.e. the electric motor emissions being counted as zero).

The District used the reductions from Tier 3 emissions to zero for the equivalency demonstration. The District did not use the emissions reduction benefit from the replacement of Tier 0, 1, 2 diesel emissions to the equivalent activity with Tier 3 levels of emissions. That reduction benefit was not utilized for equivalency. To be eligible for the equivalency demonstration, an emission reduction must be creditable meaning, among other criteria, that it must be based on real or actual emissions.[42] A portion of the reductions claimed by the District from AG-ICE do not qualify as real because the calculation methodology used by the District assumed the replaced engines' operated with a load factor of 1.0 rather than the actual load or the default load factor provided by the Carl Moyer Program Guidelines.

The Carl Moyer Program ensures reductions it funds are real (and thus SIP creditable) by using calculation methods that represent real emissions. For emission reductions based on the AG-ICE program, the Carl Moyer Program Guidelines in Appendix C prescribe the following method when the engine activity level is based on annual hours of operation:[43]

[42] District Rule 2201, Section 7.1.5 (amended 8/15/19)
[43] The Carl Moyer Program Guidelines Part IV, Appendix C, 1. Calculating Annual Emissions Based on Hours of Operation, C-3 (November 17, 2005)

Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr):

*Emission Factor or Converted Emission Standard (g/bhp-hr) * Horsepower * **Load Factor** * Activity (hr/yr) * Percent Operation in CA * ton/907,200g*

The engine load factor is an indicator of the nominal amount of work done by the engine for a particular application. It is given as a fraction of the rated horsepower of the engine and varies with engine application. For projects in which the horsepower of the baseline technology and reduced technology are different by more than 25 percent, the load factor must be adjusted following formula C-5 below. It is important to understand the replacement load factor must never exceed 100 percent in cases where the reduced technology engine is significantly smaller than the baseline technology engine.

Formula C-5:

*Replacement Load Factor = Default Load Factor $_{baseline}$ * hp $_{baseline}$/hp $_{reduced}$*

Moyer uses a default load factor for agricultural irrigation pumps of 0.65 as determined from historical emissions inventory.[44] The default load factors for dozens of types of off-road heavy-duty diesel engines are given in Table B-13 of the Guidelines, and those range from 0.30 to 0.78.

Following the above Appendix C method, the CARL database uses the horsepower of the electric motor in the formula C-4 above and bases the Tier 3 emission factor on the horsepower rating of the electric motor. The CARL database uses the electric motor horsepower only in conjunction with the replacement load factor in the calculation of emissions. This ensures the activity used to calculate the reduction, measured as horsepower-hours, does not increase beyond the baseline of the replaced diesel IC engine.

However, in Appendix D of the same Carl Moyer Program Guidelines, an example calculation for an AG-ICE project is given where no adjustment to the default load factor (0.65) is made although the electric motor that replaced the diesel IC engine has a horsepower that is more than 25 percent different.[45] The example calculation uses the horsepower rating of the replaced diesel IC engine in the formula C-4 above and bases the Tier 3 emission factor on the rated horsepower of the IC engine. This method likewise ensures that the activity used to calculate the reduction equals the baseline of the replaced diesel IC engine.

[44] Carl Moyer Program Guidelines, Part IV, Appendix B, Table B-13 (November 17, 2005)
[45] The Carl Moyer Program Guidelines Part IV, Appendix D, XII. Zero-Emission Technologies, Example 2, D-64 (November 17, 2005)

CARB staff believe that either of the two methods (Appendix C or Appendix D of the Carl Moyer Guidelines Part IV) is an acceptable calculation for determining the amount of actual emission reductions from an AG-ICE project. The District used the Appendix D method with one significant deviation -- the District used a load factor of 1.0 rather than the default load factor of 0.65.

Staff reviewed District calculations from the 10 sample electrification projects. Table 13 lists the variables used and the results of the calculated amount of creditable emission reductions by the District compared to the Carl Moyer Program Guidelines Appendix D and CARL (Appendix C) described above. The District calculation for the amount of creditable NOx reductions that can be claimed for these projects is higher for all 10 projects compared to either Carl Moyer method. CARB staff believes the District over-credited these 10 electrification projects by 35 percent or more because of the use of a load factor of 1.0 tied to the horsepower of the diesel engine being replaced.

Table 13: Creditable Emission Reduction Calculations from 10 Electrification Projects[46]

Tracking ID	Model Year	Tier	IC Engine Horsepower	Operating Hours (hr/year)	Carl Moyer Tier 3 NOx EF (g/bhp-hr)[47]	District Calculated Reduction NOx (t/yr)[48]	Moyer Appendix D Calculated Reduction NOx (t/yr)[49]	CARL Calculated Reduction NOx (t/yr)[50]
2008-S-8881142-3089-1	1979	0	125	6,800	2.32	2.2	1.4	0.8
2008-S-8881145-3090-1	1996	0	150	6,739	2.32	2.6	1.7	Not in CARL
2008-S-8881262-3137-1	2003	2	152	4,000	2.32	1.6	1.0	0.9
2008-C-8881814-3634-1	2003	2	125	3,000	2.32	1.0	0.6	0.5
2008-C-8881829-3637-1	2004	2	113	2,500	2.74	0.9	0.6	0.6
2008-C-8881878-3659-1	2004	2	139	4,000	2.32	1.4	0.9	0.9
2008-C-8881896-2980-1	2001	1	105	2,500	2.74	0.8	0.5	Not in CARL
2008-C-8881901-2908-1	1992	0	76	1,600	2.74	0.4	0.2	Not in CARL
2008-C-8881971-2996-1	2001	1	230	2,200	2.32	1.3	0.8	0.9
2008-C-8881972-3000-1	2002	1	230	2,200	2.32	1.3	0.8	Not in CARL
					Sum	13.5	8.5	N/A

[46] Supplemental calculations and tables related to the electrification projects will be included in a document on the San Joaquin Valley ERC Program Review Public Documents web page.

[47] Tier 3 Emission Factors from 2008 Carl Moyer Program Guidelines Part IV, Appendix B, Tables for Emission Reduction and Cost Effectiveness Calculations, Table B-13. The emissions factor from the 2005 and 2008 guidelines differ for some horsepower ranges. CARB staff used the guideline the District proposed.

[48] District calculation: NOx (t/yr) = BHP × **Load Factor (1.0)** × Operating Hours (hr/yr) × EF (g-NOx/bhp-hr) × 1 lb/453.6 g × 1 ton/2,000 lb

[49] CARB staff calculation following Carl Moyer Guidelines Appendix D:
NOx (tons per year) = BHP × **Load Factor (0.65)** × Operating Hours (hr/yr) × EF (g-NOx/bhp-hr) × 1 lb/ 453.6 g × 1 ton/ 2,000 lb [equation from 2005 Carl Moyer Program Guidelines Part IV, Appendix D, Examples Calculations, XII. Zero Emission Technologies. Also 2008 Carl Moyer Program Guidelines Part IV, Appendix E, Examples Calculations, VII. Agricultural Sources]

[50] CARL calculation following Carl Moyer Guidelines Appendix C:
NOx (tons per year) = BHP (ICE) × Default Load Factor (0.65) × (BHP (ICE)/HP electric motor) × Operating Hours (hr/yr) × EF (g-NOx/bhp-hr) × 1 lb/ 453.6 g × 1 ton/ 2,000 lb [modified load factor equation from 2005 Carl Moyer Program Guidelines Part IV, Appendix C.

- *Issues Regarding Permitted Sources*

To be eligible for use in the surplus-at-time-of-use demonstration an unbanked reduction must have been generated as a result of a permitting action:

> *For purposes of the demonstration described in Section 7.2.2, the comparison may also include the surplus value of additional creditable emission reductions that have not been used as offsets and have been banked or have been generated as a result of permitting actions. [Rule 2201, section 7.2.2.2]*

According to the District, none of the replaced engines from the sample of 10 projects had a permit prior to removal, nor was a permit issued for the electrified pump that replaced it. Thus, the reductions associated with the replacement engines were not generated as a result of a permitting action.

- *Issues Regarding Crediting of State-Funded Projects*

Some of the AG-ICE projects received co-funding from the Carl Moyer Program. California law prohibits the use of any project funded by Carl Moyer from being used as an emissions offset. While the District recognizes that some of the projects were co-funded by Moyer and the utilities, the District believes that because they are using only the portion of the total emission reductions generated equal to the replacement of a Tier 3 engine with an electric motor the requirements of State law are met. Aside from the funding issue, it is important to note that there does not appear to have been any double counting of emissions reductions, meaning the emissions the District claimed for use in equivalency were not counted in any other way for SIP purposes.

California Health and Safety Code, section 44281 (b) states:

> *No project funded by the [Carl Moyer] program shall be used for credit under any state or federal emissions averaging, banking, or trading program. No covered emission reduction generated by the program shall be used as marketable emission reduction credits or to offset any emission reduction obligation of any person or entity.*

The 2005 Moyer Guidelines, which are incorporated by reference under the Health & Safety code and implemented the Moyer statute at the time when the AG-ICE program was implemented, also specifically provided that the reductions from AG-ICE funded project belonged to the Carl Moyer Program if the project also received Moyer funds:

> *Carl Moyer Program applicants using the PG&E and SCE incentive programs will also have to make adjustments to the emission reduction calculations. Because to date virtually no electric agricultural pump projects have been funded through Carl Moyer Program grants, the PG&E and SCE incentive programs take credit for the emission reduction*

between a Tier 3 engine and an electric motor. ***As a condition of the PG&E and SCE incentive programs, these emission reductions must be donated to the Carl Moyer Program for clean air.*** *The emission reduction benefit between the replaced engine and a Tier 3 engine, may be included in the cost-effectiveness calculation to determine the grant amount. An example of this calculation is provided in Appendix D. (ref. 2005 Carl Moyer Program Guidelines, Part II, Project Criteria, Chapter XII, Zero Emission Technologies, XII-p. 5)*

The AG-ICE program operated with both funding between public utilities, and the State of California in part through the Carl Moyer program. Specifically, the Carl Moyer program funded conversion to electric pumps, and the public utilities provided line extensions and rate incentives. Joint funding was necessary because funding levels from the Carl Moyer program alone were not sufficient to entice a transition from diesel to electric agricultural pumps.

A joint settlement between the California Public Utilities Commission, Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), the Office of Ratepayer Advocates, the Utility Reform Network, Agricultural Energy Consumers Association, the California Farm Bureau Federation, and the California Air Resources Board[51] in March 2005 established favorable electric rates which helped encourage the transition from diesel to electric pumps.

The District believes the record of the CPUC proceedings show that the agreement apportioned emission reductions between the utilities, the State, and the District. The District believes that under the agreement the State would retain criteria pollutant emission reductions generated by the transition between the engine being replaced and a Tier 3 engine, and the District (through the utilities) would retain criteria pollutant emission reductions from a Tier 3 engine to zero emissions. The District relied on their understanding of this agreement when deciding to use the AG-ICE emission reductions from Tier 3 to zero emissions for demonstrating offset equivalency. CARB staff does not concur with this assessment.

CARB staff has not determined the exact number of electrification projects that received Carl Moyer funding. In the sample of ten AG-ICE electrification projects using serial numbers for the replaced diesel engines along with other project specific information[52] CARB staff noted that six of the ten engines matched engine records in CARB's Clean Air Reporting Log (CARL) database strongly indicating these six projects received Moyer funding or co-funding.

[51] http://docs.cpuc.ca.gov/publishedDocs/published/Graphics/47069.PDF

[52] CARB staff does not have the serial number for all 919 diesel engines replaced as this information is not part of the District's equivalency tracking database that CARB staff has access to.

A preliminary review of the 919 electrification projects suggests that a large number of those could have also received Carol Moyer funding.

Issues Regarding Permanency of Reductions

Another of the criteria for claiming a reduction in the surplus-at-time-of-use demonstration is that the reductions be permanent.

The AG-ICE Program had a limited life, as explained in a July 27, 2005 document titled *Agricultural Internal Combustion (IC) Engine Conversion Incentive Program Questions and Answers*, published by PG&E, California Farm Bureau Federation, and Agricultural Energy Users Association[53]

> *Q7. Do I have to stay on the AG-ICE rate for the whole 10 years?*
>
> *A. No. You will only be required to stay on the AG-ICE rate for 12 months under Electric Rule 12. However, if you elect to leave the AG-ICE rate for a different PG&E electric tariff, you may not return to the AG-ICE rate.*
>
> *After the program expires on December 31, 2015, nothing in the AG-ICE program precludes a grower from leaving PG&E to disconnect or choose an alternative power source such as an IC engine, although there is no certainty as to the air quality regulations that will be in place at that time. The customer would still be responsible for non-passable charges if going to an alternate electrical source provided those charges are in existence at the time of departure.*

With the Carl Moyer Program, to ensure satisfaction of the permanence requirement, SIP creditability of reductions ends with the contract expiration. Similarly, with the AG-ICE program, reductions from the electrification projects may not be enforceable after the expiration of the contract, meaning, after the contract expires, they may not meet the criterion for permanence under Rule 2201, section 7.1.5 to be used in the equivalency demonstration.

b. Orphan Shutdowns

Orphan shutdowns are unclaimed emission reductions from facilities that have shut down and surrendered their air permits, but did not claim the actual emission reductions, if any, from the cessation of emissions. The District collects the actual emission reductions from orphan shutdowns and retires them for use in the equivalency demonstration. The District never uses emission reductions from orphan shut downs to directly offset emission increases from ATC projects.

[53] Ref. Agricultural Internal Combustion (IC) Engine Conversion Incentive Program Questions and Answers from July 27, 2005, Published by PG&E, California Farm Bureau Federation, and Agricultural Energy Users Association.

Although orphan emission reductions are not formally banked as ERCs, Rule 2201 does require them to meet the same evaluation criteria as ERCs.[54] The reductions must be real, surplus, permanent, quantifiable, and enforceable.

According to the District's internal guideline document "Offset Equivalency Step-by-Step Instructions," actual emissions reductions from orphan shutdowns are calculated using the following method:[55]

> *The database will calculate the emissions for units at the deleted facilities using the following protocol:*
>
> - *use the two most recent [Emissions Inventory] years from the past 5 years.*
> - *if both years are available, average the two*
> - *if only one year is available, use that year (no average)*
> - *if both years are blank[56], use 1/2 of the PE [potential to emit]*

The District's method for crediting emission reductions from orphan shutdowns is an attempt to treat orphan shutdowns in a manner similar to ERC banking applications by applying the concepts "baseline period" and "actual emission reductions" from Rule 2201.[57] That is, the District bases the amount of creditable emissions reductions on actual operating data from the most recent two-year period from the past five years preceding shutdown. The period immediately preceding shutdown is usually the lowest emitting period in the life of a facility. Rule 2201 and federal NSR allow a different 24-month period from the past five years if the permitting authority determines that a different 24-month period is more representative of normal operation. Therefore, in this respect, by using the most recent time period instead of the most representative operating period, the District's method for crediting orphan shutdowns is more conservative than Rule 2201 or federal NSR for crediting emission reductions.

However, the District's orphan credit procedure is less stringent than its normal ERC banking procedure or federal NSR for establishing real emissions in that it allows for use of one years' worth of data, or the use of half of the potential to emit, if no emissions inventory record is available from the previous five years. For facilities where the record on actual emissions is absent or missing, relying on some fraction of the permitted or potential to emit of a source as a way of representing actual emissions may be a reasonable practical accommodation. Unlike with ERC applications, where the applicant has an active interest in providing operating data,

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[54] District Rule 2201, section 7.1.5 (8/15/19)
[55] SJVAPCD *Offset Equivalency Step-by-Step Instructions*, III.C. Entering Deleted Facilities (C.III.6)
[56] The word "blank" implies missing or absent data. However, CARB staff would note that in practice "blank" appears to include instances of zero emissions, i.e. zero actual emissions is taken to be the same as missing data, justifying the use of ½ of the potential to emit.
[57] District Rule 2201, sections 3.2 and 3.9 (8/15/19)

the District is forced to rely on its own records of operating history to discern the actual emissions from the operation, which may be incomplete for older shutdowns. The question of whether the multiplier of half of the permitted emissions is appropriate here would require further research beyond the scope of this review. For purposes of this review, CARB staff assumed, consistent with District practice, half of the potential or permitted emissions where no emissions inventory or operating record was available.

The District does not discount or surplus the orphan shutdowns when they are added to the federal offset equivalency tracking system. This practice is indicated in their internal guidance document Offset Equivalency Step-by-Step Instructions*:* [58]

> *For deleted facilities, the District does not discount the emissions reductions. Therefore, enter "0" for:*
>
> - *"Permitted Potential to Emit after the initial action (t/y)",*
> - *"Discount quantity for federal rules in place at the time of initial action (t/y)"*
> - *"Discount quantity for federal rules SINCE the time of initial action (t/y)".*

CARB staff would agree that for most orphan shutdowns, the permit at the time of surrender should reflect all the applicable emission standards. Therefore, any actual emission reductions generated in conformity with the permit should be surplus at the time of permit surrender. However, CARB staff would note several examples discovered in this review where this assumption turned out to be unwarranted, e.g. permits representing "non-compliant dormant emissions units" or "fee-paying units," which contain emission limits that are not reflective of the applicable rule standards. Nevertheless, this by itself should not cause any inaccuracies in the equivalency demonstration provided the surplus value of the reductions is determined at the time the reductions are used as mitigation.

CARB staff has determined that the District's procedure above for assessing actual emissions reductions from orphan shutdown is reasonable and appropriate, with four clarifications. First, in step 4 of the procedure for determining the amount of emission reduction, the word "blanks" should be understood to refer to an absence of data, not actual zeros, i.e., where the record clearly indicates zero emissions or non-operation. Second, orphan reductions should be subject to the surplus-at-time-of-use requirement as required by Rule 2201. Third, when a shutdown involves multiple emissions units, only one consecutive 24-month period (or 12-month period per the District's procedure referenced above) should be used to determine the actual emissions. This stipulation should be observed for determining the amount of creditable reductions from orphan shutdowns because it prevents double counting of emissions that are merely shifting from unit to unit over time (i.e., shifting to a similar

[58] SJVAPCD Offset Equivalency Step-by-Step Instructions, III.C. Bullet point i (C.III.24).

source within a facility or counting emissions that were relied on in an internal offset or netting action). Thus, to use a specific period of emissions inventory for one unit, but not for other units, (and instead using, for example, ½ PE) is inconsistent with this stipulation and inconsistent with how the District would normally bank these reductions were they to go through a formal banking process. Fourth, related to the previous point, the District should not credit emission reductions related to older cancelled permits that could not legally operate or emit at the claimed levels within the five-year look-back period to determine the actual emissions.

CARB staff reviewed a random sample of 11 orphan shutdowns used as mitigation in the 2018 tracking period (Table 14).[59] CARB staff determined a lower value for the reductions than the District had for most of the orphan shutdowns. The differences between CARB's determination and the District's determination appear to result mainly from (1) the District not following the procedure in Steps 1 – 4 noted above, or (2) the District not appropriately discounting the emission reductions to reflect their surplus value.

In orphan reduction 2011-S-9990046-4884, the District did not use the available emission inventory record, the compliance record, correspondence from the operator, or the PE value as indicated on the permit to determine the amount of creditable emission reductions. This shutdown consisted of six petroleum storage tanks and one wastewater storage tank. The District received a letter from the operator requesting cancellation of the permits on November 29, 2010. In the letter, the operator noted the tanks had not operated since summer of 2001. The District's June 29, 2010 inspection report also stated the facility had been out of service since 2001. In June of 2011, the facility submitted a 2010 emission inventory report indicating no throughput for any of the equipment in 2010.

The District claimed 525.8 tons per year of VOC creditable reductions for the surplus-at-time-of-use equivalency in 2011 as indicated by the equivalency database entries showing ini_r_voc and aer_voc = 528.8 tons per year. As of the 2018 equivalency report, 320.1 tons per year VOC had been used in the equivalency demonstrations since 2011 (used_voc) with 205.7 tons per year remaining (r_voc).

CARB staff found that the record demonstrated that actual emissions were zero for this facility since summer of 2001. Following the District's rules for crediting reductions from deleted facilities, the amount of creditable VOC reductions available from the shutdown should have been 0 tons per year. If one allows that the District system tracked these zeros as "blanks" or missing data, then ½ PE would be used. The facility-wide Title V permit S-46-0-2 renewed for this facility in 2009 had a facility-wide cap on

[59] All orphan reductions can be identified in the tracking system and annual reports by the "999----" in their tracking number. The tracking number also reveals the facility identification number associated with the permits and when the District claimed the emission reductions for the tracking system. For example, orphan reduction 2011-S-9990046-4884-1 was from the shutdown of facility S-46, and the District claimed those reductions for the equivalency demonstration in 2011.

VOC emissions of 50 tons per year. Using the District rule that would credit ½ PE for a shutdown facility in the absence of any emission inventory data from the previous five years. At most, the District could claim 25 tons per year of VOC for use in the equivalency demonstration. CARB staff believes the permissible creditable reductions for the shutdown of this facility in 2011 should be 0 tons per year VOC; however, in no case should the amount of creditable reductions be greater than 25 tons per year VOC. The District acknowledged and indicated they would address this issue.

The results from CARB staff's review of the sample of 11 emission reductions from orphan shutdowns used in whole or in part in the 2018 Equivalency Report is presented in Table 14. For each of these shutdowns, CARB staff calculated the amount of orphan actual emission reductions (AER) that could be claimed or used and compared to the amount of credit taken in the District Track_Master and Track_Allocate databases. CARB's results were consistently lower than District's recorded values. These results may or may not be representative of other orphan shutdowns, because each orphan shutdown presents a unique set of circumstances that determines the amount of credit that can be claimed. Detailed explanations and reference documents for all the orphan shutdowns indicated in Table 14 will be included on the San Joaquin Valley ERC Program Review Public Documents web page.

Table 14. Orphan Credit Comparison between CARB and District Staff for Mitigations Used in the 2018 Report[60]

Track Number	NOx (tons per year) District Database	NOx (tons per year) CARB Calculated	VOC (tons per year) District Database	VOC (tons per year) CARB Calculated
2011-S-9990046-4884	-	-	525.8	0
2013-C-9990512-5391	0.59	0.28	7.14	3.14
2013-S-9990204-5386	2.63	0.83	0.17	0.05
2010-C-9990263-4278	1.0	0.3	0	0
2010-C-9990583-4282	1.2	0.04 or 0.09	1.3	0.08
2004-S-9990252-1439	0.6	0.07 or 0.21	0.11	0.003 or 0.11
2015-N-9990290-6076	0.75	0.70	0.15	0.15
2015-S-9990494-6077	0.63	*	0.14	*
2017-C-9990646-6593	9.74	1.36	2.29	1.28
2018-C-9990445-6878	1.93	0	0.41	0
2018-C-9990547-6880	4.03	0	0.37	0

*CARB staff did not have the information to verify the District's value.

[60] The District values in the table below are found in Track_Master under one or more fields aer_pollutant ini-r_pollutant, and used_pollutant.

V. Part 4: Application of Offset Requirements to Permitting

The District's ERC system works as part of a larger NSR program to accomplish the air quality goals in the San Joaquin Valley. ERCs are the currency of offsets, and offsets are a NSR requirement. In most cases, BACT is triggered and evaluated prior to offsets being required. As a result, BACT has a direct relation to whether offsets are triggered and how many are required as part of NSR. Therefore, the final portion of the review focused on how the District calculated and used offsets in the permitting process.

Based on the limited analysis we have conducted, we found the District generally appears to apply its NSR program consistent with its rules and policies. In addition, we found no difference in the application of the District's NSR program between ATCs selected from the community list, and those selected at random.

CARB staff selected 30 ATC projects for this portion of the review. Most of the projects were drawn from a list generated by District staff of approximately 7,200 ATC projects issued by the District from 2016 to 2018. A few projects outside this window were chosen when staff could not locate a project within the 2016 - 2018 window that met the other selection criteria. Half (15 of the ATCs) were selected from random facilities, and the other half (15 of the ATCs) were selected from a list of facilities raised by community groups: Rio Bravo Fresno, Vitro, San Fe Petroleum Terminal, MB Technology, Chevron USA Inc, Aera Energy LLC, Kern Oil and Refining, Alon Bakersfield Refining, and Gallo Glass Company. It should be noted that for the 15 facilities from the list, there were hundreds of individual ATCs from which one was selected at random, from each facility.

CARB selected projects based on several criteria. The main criterion was that the projects had to illustrate some facet of the offsetting requirements, offset exemptions, or calculation methods that feed offset determinations in District Rule 2201. Other aspects of the projects, e.g., BACT, risk assessments, application of prohibitory rules, were also reviewed, however, as they were integral to the ATC project approval. Table 15 lists the projects selected for analysis:

Table 15. Authority-to-Construct Applications Selected for Review

Project ID	Project ID	Project ID	Project ID
S-1171639^	S-1182997^	S-1182363	N-1153167
S-1170151^	S-1173785^	S-1150871	N-1172193
S-1160023^	C-1172937^	S-1153552	N-1162806
S-1173694^	N-1182628^	S-1153263	C-1141302
S-1153809^	C-1182872^	N-1162235	C-1181525
S-1183520^	C-1051325^	N-1152244	N-115001
S-1182998^	C-1181006^	N-1153643	
S-1163220^	S-1183515	N-1183369	

^ Project selected at random from one of 9 facilities requested by community stakeholders.

Consistent with CARB staff's evaluation of ERCs in Part 2 of this report, CARB staff's analysis identified transparency and record gaps as an issue. In a majority (21 of 30) of projects reviewed, the evaluation did not provide enough information to replicate or verify the information used in the District evaluation or provided in the facility application, or did not clearly document calculations. In some cases, citations were not provided for assumptions or the evaluation lacked explanation for determinations. The following ATCs were impacted by lack of information: S-1150871, S-1153263, S-1153552, S-1153809, S-1160023, S-1163220, S-1170151, S-1171639, S-1173694, S-1173785, S-1182363, S-1182997, S-1182998, S-1183515, S-1183520, N-1152244, N-1183369, C-1172937, C-1181006, C-1181525, and C-1182872.

Examples of transparency issues found include:

- S-1183520: The engineering evaluation did not include emission factors or emission calculations used to determine the potential to emit. There was no explanation for the ranking of control technologies in the BACT analysis. The PE and BE calculations were not clear, which affects the quantity of offsets required.
- S-1173694: There were no emission calculations provided, so it was not possible to verify if the District's conclusion that there would be no change in emissions. This affects applicability of BACT, Offsets, and public notice.
- S-1153552: The project was for a relaxation in monitoring requirements, but was classified as a Title V minor modification without a justification in the evaluation. Calculation issues in the PE1 and PE2 tables make the values difficult to follow.

Finally, CARB staff conducted a cursory review of the SJVAPCD and other district's offset thresholds, BACT trigger levels, BACT cost-effectiveness thresholds, and BACT cost-effectiveness assumptions. There are clear differences between the District's BACT trigger and threshold levels compared to other districts. There are also clear differences in these factors among all the districts. While all air district NSR programs have the same basic structure, they vary in their detail. As a result, staff's review of offset thresholds, BACT trigger levels, BACT cost-effectiveness thresholds, and BACT cost-effectiveness assumptions was not sufficient to make specific conclusions about the overall stringency of the District's NSR program. Such an assessment of the district's NSR program is beyond the scope this report.

California air quality policy and management is increasingly focused on addressing community scale impacts along with the long-standing focus on regional attainment of air quality standards governed by both the Clean Air Act and State law. As a result, there is a growing need to understand how existing NSR programs address both regional and community scale needs. The review necessary to develop a sufficient understanding of NSR programs and how they are applied must be broader than an evaluation of a single district's program. As noted NSR programs can vary in complex and nuanced ways. Understanding how they work and what the opportunities are to optimize the systems to ensure they meet current and future needs will require the focused efforts of staff from multiple air districts as well as CARB staff. CARB staff proposes to begin a discussion with the air districts as well as stakeholders concerning the approach for conducting such a review.

VI. Summary and Recommendations for Future Action

The current SJVAPCD ERC bank contains nearly 11 million pounds of NOx ERCs when valued at time-of-issuance. While the bank is large, 80% of the ERCs it contains were issued more than 20 years ago. As the District's programs have become more stringent, the time-of-use value of these ERCs has declined. The District estimated in 2016 that these ERCs, when valued using time-of-use assumptions, are worth about 18% of the time-of-issuance value. This decline has no immediate impact on the holders of the ERCs, because the value of these ERCs under the District's NSR program is based on time-of-issuance. However, this decline is the reason why EPA requires the equivalency determination – to ensure that the difference between time-of-issuance and time-of-use ERC value is accounted for through sufficient offsets generated by the overall increased stringency of the District's program relative to federal requirements.

The equivalency demonstration was designed to allow the District to take credit for other reductions that are generated through their NSR program, such as the application of NSR to non-major sources, and other areas where the District's program is more stringent than federal requirements. However, when the District was reclassified to extreme non-attainment, the major source emission thresholds were reduced, which substantially reduced the advantage between the District's and federal NSR requirements. For the past decade, the District has heavily relied on orphan shutdowns and electrification projects to demonstrate equivalency. It should be noted that these projects are not related to the stringency of the District's NSR rules.

This review identified three groups of findings which, when viewed together, indicate that the District should strengthen its ERC system, to ensure the program will result in no net increase emissions across the basin, while also providing the ERCs industry needs in the San Joaquin Valley. In reviewing ERC banking actions, ATC evaluations, and the District's equivalency database, staff identified general findings in three areas:

A. Transparency and Rigor of Analysis

- In many of the ERC and ATC projects reviewed, the evaluations lacked supporting documentation that is necessary to replicate, verify or fully review the District's actions. ERC banking actions were missing information such as emissions inventory submittals, choice of baseline period, Continuous Emissions Monitoring data, source test data, and other information. ATCs in some cases were missing citations for assumptions, and some evaluations lacked explanation for determinations.
- The District's equivalency system database is lacking technical documentation, and is not self-contained, meaning that many calculations are conducted external to the database system, performed by input from or output to spreadsheet files for additional analysis. As a result, the calculations are not fully trackable within the

database system. Staff's analysis identified orphan records in the system and calculation discrepancies in the District's offset requirement equivalency demonstration (i.e., Test 1), caused in part by issues in data entry and data processing procedures before data is entered into the database. Overall, these issues highlight areas for improvement, both in District's staff's analysis, and in the database environment where staff perform calculations and engineering analyses. After the bump-up to extreme non-attainment in 2010, the number of projects has increased, creating a quality assurance challenge in an already complex system.

- Staff's analysis identified several calculation issues relating to orphan shutdowns and electrification projects affecting the surplus-at-time-of-use equivalency demonstration (i.e., Test 2). Electrification projects and orphan shutdowns both appear to be overestimated. In particular, the emission reductions from electrification projects appear overestimated by at least 35 percent. These issues need to be addressed going forward to provide confidence in the surplus-at-time-of-use equivalency demonstration to be submitted in 2020.

B. Rule Implementation

In the second set of findings, staff identified rule implementation issues:

- ERC Timeliness

In 15 of the 52 ERC projects reviewed, the District granted ERCs, generated by facility shutdowns, in which emissions ceased more than 180 days before submission of the ERC application. The District followed its long-standing policy defining shutdown as the surrender of the operating permit, when deciding to grant these ERCs. However, the District's policy conflicts with its Rule, which requires the application to be submitted no later than 180 days after the emission reductions occurred. The District should follow its Rule as written and make adjustments so that both the policy and rule are consistent.

- ERC Surplus Reductions

In four of the 52 ERC projects reviewed, the District granted ERCs even though they appeared to not be surplus of every federal, State, or district law, rule, order, permit, or regulation. This increased the value of the ERC to the applicant, and decreased the value of the ERC in the equivalency demonstration when the ERCs are used. Over time these types of decisions may put the District's offset equivalency demonstration at risk.

C. Offset Equivalency

In the third set of findings, staff identified several issues in the District's equivalency demonstration.

- ERC Electrification Project Eligibility and Calculations

The District relies on electrification projects, generated through the Agricultural Internal Combustion Engine (AG-ICE) incentive program, to demonstrate NOx equivalency with federal requirements. In calculating and claiming credit for these projects, the District used an incorrect load factor, resulting in a significant overvaluing of reductions in the equivalency demonstration. In addition, these reductions were not documented to have resulted from a permitting action, were not documented to be permanently enforceable, and potentially half of the credited projects appeared to be funded in part through the Carl Moyer program. These issues affect the magnitude and eligibility of electrification projects that are the primary basis for NOx equivalency over the past ten years. The District should address these issues in its 2020 Equivalency Demonstration.

Recommendations for Future Action

The issues identified in this report are complex, and impact a wide array of stakeholders in the San Joaquin Valley including residents of the Valley, industries that rely on offsets and ERCs in order to expand or build new business, environmental organizations who advocate for cleaner air, and community groups representing those living near stationary and mobile sources who are impacted the most by emissions at the local level.

As a result of the findings highlighted in this report, CARB staff recommends that the District take specific action to address the following overarching findings as detailed in this evaluation.

- Revise the program to make it more transparent to the public and industry and more rigorous.
- Upgrade the District's Implementation procedures and policies.
- Review and revise assumptions in the equivalency demonstration as identified.

VIEW ALL NEWS

California Resources Corporation Announces Carbon Dioxide Management Agreement For CTV's First Permanent Carbon Storage Project

07 Dec, 2022

Project Aims to Sequester Initial 100,000 Metric Tons of CO_2 Per Annum in 2025

LONG BEACH, Calif.--(BUSINESS WIRE)-- California Resources Corporation (NYSE: CRC) today announced a Carbon Dioxide Management Agreement (CDMA) between Carbon TerraVault JV Holdco, LLC (CTV JV) and Lone Cypress Energy Services, LLC (Lone Cypress), an independent energy company focused on the development of low-carbon hydrogen generation facilities and energy infrastructure, to sequester 100,000 metric tons (MT) of carbon dioxide (CO_2) per annum from a newly constructed blue hydrogen plant at the Elk Hills Field in Kern County. Called the Lone Cypress Hydrogen Project, the project aims to be California's first blue hydrogen facility producing 30 tons per day and has the potential to expand to 60 tons per day of blue hydrogen with up to 200,000 MT of CO_2 sequestration per annum.

Blue hydrogen is a net zero-carbon intensity fuel produced from natural gas. The CO_2 generated during the methane reforming process is captured and will be stored permanently underground.

"We are excited to be at the forefront of the energy transition in California. CRC is enabling the net zero energy economy by partnering with Lone Cypress to site a brand-new hydrogen facility at our Elk Hills Field as well as offering permanent CO_2 sequestration through Carbon TerraVault," said Mac McFarland, CRC's President and Chief Executive Officer. "Because capture and compression are built into the project development, we anticipate limited capital requirements from the CTV JV and EBITDA per metric ton within our previously stated range. This CTV storage project is a meaningful

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step forward in CRC's rollout of carbon capture and sequestration technology across the state and is the first of, what we believe, will be many projects to come. We are also excited about the ability to leverage our Elk Hills asset to create a Net Zero Industrial Park by combining green field development and carbon sequestration."

CDMA Highlights:

- The CDMA frames the contractual terms between parties by outlining the material economics and terms of the project and includes conditions precedent to close. The CDMA provides a clear path for the parties to reach final definitive documents and a Final Investment Decision (FID)
- The Lone Cypress Hydrogen Project will employ a proprietary steam methane reformation technology with an integrated carbon capture system. The facility is expected to produce 30 tons per day of hydrogen at startup with the ability to expand to 60 tons per day of hydrogen which is under consideration. This translates to an initial 100,000 MT per annum of associated CO_2 that will be permanently sequestered through CTV or 200,000 MT per annum of CO_2 that will be permanently sequestered if the project is expanded
- Project FID is targeted in late 2023, with full operations by the end of 2025, in line with the CTV JV's stated goal of first injection in 2025
- The CDMA provides Lone Cypress with access to 50 surface acres at the Elk Hills Field with the option for an additional 50 acres if expansion to a 60 ton per day project is pursued
- The CTV JV will provide infield transportation and a permanent CO2 sequestration site at 26R in exchange for an injection fee on a per ton basis that fits within the previously disclosed economic type-curve for projects that require a storage-only solution
- The project's location at Elk Hills will eliminate the need for long haul CO_2 transportation and certain midstream capital requirements
- CO_2 capture capital will be effectively eliminated as CO_2 capture equipment, the most capital-intensive portion of carbon capture and sequestration (CCS) projects, will be built into the design of the new Lone Cypress hydrogen facility
- These project attributes will enable CTV JV and Lone Cypress to supply cost competitive, blue hydrogen to California's burgeoning zero emissions mobility and industrial markets
- In addition, the CTV JV has the right to take a majority equity stake in the project, as well as to provide sequestration services for all subsequent Lone Cypress hydrogen projects in California

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“Partnering with CTV JV represents an incredible opportunity to continue the growth of our hydrogen and carbon capture businesses. California is at the forefront of the global energy transition and through this partnership, we intend to be a leader in its low-carbon fuels market,” said Greg Brooks, President and Founder of Lone Cypress Energy Services. “CTV’s unique expertise in subsurface operations and permitting, large CO_2 storage position and ability to deliver on highly complex and capital-intensive projects provide us with a clear line of sight as we continue to evaluate additional projects in California. We are excited to generate the first blue hydrogen molecule in the state of California and provide the market with a low-cost low-carbon option to meet its decarbonization goals.”

In line with Governor Newsom’s recently announced climate measures, the construction process of the new Lone Cypress Hydrogen Project and associated CCS infrastructure is expected to provide at its peak approximatively 125 temporary construction jobs and 18 permanent technical jobs, further benefitting California’s economy and supporting the state’s leading climate goals.

About Carbon TerraVault Joint Venture

Carbon TerraVault Joint Venture (CTV JV) is a carbon management partnership focused on carbon capture and sequestration development, and was formed between Carbon TerraVault (CTV), a subsidiary of CRC, and Brookfield Renewable. The CTV JV develops both infrastructure and storage assets required for CCS development in California. CRC owns 51% of the CTV JV with Brookfield Renewable owning the remaining 49% interest.

About California Resources Corporation

California Resources Corporation (CRC) is an independent oil and natural gas company committed to energy transition in the sector. CRC has some of the lowest carbon intensity production in the US and CRC is focused on maximizing the value of our land, mineral and technical resources for decarbonization by developing CCS and other emissions reducing projects. For more information about CRC, please visit www.crc.com.

About Lone Cypress Energy Services

Lone Cypress Energy Services, LLC is an independent energy company focused on the development and operation of infrastructure across the entire energy value chain. Headquartered in Tulsa, OK, Lone Cypress offers a full suite of technology-enabled solutions including project development, project management, EPC contracting, and asset operations. Lone Cypress specializes in the development of hydrogen generation and

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distribution projects, waste to energy plant solutions, and traditional oil and gas midstream facilities. For more information, please visit www.lonecypressenergyservices.com.

Forward-Looking Statements

This document contains statements that CRC believes to be “forward-looking statements” within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. All statements other than historical facts are forward-looking statements, and include statements regarding CRC's future financial position, business strategy, projected revenues, earnings, costs, capital expenditures and plans and objectives of management for the future. Words such as "expect," “could,” “may,” "anticipate," "intend," "plan," “ability,” "believe," "seek," "see," "will," "would," “estimate,” “forecast,” "target," “guidance,” “outlook,” “opportunity” or “strategy” or similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those expressed in, or implied by, such statements.

Although CRC believes the expectations and forecasts reflected in CRC's forward-looking statements are reasonable, they are inherently subject to numerous risks and uncertainties, most of which are difficult to predict and many of which are beyond CRC's control. No assurance can be given that such forward-looking statements will be correct or achieved or that the assumptions are accurate or will not change over time. Particular uncertainties that could cause CRC's actual results to be materially different than those expressed in CRC's forward-looking statements include:

- fluctuations in commodity prices and the potential for sustained low oil, natural gas and natural gas liquids prices;
- equipment, service or labor price inflation or unavailability;
- legislative or regulatory changes, including those related to (i) the location, drilling, completion, well stimulation, operation, maintenance or abandonment of wells or facilities, (ii) the management of energy, water, land, greenhouse gases (GHGs) or other emissions, (iii) the protection of health, safety and the environment, (iv) CRC's ability to claim and utilize tax credits or other incentives, or (v) the transportation, marketing and sale of CRC's products and CO_2;
- availability or timing of, or conditions imposed on, permits and approvals necessary for drilling or development activities and carbon management projects;
- changes in business strategy and CRC's capital plan;
- lower-than-expected production, reserves or resources from development projects or acquisitions, or higher-than-expected decline rates;

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- incorrect estimates of reserves and related future cash flows and the inability to replace reserves;
- the recoverability of resources and unexpected geologic conditions;
- CRC's ability to successfully execute on the construction and other aspects of the infrastructure projects and enter into third party contracts on contemplated terms;
- CRC's ability to realize the benefits contemplated by the business strategies and initiatives related to energy transition, including carbon capture and storage projects and other renewable energy efforts;
- CRC's ability to successfully identify, develop and finance carbon capture and storage projects and other renewable energy efforts, including those in connection with the Carbon TerraVault JV;
- CRC’s ability to finalize definitive documents and reach a final investment decision with respect to the project contemplated by a carbon development management agreement, and its ability to enter into new carbon development management agreements that are under discussion with other counterparties;
- the ability of the Lone Cypress Hydrogen Project to achieve expected production volumes of hydrogen and associated CO_2 and the ability of the CTV JV to sequester such CO_2 volumes;
- global geopolitical, socio-demographic and economic trends and technological innovations;
- changes in CRC's dividend policy and its ability to declare future dividends under its debt agreements;
- changes in CRC's share repurchase program and its ability to repurchase shares under its debt agreements;
- production-sharing contracts' effects on production and operating costs;
- limitations on CRC's financial flexibility due to existing and future debt;
- insufficient cash flow to fund CRC's capital plan and other planned investments, stock repurchases and dividends;
- insufficient capital or lack of liquidity in the capital markets or inability to attract potential investors;
- limitations on transportation or storage capacity and the need to shut-in wells;
- inability to enter into desirable transactions, including acquisitions, asset sales and joint ventures;
- CRC's ability to achieve expected synergies from joint ventures and acquisitions;
- CRC's ability to utilize its net operating loss carryforwards to reduce its income tax obligations;

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- CRC's ability to successfully gather and verify data regarding emissions, its environmental impacts and other initiatives;
- the compliance of various third parties with CRC's policies and procedures and legal requirements as well as contracts it enters into in connection with CRC's climate-related initiatives;
- the effect of CRC's stock price on costs associated with incentive compensation;
- changes in the intensity of competition in the oil and gas industry;
- effects of hedging transactions;
- climate-related conditions and weather events;
- disruptions due to accidents, mechanical failures, power outages, transportation or storage constraints, natural disasters, labor difficulties, cyber-attacks or other catastrophic events;
- pandemics, epidemics, outbreaks, or other public health events, such as the COVID-19; and
- other factors discussed in Part I, Item 1A – Risk Factors in CRC's Annual Report on Form 10-K and its other SEC filings available at www.crc.com.

CRC cautions you not to place undue reliance on forward-looking statements contained in this document, which speak only as of the filing date, and CRC undertakes no obligation to update this information. This document may also contain information from third party sources. This data may involve a number of assumptions and limitations, and CRC has not independently verified them and do not warrant the accuracy or completeness of such third-party information.

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Los Angeles Times

The toxic legacy of old oil wells: California's multibillion-dollar problem

By MARK OLALDE and RYAN MENEZES

Co-published with the Center for Public Integrity

February 6, 2020

ARVIN, Calif. — Across much of California, fossil fuel companies are leaving thousands of oil and gas wells unplugged and idle, potentially threatening the health of people living nearby and handing taxpayers a multibillion-dollar bill for the environmental cleanup.

From Kern County to Los Angeles, companies haven't set aside anywhere near enough money to ensure these drilling sites are cleaned up and made safe for future generations, according to a months-long data analysis and investigation by the Los Angeles Times and the Center for Public Integrity.

Of particular concern are about 35,000 wells sitting idle, with production suspended, half of them for more than a decade. Though California recently toughened its regulations to ensure more cleanup funds are available, those measures don't go far enough, according to a recent state report and the Times/Public Integrity analysis.

California's oil industry is in decline, which increases the chances that companies will go out of business. That in turn could leave the state with the costs for cleaning up their drilling sites, which if left unremediated can contaminate water supplies and waft fumes into people's homes.

Under federal, state and local laws, fossil fuel companies are required to post funds, called bonds, to ensure that wells are ultimately plugged and remediated. These set-aside funds are a response to the oil industry's history in the United States, in which thousands of companies went out of business without banking enough financial reserves to pay for remediation.

Steam comes off the down pipe of an oil pump at the Belridge Oil Field in northwestern Kern County. (Robert Gauthier / Los Angeles Times)

Industry representatives say they are doing their part to pay for cleanup in California, but their bonds are woefully inadequate to meet the expected costs. The Times/Public Integrity investigation found that bonds posted to the state by California's seven largest drillers, which account for more than 75% of oil and gas wells, amount to about $230, on average, for every well they must decommission. Other bonds held by federal and local regulators don't significantly raise those amounts.

By contrast, the average per-well cost for capping wells and dismantling associated surface infrastructure in California is between $40,000 and $152,000, depending on whether a well is in a rural or urban area, according to a study released in January by the California Council on Science and Technology.

The result is a yawning gap between what the industry has provided and what ultimately will be needed. Companies have given the state only $110 million to clean up the state's onshore oil and gas wells, the council found. In actuality, it

could cost roughly $6 billion for that cleanup, according to a Times/Public Integrity analysis of state data provided to the science and technology council.

Decommissioning offshore oil wells and platforms, which is not included in those figures, will cost several billion dollars.

“These liabilities are hiding in plain sight,” said Clark Williams-Derry, an energy finance analyst at the Institute for Energy Economics and Financial Analysis. “They’re huge, but somehow they’ve become invisible to us.”

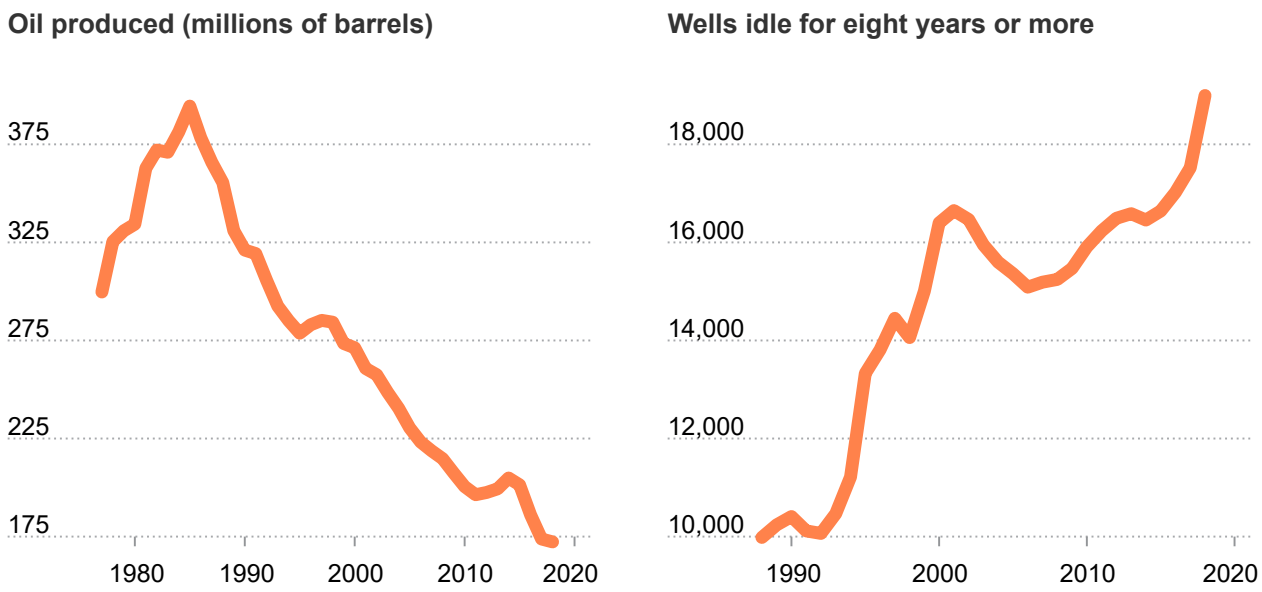
A key question is whether California’s oil industry — once a top-three U.S. producer — has the resources and staying power to pay for future cleanups.

Industry representatives contend that they will be in the state as long as Californians consume fossil fuels. “There are significant projects that are being proposed,” said Rock Zierman, chief executive of the California Independent Petroleum Assn., adding that the state’s oil industry supports roughly 18,000 jobs.

But California oil production has fallen nearly 60% from its peak in 1985, in part because the state’s deposits of heavy crude can’t compete in a world that prefers cheaper natural gas.

California's withering oil industry

As the state extracts less oil, more and more wells sit unused.



California Geologic Energy Management Division, Times/Public Integrity analysis

If output continues to drop, more communities may be left in the predicament of Arvin, a largely Latino town of 20,000 in Kern County that's dotted by drill sites. Many of those wells sit idle or produce little.

Until such wells are plugged, they can release toxic emissions and flammable gases from both their casings and the pipes that connect to them. Elvia Garcia knows that all too well.

In 2014, flames shot out of wall sockets in Garcia's home. Her pregnant daughter suffered from sudden blackouts. Government inspectors drilled test holes in lawns and found explosive levels of gas leaking from a pipe servicing wells at the end of the block.

They gave residents one hour to evacuate. It was nine months before Garcia's family was allowed to return.

"We smelled strong odors of something decaying, and that smell was coming from the outlets," she said in Spanish. "We thought there was something in between the walls that had died."

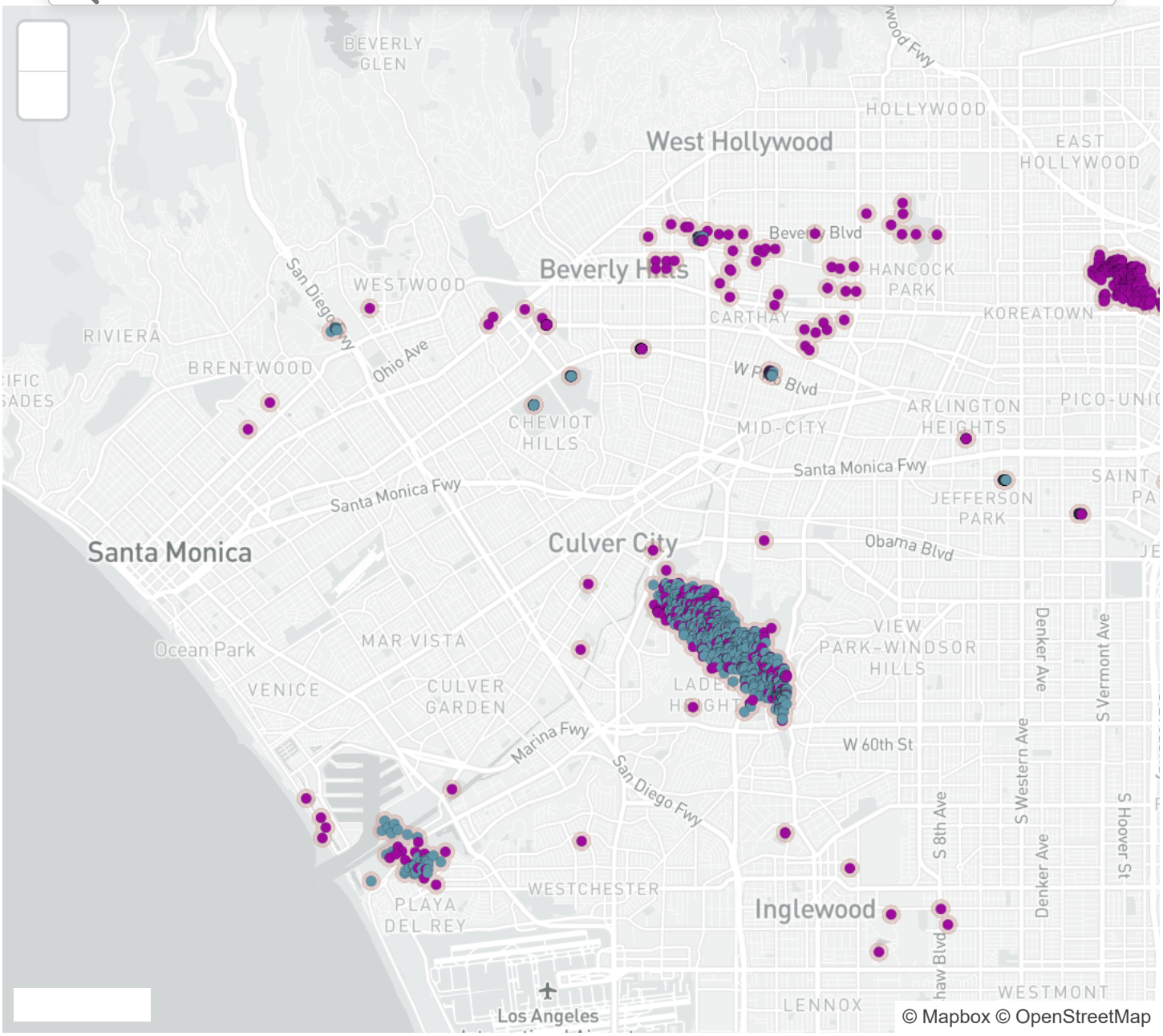
Elvia Garcia stands by an idle pump station near her home on Nelson Court in Arvin, Calif. (Robert Gauthier / Los Angeles Times)

More than 350,000 Californians live within 600 feet of unplugged wells, a Times/Public Integrity analysis of census data found. That's the distance at which people are exposed to degraded air quality, according to a 2019 report from the office overseeing oil and gas in Los Angeles.

Oil wells are known to emit likely carcinogens including benzene and formaldehyde. Uncapped, these wells also release a potent greenhouse gas, methane, that helps drive climate change.

The Times/Public Integrity investigation raises questions about the effects of these ongoing emissions if more of the state's idle wells are deserted without enough money to clean them up.

Do you live within 600 feet of California's 70,000 active or 35,000 idle wells?



It has long been industry practice to let wells go temporarily idle — for maintenance purposes, for example, or when commodity prices are low. But according to data maintained by the California Geologic Energy Management Division, or CalGEM, the agency that regulates oil and gas producers, the oil industry since its peak-production days has doubled the instances in which it idles wells for at least two years at a time.

Most cases of oil and gas wells going idle in California are short-term. But once a well has been dormant for just 10 months, there's a 50-50 chance it will never produce again, a Times/Public Integrity analysis of 40 years of state data

found. By the time federal regulators begin raising concern — at five years of inactivity — the chance that a well is ever active again falls to 1 in 4.

Industry critics say lax state regulations are allowing oil companies to walk away from wells and the liability they represent.

“All they want to do is rape the land and leave,” said state Sen. Hannah-Beth Jackson, a Santa Barbara Democrat deeply involved in attempts to regulate the oil and gas industry. “They are taking the resources of California, monetizing them and leaving us with the mess.”

Zierman, of the California Independent Petroleum Assn., rejected such claims, arguing that the use of cleanup bonds and fees on both idling and production means companies bear their share of costs.

Such bonds act like a security deposit on an apartment, with the money returned if a company meets its cleanup obligations and kept by the state if it does not. If a company goes out of business without adequate bonds, the state is on the hook for the difference or, alternately, could leave the site contaminated.

Zierman also disputed the idea that the state’s industry has no future. The problem, he said, is that state and local governments are blocking proposed projects. “Part of it is just a concerted effort to stop oil in California,” he said.

For their part, state regulators say they’re operating under the assumption that California oil and gas is on the way out.

The role of CalGEM “is really to manage that decline,” said Jason Marshall, the Department of Conservation’s chief deputy director and until late 2019 the acting head of its oil and gas division. “To make sure that when the last barrel of oil gets produced, that there are resources available so the well that produced it and all the other wells can be plugged.”

State regulators say they have new tools in place to protect taxpayers and the environment.

In October, Gov. Gavin Newsom signed legislation that gave California more authority to limit the financial liability shouldered by taxpayers. It also mandated companies conduct more thorough reporting of emissions and liability. A month later, Newsom announced the state would study the possibility of a no-drilling buffer zone around communities.

A pump station sits idle near homes on Nelson Court, where toxic fumes from a nearby well sickened residents and forced evacuations. (Robert Gauthier / Los Angeles Times)

Last April, CalGEM enacted regulations targeting idle wells. Those included increased fees on idle wells to create an incentive for producers to plug them. CalGEM, previously called the Division of Oil, Gas, and Geothermal Resources, collected $4.3 million in such fees in 2018.

Though state officials say these new regulations will better protect the state from liability, they still leave California exposed, experts say.

“The amount of the bonds currently on file is really small compared to the magnitude of the plugging obligations,” said Judson Boomhower, an environmental economist and assistant professor at UC San Diego who was the lead author of the California Council on Science and Technology report.

California’s ability to handle the shrinking size of the industry could soon be tested. One of the state’s largest producers, California Resources Corp., is responsible for the third-most idle wells of any company in the state and faces cleanup costs that far outstrip its total market value. CRC and its subsidiaries operate more than 17,000 unplugged wells, either idle or active, including four artificial islands built to tap offshore reserves.

If CRC were to fold, other companies would probably buy some of those wells, but many could become the state’s problem.

More than 7,600 wells on pause

On many days, there’s no horizon in western Kern County. Dust and pollution thrown up by the area’s twin economic engines, fossil fuel extraction and large-scale agriculture, blend the hazy sky with land that’s been sculpted into miles of straight-lined farms and oil fields hosting three-quarters of the state’s oil and gas wells.

In this part of the county, only a chain-link fence and 1,000 feet of dusty ground separate the fewer than 200 people living in the mobile homes and modest houses of Tupman from the 75-square-mile Elk Hills Field. This oil patch is so contaminated that a flock of sheep, 500 animals by one count, died here in 1960 when they drank from a pool of water tainted with arsenic, historically used to prevent corrosion in wells.

“Here’s a nice place to come out and eat your lunch,” Rosanna Esparza, a gerontologist and Bakersfield-based community activist, said sarcastically during a September visit to the eerily quiet Tupman. She gestured toward two gray picnic tables outside Elk Hills Elementary School, which sits on the oil field’s border.

Rosanna Esparza looks over a Bakersfield irrigation system that uses “produced water,” which is pulled up by drill rigs alongside oil and gas. (Robert Gauthier / Los Angeles Times)

Elk Hills is the largest gas-producing field in the state and the prize of California Resources Corp.’s portfolio. But this 109-year-old field is home to nearly 1,400 of the more than 7,600 CRC wells that were sitting idle statewide as of mid-January, according to CalGEM data examined by The Times and Public Integrity. The analysis of the most recent idle well inventory, published in September, found that CRC’s idle wells haven’t produced oil or gas, on average, for nearly 14 years.

This field is riddled with contaminants left behind by fossil fuel extraction. The U.S. Navy previously managed Elk Hills, and the federal government is paying the state to remediate 131 areas of concern here that contain arsenic, metals such as chromium and lead, and carcinogenic chemicals called polycyclic aromatic hydrocarbons.

“This is an example of what’s going to happen in the foreseeable future when other huge oil fields start to lose their glitter,” Esparza said. “This is what happens when the oil industry starts to slip.”

CRC was born in 2014 when Occidental Petroleum Corp. packaged its California assets and spun them off as a new company, shedding millions of dollars in environmental liability for Occidental in the process.

CRC has since faced harsh market forces. Oil production at the wells now owned by the company is down more than 70% since the 1980s. Gas is down more than 50%. CRC's shares had lost more than four-fifths of their value as of mid-January. The company's cash generated after expenses — a key financial measure known as net free cash flow — is several hundred million dollars in the red since splitting from Occidental, according to an analysis of U.S. Securities and Exchange Commission filings compiled by the energy analyst Williams-Derry, who has tracked CRC.

And CRC has nearly $5 billion worth of debt that's maturing by the end of 2022. Its credit rating is CCC+, which Standard & Poor's describes as "currently vulnerable" and just steps above default.

"The significant risk of this company is avoiding bankruptcy," said Paul Sankey, an oil and gas analyst and managing director with financial firm Mizuho.

On top of all this, CRC will eventually need to address its environmental liabilities. The company's most recent SEC filing lists $511 million in future cleanup costs called "asset retirement obligations."

After examining the state's historical costs, The Times and Public Integrity found it could cost more than $1 billion to plug all the wells CRC operates.

In emailed responses, CRC spokeswoman Margita Thompson said the company delivered strong third-quarter 2019 results, with record free cash flow, some debt repayment and stable production. She also said the $1-billion figure is misleading because the state would shoulder the responsibility only if CRC were unable to pay, which she indicated would not be necessary because

the company expects to make far more money off its reserves than it needs to address those liabilities. And she contended that the company can plug its own wells at a lower cost than if the state were to take over.

CRC across all its subsidiaries has more than $80 million in cleanup bonds outstanding with various agencies, satisfying its obligations, Thompson said.

She said the company takes its oil well "plugging and abandonment duties seriously," adding that idle wells are an important part of the company's inventory because they can eventually be used again to access oil and gas formations.

Oil pumps dot the landscape at the Belridge Oil Field near Lost Hills Road in northwestern Kern County. (Robert Gauthier / Los Angeles Times)

"Prematurely closing wells would worsen Californians' dependence on imports from places like Saudi Arabia," said Thompson, who earlier served as press secretary for Gov. Arnold Schwarzenegger.

Critics say CRC's approach to its aging wells raises questions about its long-term commitment to remediation.

Under California law, operators can either pay fees or agree to plug long-idled wells. Of the 10 operators with the most long-idled wells in the state, the only ones that opted for fees instead of cleanup were two CRC subsidiaries, according to data obtained via public records requests.

Holding off on decommissioning minimizes short-term costs, but it comes with uncertain consequences for California if CRC gets into deeper financial difficulties.

"A single bankruptcy among one of these large companies could potentially create a large number of orphan wells," the recent California Council on Science and Technology report said, specifically mentioning CRC.

Williams-Derry compared CRC's situation to short-lived coal companies that took on high levels of liability in recent years as they spun off from major producers that were financially hurting. "Those were companies that to all appearances were designed to fail," he said.

Industry lobbies to limit cleanup obligations

People living near unplugged oil and gas wells face exposure to cancer-causing chemicals, and toxic residue brought up by drilling below Earth's surface can contaminate aquifers that could become future drinking water supplies.

This year, California lawmakers are considering a bill that would create a 2,500-foot buffer separating wells from homes, schools, hospitals and other public buildings.

According to a Times/Public Integrity analysis, more than 2 million Californians live within that distance of an unplugged oil or gas well, with Latino, black and low-income people living nearby at a slightly higher rate than

the California population as a whole. Half of those 2 million people reside in Los Angeles.

A strict buffer requirement faces long odds in the Legislature. It's opposed by labor and oil industry groups, two of Sacramento's most well-funded lobbying forces.

In 2016, when lawmakers were considering legislation that ultimately overhauled the management of idle wells, the Western States Petroleum Assn., a trade group representing oil and gas interests, reported spending $7 million to lobby on it and other bills. Over the last five years, the trade group pumped more than $41 million into lobbying in California, by far the most of any organization in the state.

Das Williams, now a Santa Barbara County supervisor and formerly a Democratic member of the Legislature, sponsored the 2016 legislation after it became clear that decommissioning offshore oil infrastructure would be costly for the state. That law also increased state bonding, although not to the level its authors had hoped. Williams said that industry groups occupied an opposing seat at the bargaining table and that the bill's language was "a product of haggling."

The resulting changes to how the state manages idle wells have produced some progress on cleanup, according to a study CalGEM released in November. Companies plugged 988 long-term idle wells in 2018, and nine operators decommissioned more wells than the statute required.

"It's doing what we wanted it to do," said Marshall, with the Department of Conservation.

But companies continue to put off more expensive cleanup jobs in urban areas such as Los Angeles, instead focusing on rural wells that are easier to decommission, mainly in Kern County. That finding is based on data The

Times and Public Integrity obtained for every well-plugging plan that operators submitted and CalGEM approved in 2019.

The Inglewood Oil Field in unincorporated L.A. County is home to nearly 1,000 wells. It abuts the residental neighborhood of View Park-Windsor Hills. (Al Seib / Los Angeles Times)

If these wells are left open, the state will need to step in.

Because the money that defunct companies had set aside for cleanup usually falls short, the state relies on fees on idle wells and production. By law, CalGEM isn't allowed to spend more than $3 million a year to plug orphan wells, a temporary increase that will drop back to $1 million after 2021. The agency has plugged more than 1,350 such wells since 1977.

From Appalachia to the Mountain West, many other states are in a similar predicament, struggling to address cleanup of old oil wells. Utah acknowledged a funding shortfall in November, for example, and Colorado announced its cleanup would cost 14 times more than what companies set aside.

Boomhower, the California Council on Science and Technology bonding report's lead author, said oil companies often find it cheaper to forfeit an

insufficient bond than to pay for cleanup and capping. “You do have to worry that some of these small and mid-sized operators don’t have incentive to clean up,” he said.

In Arvin, fumes remain near homes and schools

Five years ago, Elvia Garcia returned to her home in Arvin, which she said had been looted while she was gone. Since then, her family has continued to suffer from lingering headaches brought on by occasional odors. State regulators fined the company responsible for the leak, Petro Capital Resources LLC. The company installed machines on homes in the neighborhood, including Garcia’s, to remove gas — and vent it into backyards.

During a September visit to Arvin, various wells near Garcia’s neighborhood hummed as they pulled up a trickle of hydrocarbons. The odor of mercaptan, the compound added to natural gas to give it its distinctive smell, hung in the air. At one site, oil stained a patch of dirt, the leak appearing to originate from another company’s storage tank.

Elvia Garcia, left, walks with community organizer Elizabeth Perez past an idle pump station in Arvin. (Robert Gauthier / Los Angeles Times)

The largely disused wells here are part of a trend. At the industry's peak, about 2.5 times as many wells produced as sat idle statewide. That ratio has fallen to about 1.5 times as many active as idle wells, the Times/Public Integrity analysis found.

Francisco Gonzalez, who lives down the street from Garcia, moved to Arvin to enjoy a quiet retirement outside Los Angeles. He said his family still smells nauseating levels of gas at certain times, and he worries about the health of children attending the schools across the street from wells.

"What is the company going to do?" he asked in Spanish. "They are not going to do anything."

Jeff Williams, Petro Capital Resources' production manager, said there can't be leaks in homes, because the pipeline hasn't been used since 2014 and wells are pulling up only enough gas to relieve pressure buildup. He said the company has no near-term plans to plug and abandon the wells because it hopes to one day restart production there.

Two blocks away, next to Arvin High School, 25 unplugged wells owned by a company called Sunray Petroleum Inc. sit deserted, 40 years after some of them last operated. Pump jacks rise above fields of almond saplings like rusting scarecrows.

Sunray, which filed for bankruptcy in 2011 and has racked up numerous violations for unpaid fees and inadequate pollution monitoring, saw its production fall off a cliff in the late 1980s. The last of its wells went quiet in 2015.

A phone number listed for the company has been disconnected, and other attempts to reach Sunray proved futile. The company has posted a cleanup

bond for its wells, but it is far less than what the law requires and what will ultimately be needed for cleanup.

In March 2017, CalGEM mailed a notice of violation to the Las Vegas-based company. In a certified letter, the division wrote that Sunray ignored requirements to test its long-idled wells, including those near Arvin High School, for indications of groundwater contamination. The agency said that failure to submit those tests could constitute a crime.

The post office sent the letter back to CalGEM with this stamp: "RETURN TO SENDER. UNCLAIMED. UNABLE TO FORWARD."

About this story

This story was a partnership between the Los Angeles Times and the Center for Public Integrity, a nonprofit news organization in Washington. It was reported and written by Mark Olalde of Public Integrity and Ryan Menezes of The Times.

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LETTER

Potential increase in oil and gas well leakage due to earthquakes

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Abstract

Earthquakes occurring naturally or induced by human activities can damage surface and subsurface infrastructure. Oil and gas wells represent a category of subsurface infrastructure that can act as leakage pathways connecting oil and gas reservoirs, groundwater aquifers, and the atmosphere. The integrity of these wells can be compromised through a wide range of processes and contribute to groundwater contamination, greenhouse gas emissions, and air quality degradation. We estimate the increase in such subsurface leakage potential due to seismic activity through geospatial analysis of 579,378 oil and gas well and 196,315 earthquake (magnitudes greater than 1.0) locations in Oklahoma, California, and British Columbia. We perform density-based clustering analysis and point density mapping using *ArcGIS*. We combine the well and earthquake point density maps to identify hot spots of joint high well and earthquake densities. We find that oil and gas wells and earthquakes are clustered in space, with densities reaching ~60 wells per km^2 and ~40 earthquakes per km^2 in California. There are at least two hot spots where these clusters overlap in each state/province. In Oklahoma and British Columbia, the hot spots are more correlated with earthquake densities; while, in California, the hot spots are more correlated with well densities. Our findings indicate the need to investigate the role of earthquakes on wellbore leakage through additional analysis of earthquake characteristics, wellbore attributes, improved data collection, and empirical field studies for all oil and gas wells, including those that are abandoned. In particular, large scale geospatial analysis establishing the scope of the problem and empirical field studies focusing on identified hot spots are needed to understand potential environmental impacts of earthquakes, especially those induced by oil and gas activities.

1. Introduction

Oil and gas wells can act as pathways for fluid leakage leading to groundwater contamination and emissions of greenhouse gases and air pollutants, thereby impacting climate, air quality, and water resources. Subsurface leakage via oil and gas wells are identified as a major concern in geologic storage of carbon dioxide projects and oil and gas production [1]. Failure in barriers to well leakage, or wellbore integrity issues, can occur due to thermal, chemical, and/or mechanical stresses during oil and gas production and other activities and create or enhance fluid leakage in and around wellbores [2–5]. Database analysis are used to estimate rates of wellbore integrity failures such as cement and casing impairment and to link these issues to well characteristics, spud date, well type and construction, production history, well location, geology, operator, abandonment method, oil price, and regulatory changes [6–11]. However, there remain uncertainties in the relative contribution of these factors to wellbore integrity, and a recent study shows that we are likely to be missing important controlling factors [12]. A particularly salient process that is yet to be studied in linkage with oil and gas well leakage is earthquakes.

Earthquakes or seismic events induced by oil and gas development activities is gaining scientific and media attention due to recent earthquakes of magnitude 4 and greater ($M \geqslant 4$) in central and eastern US [13] and

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Western Canada [14, 15]. Although there is active research on mechanisms leading to induced seismicity, relatively few studies have looked at its role on creating or enhancing subsurface leakage and associated environmental impacts [16]. Although earthquakes and other tectonic activities are listed as geomechanical factors to consider in risk assessments for geologic storage of carbon dioxide [5] and oil and gas production [4], the level of risk that earthquakes pose to such engineering projects has not been quantified.

Fluids originating from an oil-and-gas reservoir or gas pockets in non-producing formations can migrate through a leakage pathway and contribute to (1) groundwater contamination and gas emissions to the atmosphere, (2) groundwater contamination only, or (3) gas emissions only. The oil and gas industry has developed standards for well integrity in drilling and operations [17, 18] so that any leakage can be quickly detected and mitigated. However, oil and gas well leaks continue to impact our environment. Furthermore, there are no standards or requirements to monitor oil and gas wells after they have been abandoned in any jurisdiction [19] and many leaks remain undetected. Monitoring can be costly, and leakage is difficult to detect and attribute [20]. Wellbore integrity studies using laboratory testing and modeling demonstrate the wide range of potential pathways and mechanisms through which a well can fail and cause leakage [2, 4, 5, 21]. The failure can lead to fluid migration ranging from small hard-to-detect leaks to catastrophic events [22], all of which can be caused by strong shaking or finite offset during earthquakes. Furthermore, small- and large-scale failures may not necessarily be independent and small failures accumulated over time may reduce the integrity of a wellbore barrier system to withstand earthquakes and other drivers of leakage. In addition to understanding wellbore integrity and the hydraulic characteristics of each leaky well, there is a need to define the geographic scope of the wellbore leakage problem, including smaller but more prevalent leaks.

We perform geospatial analysis of earthquakes and oil and gas well data in California (CA), Oklahoma (OK), and British Columbia (BC) to make the first evaluation of enhanced subsurface leakage potential due to earthquakes. The three different regions are chosen based on oil and gas production history and seismic activity. CA is the fourth-largest oil producer (174,107 thousand barrels in 2017) by state in the US and is well-known for natural and induced earthquakes [23]. OK is the sixth-largest crude oil (165,920 thousand barrels in 2017) and fourth-largest natural gas (8518 million cubic feet per day in December 2018) producing state and has recently experienced numerous earthquakes due to oil-and-gas-related wastewater injection. BC has limited oil production but is the second-largest natural gas (5018 million cubic feet per day in December 2018) producing province in Canada with increasing use of hydraulic fracturing, which has been linked to recent $M \geqslant 4$ earthquakes [14]. Due to the range in oil and gas development and seismic activity, the analysis of these three states/province can provide broad insights on the potential link between earthquakes and well leakage.

2. Methods

We analyze 27,679 permitted well records from the BC Oil and Gas Commission (downloaded in February 2019), 229,561 wells in the CA Division of Oil, Gas, and Geothermal Resources Well Records (downloaded in February 2019), and 534,662 oil and gas well data for OK from the National Oil & Gas Gateway (downloaded in September 2019). Wells in the CA database were drilled from 1887 to 2018 and 10% of the wells were drilled in 2009 to 2018. Wells in the BC databases were drilled from 1912 to 2018, with most (77%) being drilled from 2009 to 2018. Wells in the OK database were completed from 1894 to 2019 with only 5% of the wells drilled from 2009 to 2018. These date ranges are based on available drilling, completion, or spud dates, which are not available for all well records. For BC and CA, we neglect 'cancelled' wells because we assume that these wells were never drilled and cannot act as leakage pathways. For OK, we do not analyze wells with the status 'Expired Permit Not Drilled' for the same reason. Table 1 describes the data used to represent all oil and gas wells and abandoned oil and gas wells in our analysis.

We analyze 196,315 seismic events with $M \geqslant 1.0$ in the US Geological Survey (USGS) catalog from 2009 to 2018. Most of the data (179,969 or 92%) is for CA. There are 10,109 and 6237 events for OK and BC respectively. The completion magnitudes are 1.1, 2.5, and 1.6 for CA, OK, and BC respectively (figure S7). We include all earthquake data with $M \geqslant 1.0$ to evaluate the role of frequently-occurring small-magnitude seismic events. We also map major fault traces from the USGS fault and fold database for CA and OK [24] and the BC Geological Survey's Geology Faults database for BC [25]. Faults can be a conduit, a barrier, or a conduit-barrier system, and the impact of faults on leakage can be highly variable. However, there is no available database, to our knowledge, that we can use to characterize the mapped major faults as conduits or barriers.

We perform two different spatial analysis using tools in *ArcGIS* to (1) identify clusters of wells and earthquakes and (2) combine point density distributions to determine hot spots where high well and earthquake densities overlap. First, we use the Density-Based Spatial Clustering of Applications with Noise (DBSCAN) algorithm [26] in the *ArcGIS Density-Based Clustering Analysis* tool to identify the number of clusters in each state/province for cell sizes of 5 km and 10 km and with 10 as the minimum number of wells or earthquakes. The

Table 1. Description of all and abandoned oil and gas well data by state/province with sufficient location and status information (as of February 2019 for BC and CA and October 2019 for OK).

		All wells		Abandoned wells	
	Source(s)	Count	Description	Count	Description
BC	BCOGC permitted well records	27,679	All well activity statuses, except cancelled	12,195	Well activity statuses: suspended ('SUSP'), abandoned ('ABAN')
CA	DOGGR well search	229,561	All well status codes, except cancelled	153,308	Well status codes: B (Buried-Idle), I (Idle), U (Unknown), P (Plugged and Abandoned)
OK	National Oil and Gas Gateway	322,138	All standard well status, except expired permit, not drilled	70,341	Standard well status: Abandoned, Inactive

resulting density-based clusters are used to evaluate spatial clustering in each dataset and how the number, shape, size, and distribution of clusters vary between regions. The second analysis is used to determine hot spots of high well and earthquake densities within a region and employs a two-step approach. First, we use the *Point Density* tool with a cell size of 10 km and a rectangular neighborhood to develop maps of well and earthquake densities, $w_i(x, y)$ and $e_i(x, y)$, where i denotes the state/province and x and y are the geographical coordinates. Then, using the *ArcMap Spatial Analyst Map Algebra Operators*, we normalize $w_i(x, y)$ and $e_i(x, y)$ by the maximum point density in each province/state, w_i^{max} and e_i^{max}, and estimate the enhanced leakage potential in region i, $L_i(x, y) = (w_i(x, y)/w_i^{max}) \times (e_i(x, y)/e_i^{max})$. In other words, the leakage potential ($L_i(x, y)$) represents the combination of normalized well and earthquake densities for a given state/province i. We then normalize the leakage potentials in each region by the maximum leakage potential in that region and map $L_i'(x, y) = L_i(x, y)/L_i^{max}$. We define 'hot spots' of joint high well and earthquake densities as $L_i'(x, y) \geqslant 0.1$ but also present $0.05 < L_i'(x, y) < 0.1$ (figure 1).

3. Results

Oil and gas wells and earthquakes are clustered in space in all three study areas (figure 1 and S1–S6). In CA, oil and gas wells are densely clustered in highly productive oil and gas regions, specifically the southern portion of the Central Valley of CA and the southern coastal region (Los Angeles, Ventura, and Santa Barbara Counties). Earthquakes in CA are clustered in the vicinity of the San Andreas Fault and the Eastern California Shear Zone. Oil and gas production in BC is confined to the gas-bearing Montney Basin and Horn River Basin in the northeastern portion of the province. The increase in seismicity in this northeastern BC area over the past decade is mainly attributed to hydraulic fracturing activities [14], while the earthquake clusters along the coast are mostly due to plate tectonics. Oil and gas production is prevalent throughout OK. However, earthquakes in OK are clustered in the north-central portion of the state.

California has the highest maximum densities of oil and gas wells and earthquakes with $M \geqslant 1.0$, reaching 60 wells per km^2 and 40 earthquakes per km^2 (figure 1). State-wide average earthquake densities are also highest in CA at 0.42 earthquakes per km^2 (table 3). However, OK has the highest state-wide well densities of 1.8 wells per km^2 (table 2) but with a maximum well density of 15 wells per km^2 (figure 1). BC has the smallest region-wide density of oil and gas wells at 0.03 wells per km^2 and the lowest density of earthquakes at 0.007 earthquakes per km^2 (tables 2 and 3). Correspondingly, the maximum point densities of wells and earthquakes are the lowest in BC at 3 wells per km^2 and 3 earthquakes per km^2 (figure 1).

Spatial clusters of wells are found throughout OK, whereas in BC and CA, the well clusters are concentrated in a few regions (see supporting information and figures S1–S6 available online at stacks.iop.org/ERC/1/121004/mmedia). There are 0.2 to 1.2 clusters of all wells per 1000 wells in CA and BC and 0.028 to 0.084 clusters of all wells per 1000 wells in OK (table 2) with the number of clusters increasing by a factor of 2.9 to 4.9 when the search radius is decreased from 10 km to 5 km. The well clusters in CA clearly delineate the Central Valley and southern coastal regions where oil and gas development is prevalent (figure S1). A decrease in the search radius from 10 km to 5 km separates northern and southern Central Valley into two separate clusters with the divide occurring around the Delta and the southern coastal area is separated into clusters for Los Angeles, Ventura, and Santa Barbara (figure S1). For BC, the 10-km search radius identifies the entire northeastern oil and gas-producing region as a single cluster, with a few small clusters in the northern portion (figure S2). The

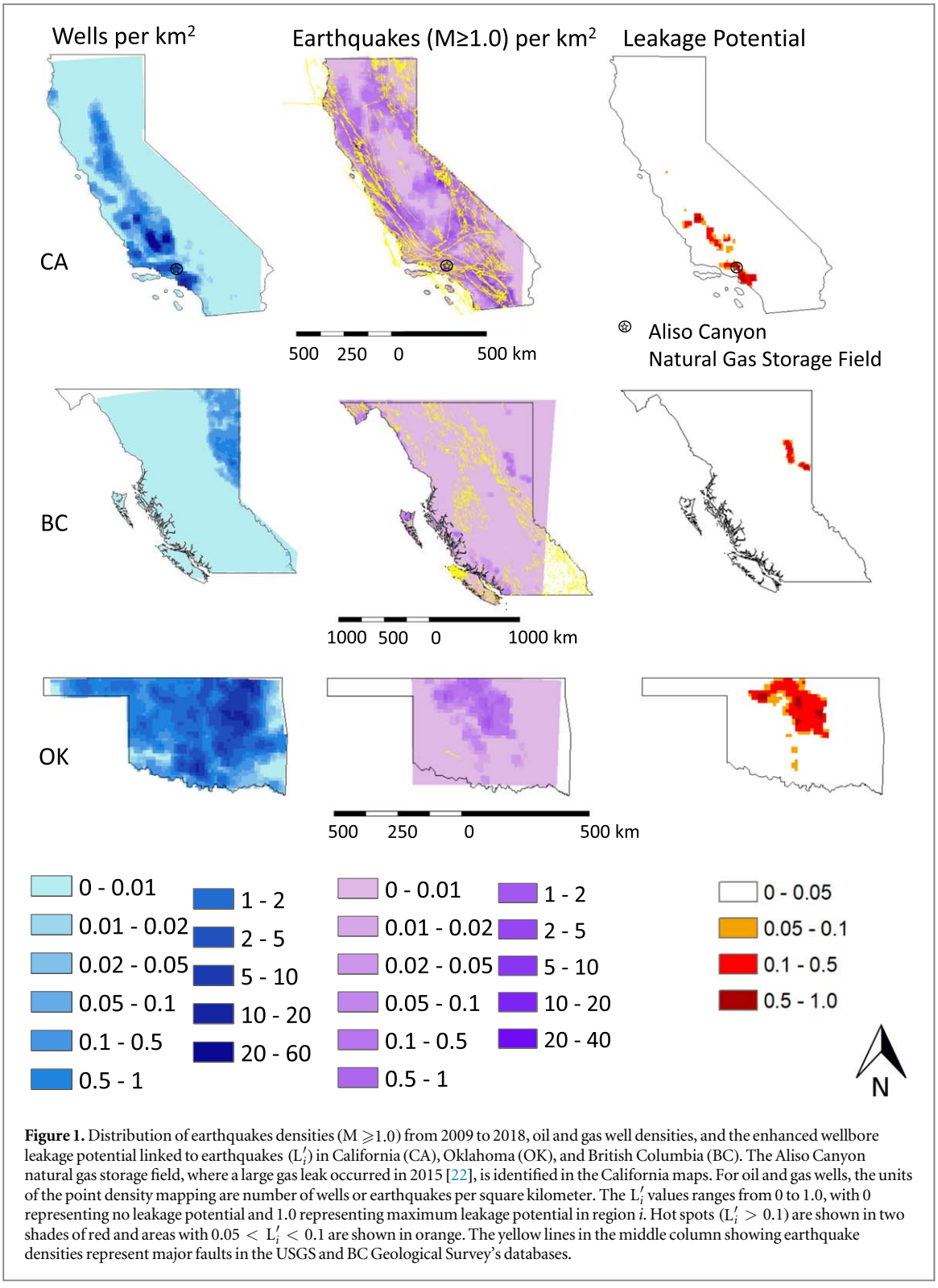

Figure 1. Distribution of earthquakes densities (M $\geqslant$1.0) from 2009 to 2018, oil and gas well densities, and the enhanced wellbore leakage potential linked to earthquakes (L_i') in California (CA), Oklahoma (OK), and British Columbia (BC). The Aliso Canyon natural gas storage field, where a large gas leak occurred in 2015 [22], is identified in the California maps. For oil and gas wells, the units of the point density mapping are number of wells or earthquakes per square kilometer. The L_i' values ranges from 0 to 1.0, with 0 representing no leakage potential and 1.0 representing maximum leakage potential in region *i*. Hot spots ($L_i' > 0.1$) are shown in two shades of red and areas with $0.05 < L_i' < 0.1$ are shown in orange. The yellow lines in the middle column showing earthquake densities represent major faults in the USGS and BC Geological Survey's databases.

5-km search radius divides the large cluster into one large cluster in the southern portion of the oil and gas region, representing the Montney Basin, and many small clusters in the northern region. However, these small clusters do not obviously follow boundaries of the Horn River or Liard Basin. In OK, there are 1.1 and 3.2 well clusters per 1000 wells when using a search radius of 10 km and 5 km respectively, both producing one large cluster in the middle and several small clusters around the fringes of the state (figure S3). The earthquake clusters also show that both 5-km and 10-km search radiuses produce meaningful clusters, some of which can be linked to tectonic activities (figures S4–S6).

Abandoned wells generally follow the same distribution as all wells in CA and BC (figures S1 and S2). This is in line with the expectation that wells are clustered in oil and gas basins, which is likely to have both abandoned

Table 2. Average state/province-wide densities of oil and gas well locations and numbers of well clusters per 1000 earthquakes using the DBSCAN algorithm with two search radiuses, 10 km and 5 km, for all wells and only abandoned wells. The well data is described in table 1.

	All wells			Abandoned wells		
	Density $\left(\frac{\text{Wells}}{\text{km}^2}\right)$	Number of clusters per 1000 wells		Density $\left(\frac{\text{Wells}}{\text{km}^2}\right)$	Number of clusters per 1000 wells	
		10 km	5 km		10 km	5 km
CA	5.4×10^{-1}	8.7×10^{-2}	2.5×10^{-1}	3.6×10^{-1}	1.3×10^{-1}	3.8×10^{-1}
OK	1.8×10^{0}	2.8×10^{-2}	8.4×10^{-2}	3.9×10^{-1}	1.3×10^{-1}	1.4×10^{0}
BC	2.9×10^{-2}	2.5×10^{-1}	1.2×10^{0}	1.3×10^{-2}	5.7×10^{-1}	4.5×10^{0}

Table 3. Average state/province-wide densities of earthquakes and numbers of earthquake clusters per 1000 earthquakes using the DBSCAN algorithm with two search radiuses, 10 km and 5 km, for earthquakes with $M > 1.0$ and $M > 3.0$. The earthquake data includes earthquakes that occurred from 2009–2018.

	$M > 1.0$			$M > 3.0$		
	Density $\left(\frac{\text{Earthquakes}}{\text{km}^2}\right)$	Number of clusters per 1000 earthquakes		Density	Number of clusters per 1000 earthquakes	
		10 km	5 km		10 km	5 km
CA	4.2×10^{-1}	2.2×10^{-1}	9.5×10^{-1}	5.5×10^{-3}	1.6×10^{1}	1.2×10^{1}
OK	5.6×10^{-2}	1.1×10^{0}	3.2×10^{0}	1.5×10^{-2}	1.5×10^{0}	1.4×10^{1}
BC	6.6×10^{-3}	6.3×10^{0}	9.3×10^{0}	3.3×10^{-4}	1.9×10^{1}	3.2×10^{0}

and active wells. Because of the general lower number of abandoned well densities, there are more abandoned well clusters per 1000 abandoned wells than all oil and gas well clusters per 1000 all oil and gas wells, differing by factors of 1.5(CA) to 17 (OK). This is because we use the same DBSCAN parameters for all wells, causing points to no longer be density-reachable and density-connected.

A larger number of clusters per 1000 earthquakes are found when using earthquakes with $M \geqslant 3.0$, than $M \geqslant 1.0$ (figures S4–S6). As with all and abandoned well clusters, this is because of the lower density of higher-magnitude earthquakes and the use of the same DBSCAN parameters. For $M \geqslant 1.0$, there are 0.22 to 9.3 clusters of earthquake events per 1000 earthquakes; and for $M \geqslant 3.0$, there are 1.5 to 19 earthquake clusters per 1000 earthquakes. The number of earthquake clusters consistently increase with decreasing search radius (10 km to 5 km) for $M \geqslant 1.0$ but not for $M \geqslant 3.0$. In CA and BC, the number of $M \geqslant 3.0$-earthquakes per 1000 earthquakes decrease from 16 to 12 clusters per 1000 earthquakes in CA and from 19 to 3.2 clusters per 1000 earthquakes in BC because of the minimum points criteria. In other words, many $M \geqslant 3.0$-earthquake clusters defined with a 10-km search radius become noise rather than multiple smaller clusters when a 5-km search radius is used. In OK, the number of earthquake clusters increase almost 10-fold from 1.5 to 14 clusters per 1000 earthquakes for $M \geqslant 3.0$-earthquakes. A comparison of the major fault locations and earthquakes shows that there are regions in each province/state where a major fault is not mapped but an earthquake cluster exists (figure 1). In all three regions, the $M \geqslant 3.0$ clusters are captured in the $M \geqslant 1.0$ clusters but there are numerous $M \geqslant 1.0$ clusters that are not co-located with $M \geqslant 3.0$ clusters (figures S4–S6).

Overlapping oil and gas well and earthquake locations shows that there are at least two hot spots with increased potential ($L' > 0.1$) for earthquakes to create or enhance leakage pathways in and around wellbores in each province/state (last column in figure 1). In CA, the hot spots are in the southern portion of the Central Valley and Los Angeles County, which are regions with large oil and gas production. The Aliso Canyon natural gas storage facility, which experienced one of the largest methane leakages in US history in 2015 [22], is located in this seismically active area with high well densities. However, other oil and gas well clusters such as those in coastal regions around Santa Barbara and southwestern Central Valley are not found to be hot spots due to lower earthquake densities. In BC, the hot spots are in the northeastern region, where all wells and a major cluster of earthquakes are located. Because there is no oil and gas activity in western BC, there are no hot spots, despite numerous earthquakes clusters along the coast of BC (figure S5). In OK, because oil and gas distribution is distributed throughout the state, the hot spots are in the southern portion of the earthquake cluster, where well

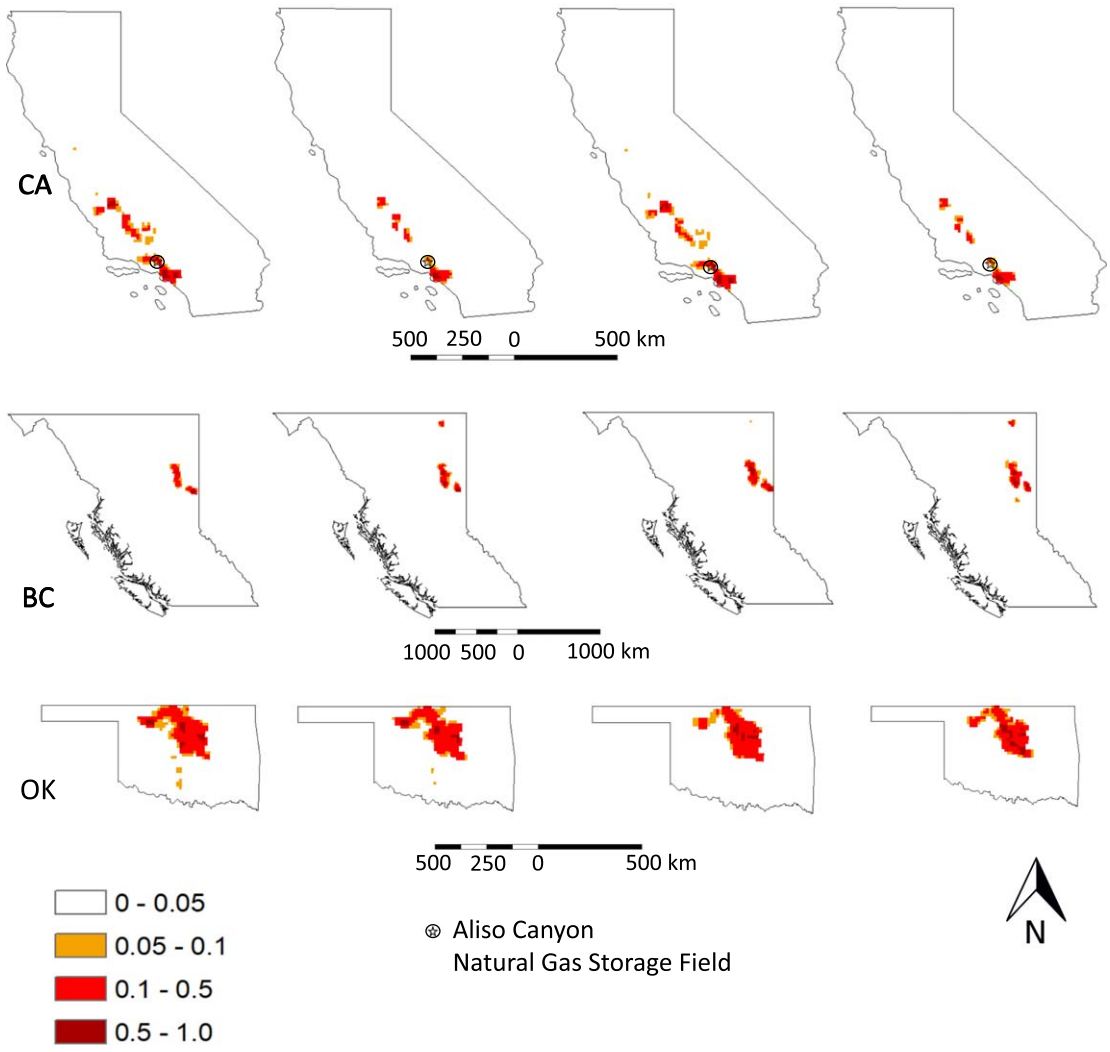

Figure 2. Distribution of enhanced wellbore leakage potential linked to earthquakes (L_i') in California (CA), Oklahoma (OK), and British Columbia (BC) for four scenarios: (1) all wells and earthquakes with $M \geqslant 1.0$, (2) all wells and earthquakes with $M \geqslant 3.0$, (3) abandoned wells and earthquakes with $M \geqslant 1.0$, and (4) abandoned wells and earthquakes with $M \geqslant 3.0$. The leakage potential ranges from 0 to 1.0, with 0 representing no leakage potential and 1.0 representing maximum leakage potential in the given study region. Hot spots ($L_i' > 0.1$) are shown in shades of red and areas with $0.05 < L_i' < 0.1$ are shown in orange.

densities are larger. Overall, hot spots are more correlated with well locations in CA and earthquake locations in BC and OK but with important local-scale differences.

The general trends in increased leakage potential do not change substantially if we consider earthquakes with magnitudes greater than 3.0, rather than 1.0, and if we consider only abandoned wells, rather than all wells (figure 2). However, there are few small but important changes. Looking only at larger-magnitude earthquakes creates new hot spots, with the most prominent one being in northeastern BC. Most notably, the Aliso Canyon Natural Gas Storage Field is no longer in a hot spot ($L' > 0.1$) when only earthquakes with $M \geqslant 3.0$ are considered. Therefore, if any leakage is enhanced by earthquakes in this region, it is due to frequent low magnitude ($M \leqslant 3.0$) events.

4. Discussion

Earthquakes and the presence of vulnerable subsurface structures such as oil and gas wells can potentially enhance or create subsurface leakage. Our geospatial analysis point to hot spots where leakage can be enhanced by earthquakes and how low magnitude but frequent seismic events may be as important as few large events. This is in line with previous findings that show earthquake magnitudes poorly predict local damages and consequences [27]. Therefore, our findings indicate the need to investigate the role of earthquakes on wellbore

leakage through analysis of different earthquake characteristics (e.g. peak ground velocity or peak ground acceleration) and wellbore attributes (e.g. age, operational status, type), demonstrate how geospatial and temporal analysis may be used to quantify the scope of the leakage problem, and identify hot spots where future measurement efforts can be focused.

There are no studies, to our knowledge, focusing on the relationship between wellbore integrity and earthquakes. There is only one study, that we know of, with air and groundwater monitoring at one unconventional well site in Poland [16], where they found elevated atmospheric methane concentrations following an earthquake of $M = 0.5$ [16]. However, the authors were not able to attribute the elevated methane concentrations to seismic activity because methane emissions associated with normal production activities on site were not characterized. They were also unable to observe any correlations between injected volumes, seismicity, and groundwater parameters [16]. Even for natural earthquakes, the relationship between groundwater contamination/gas emissions and earthquakes remain poorly defined due to the difficulty of differentiating between the wide range of anthropogenic and natural processes governing groundwater quality and methane emissions [28]. Nonetheless, methane and other gas emissions are linked to natural earthquakes and are suggested as potential warning signals for earthquake risk [29]. Groundwater contamination due to brine and seawater intrusion through leakage pathways created by natural earthquakes are also documented [30]. Impacts of earthquakes on buildings and pipelines, including those that are buried, have long been an active area of civil engineering research. There are many empirical estimates of pipeline damage that relate the number of repairs to peak ground acceleration, peak ground velocity, maximum ground strain, and other factors [31, 32]. There is great potential to extend this existing body of research to subsurface wellbore leakage caused by earthquakes. However, there are key differences between these previous studies and the wellbore leakage problem presented here such as those related to fluid and geologic formation properties at deeper depths and to wellbore construction, use, and abandonment.

4.1. The detection problem

The limited empirical evidence linking earthquakes to leakage is due to the difficulty of detecting leakage in the first place. Environmental degradation associated with subsurface leakage appears in a subset of measurements and is not easy to detect [33, 34]. In one study across the Marcellus shale basin in Pennsylvania, where there is widespread unconventional gas production, 12 household wells out of 141 had methane concentrations exceeding the US Department of the Interior's threshold for immediate remediation, while little to no methane was found in many of the sampled wells [33]. A study synthesizing numerous studies on methane emissions from natural gas systems found that emissions follow extreme distributions with only 5% of emitters accounting for more than 50% of emissions [34]. This is also in line with government data analysis studies that show only a small percentage of wells have compromised cement and/or casing integrity (e.g. 0.7 to 9.5% in Pennsylvania [7]). Furthermore, many studies and industry risk assessment procedures focus on large, catastrophic events, ignoring smaller but more prevalent leaks. As a result, the vast majority of subsurface leakage, including those enhanced or created by earthquakes, are likely to go undetected.

The scope of the subsurface leakage problem may be substantial but is also difficult to quantify. Large differences in areal size of the province/state, the level and history of oil and gas production, and earthquake frequency, magnitudes, and distribution make comparison of leakage potential between regions difficult. The leakage potential values presented here are not designed to be used for direct comparison between states/province because they are normalized by the maximum number of earthquakes or wells in the state/province. Although the DBSCAN clusters are aimed at inter-region comparisons of the distribution of wells and earthquakes, we do not use them to provide quantitative information for leakage potential estimates. Therefore, there is a need for a generalized framework to quantify leakage potential that includes local information but also allows for inter-region comparisons.

Database analysis with oil and gas industry and government data have provided many new insights on possible controls of leakage. However, they are unable to predict leakage and leakage pathway formation remains a largely random process [12]. For example, predictive modeling using logistic regression models, support vector machines, random forests, and back-propagation neural networks with data on Alberta wells show that the database is missing important predictors of leakage [12]. This is especially true for abandoned wells, for which the number of available measurements are small and information on wellbore integrity, location, and other critical factors are lacking. For example, there are approximately ~500 measurements of methane emissions from abandoned wells, yet there are at least five million abandoned wells in North America alone [35]. To better understand subsurface leakage and to identify the role of earthquakes on subsurface leakage, the current gap in data and empirical studies needs to be addressed through efficient use of, often limited, monitoring funds, especially for abandoned wells.

4.2. Wellbore integrity

There is a large body of literature on wellbore integrity, in addition to oil and gas industry standards [17, 18], considering environmental impacts of oil and gas development [3, 4, 35–37] and potential leakage in geologic storage of carbon dioxide projects [2, 5, 6, 38]. These studies show that wellbore integrity failures can occur due to a wide range of chemical and mechanical alterations or defects that could be caused by existing or injected fluids, oil and gas operations, and existing or induced geomechanical stresses [4]. Tectonic or seismic activities are listed as one of the many ways in which mechanical alterations, which involve fracture initiation and propagation, can occur. Chemical alterations may also be promoted by earthquakes as changes in pore fluid pressure drive fluids with corrosive substances to the wellbore. To avoid leakage, wellbores typically contain numerous barriers including multiple layers of steel casing and cementing [3]. Nevertheless, leakage along a wellbore can occur within cemented zones, between cement and steel casing, and between cement and the neighboring rock formation [2, 5]. The initiation and evolution of leakage pathways often involve a combination of a wide range of chemical, mechanical, and physical factors, including corrosion and dissolution of cement in acidic environments, thread leaks, poor cementing operations, pressure changes, and thermal stresses.

It is difficult to attribute wellbore leakage to earthquakes because there typically are other contributing factors and because of the detection problem. There are many factors that influence leakage with or without earthquakes that can be broadly categorized into technical degradation of the system, human intervention, process disturbance, inherent design errors, and external events, as identified to assess leakage risk on offshore petroleum installations [39]. Although advanced wireline downhole methods for determining well casing and cementing issues exist, they are not frequently done due to high cost and instrusiveness. In response, low-cost, non-intrusive, and fast monitoring system are being developed to obtain spatiotemporal data that can better detect wellbore integrity issues [40]. However, such systems are not yet available and are not widely deployed at scales needed to evaluate the large range of wellbore integrity failures and impacts. This is particularly true at abandoned wells, where measurements and data are lacking the most. Meanwhile, abandoned wells may be more prone to leakage due to their age and lack of management once the wells are abandoned. To investigate the potential link between earthquakes and subsurface-based leakage, new low-cost, non-intrusive, and fast monitoring methods [40], database analysis [6, 7, 10] and targeted field studies are needed at active and abandoned well sites. The results in this paper provide the first step to conducting additional database analysis and designing effective field studies for leakage along all and abandoned oil and gas wells.

5. Conclusions

Hotspots with frequent earthquakes and large well counts exist in CA, BC, and OK. One well-documented catastrophic leakage (Aliso Canyon Natural Gas Storage Field) is located in one of the CA hot spots. There may be many smaller leaks that remain undetected, especially in the hot spots. Furthermore, low magnitude ($M \leqslant 3.0$) but frequent seismic activity may play an important role in subsurface leakage. However, there are many gaps in oil and gas well databases and a lack of empirical field studies of all wells, especially those that are abandoned, to make a clear link. In parallel to overcoming the detection problem and improving our understanding of leakage mechanisms, geospatial analysis such as those performed in this study provide valuable insight into developing effective empirical field studies.

There are likely many oil-and-gas-producing regions outside of CA, BC, and OK, where wellbore leakage are being or have been created or enhanced by earthquakes. Although natural earthquakes are difficult to predict, there are many opportunities to minimize anthropogenic earthquakes and associated environmental impacts. Millions of wells have been and will continue to be drilled to meet growing oil and gas demands. Efforts to estimate the scale of the problem and minimize impacts of oil and gas development are needed. This need is becoming increasingly urgent as groundwater resources are depleted and contaminated and as atmospheric greenhouse gas emissions continue to grow.

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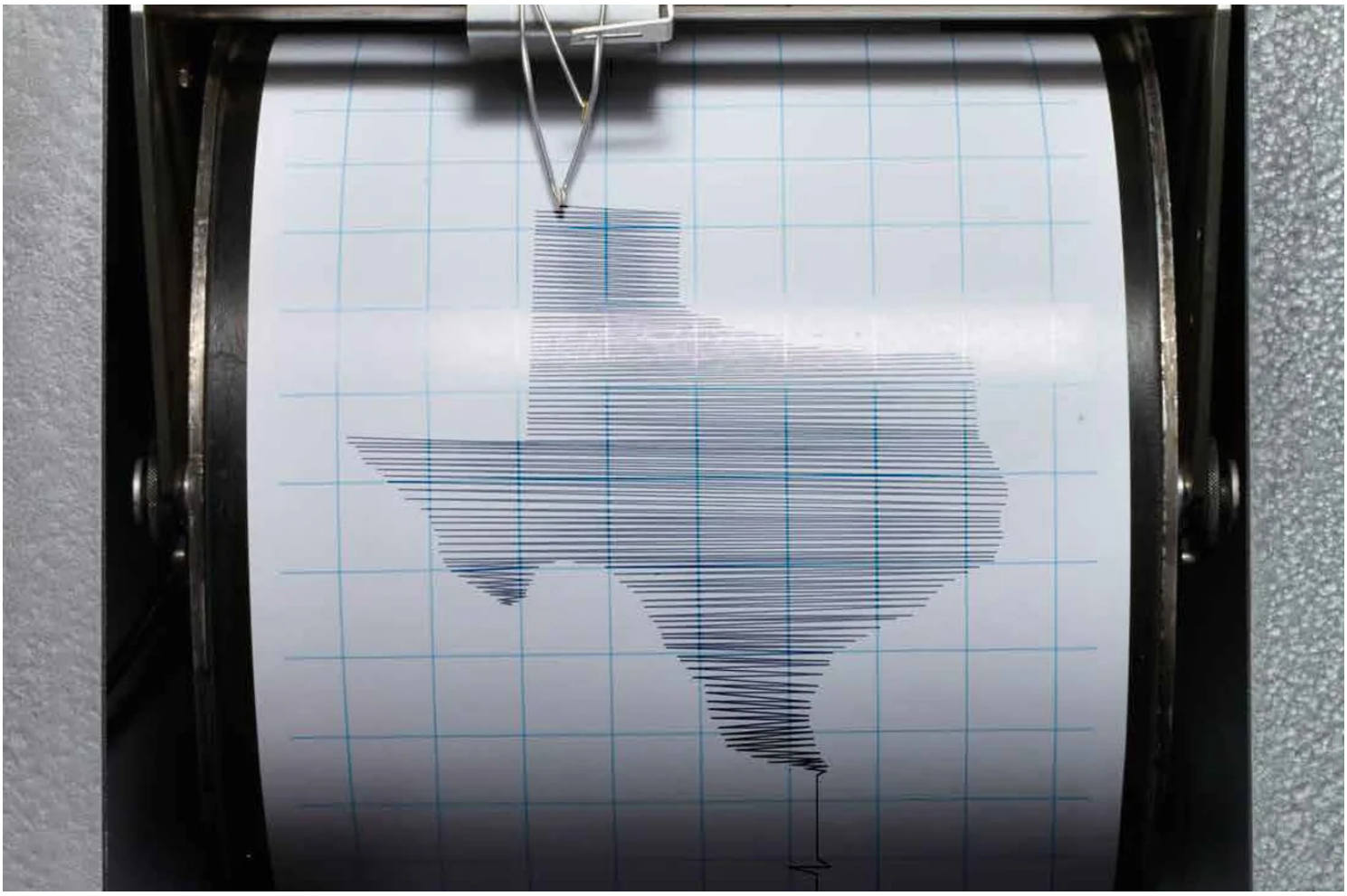
MARCH 28, 2016 | 18 MIN READ

Drilling for Earthquakes

Scientists are increasingly confident about the link between earthquakes and oil and gas production, yet regulators are slow to react

BY ANNA KUCHMENT



Credit: Photograph by The Voorhes

July 2016 Issue | Environment

Editor's Note (11/7/2016): A magnitude 5.0 earthquake struck central Oklahoma on Sunday, Nov. 6, damaging buildings across the area. Experts have not yet tied the quake to oil and gas production, but the epicenter is near wastewater disposal wells, structures that have been implicated in earlier quakes in the state.

To Cathy Wallace, the earthquakes that have been rattling her tidy suburban home in Dallas feel like underground thunderstorms. First comes a distant roar, then a boom and a jolt. Her house shakes, and the windows shudder. Framed prints on the walls clatter and tilt. A heavy glass vase tips over with a crash.

The worst moments are the ones between the rumble and the impact. "Every time it happens you know it's going to hit, but you don't know how severe it's going to be," she says. "Is this going to be a bigger one? Is this the part where my house falls down? It's scary. It's very scary."

Until 2008 not a single earthquake had ever been recorded by the U.S. Geological Survey from the Dallas–Fort Worth (DFW) area, where Wallace has lived for more than 20 years. Since then, close to 200 have shaken the cities and their immediate suburbs. Statewide, Texas is experiencing a sixfold increase in earthquakes over historical levels. Oklahoma has seen a 160-fold spike in quakes, some of which have sent people to hospitals and damaged buildings and highways. In 2014 the state's earthquake rate surpassed California's.

Credit: USGS

The rise in quakes coincides with an increase in drilling activity. Wallace's house, for instance, sits above the Barnett Shale Formation, a layer of hard black rock that holds the U.S.'s second-largest deposit of natural gas. Between

1998 and 2002 companies started drilling this deposit using hydraulic fracturing, or fracking, which involves pumping millions of gallons of water, plus sand and chemicals, into the ground at high pressure to crack the rock and release the gas. As the gas comes up the well so does the fracking fluid, along with volumes of brine so salty it is hazardous. The fluids are pumped back down a different hole drilled far below the shale into porous rock for permanent disposal. As more and more fluid is injected into these wastewater wells, pressure can start to build up on deep geologic faults. Eventually one can slip, causing an earthquake.

Researchers at the USGS and other institutions have tied earthquake surges in eight states, including Texas, Oklahoma, Ohio, Kansas and Arkansas, to oil and gas operations. Some state regulators have been slow to accept scientists' findings. Residents have become increasingly angry, and environmental groups have sued. “This is a public safety issue, and there's been a lot of denial and ignoring of the problem,” says Wallace, who has joined neighbors to push for the shutdown of nearby wastewater wells.

As scientists continue to study the phenomenon, they have found more reason for concern. Evidence suggests that earthquake risks can spread for miles beyond the original disposal sites and can persist for a decade or more after drilling stops. And although the biggest earthquake from wastewater injection was a 5.6 on the Richter scale, near Oklahoma City in 2011, scientists think that temblors as powerful as 7.0—enough to cause fatalities and damage buildings across a wide area—are possible, though unlikely.

THE FIRST SIGNS OF A LINK

Geologists have known since the 1960s that pushing fluids into the ground can set off quakes. In 1961 crews drilled a deep well at a chemical weapons plant

outside Denver, known as the Rocky Mountain Arsenal. Within months after workers started pumping hazardous waste into the well, residents felt tremors. More than 700 small to modest-size quakes shook the ground between 1962 and 1966.

A local geologist, David Evans, noticed that the volume and pressure of the injections corresponded with earthquake rates. In a 1966 paper he concluded that the well was likely to blame for the quakes. “It is believed that a stable situation,” he wrote, “is being made unstable by the application of fluid pressure.”

A wellhead in Coyle, Okla., pumps wastewater into a deep, underground rock formation for permanent disposal. Thousands of disposal wells operate across the state. Credit: J PAT CARTER Getty Images

The U.S. Army shut down the disposal well that same year. Yet the earthquakes continued and even grew stronger as pressure from the injections propagated belowground, encountering new faults and disturbing them. Matthew Hornbach, a geophysicist at Southern Methodist University (S.M.U.) in Dallas, compares the phenomenon with spilling a cup of water on a paper towel. “Even if you stop pouring, the water is still there spreading out, and it's very difficult to stop it,” he says. The largest quakes, including one that reached magnitude 4.8—strong enough to knock objects off shelves but generally not damage buildings—struck in 1967 and then gradually petered out. Residents continued to feel smaller tremors until 1981.

The case intrigued seismologists, and the USGS set up an experiment based on it a few years later. In 1969 Chevron Oil allowed the USGS to use one of its wells to more closely study the effects of fluid pressure on faults. The well was in a seismically active zone of the Rangely oil reservoir in Colorado, and Chevron had been injecting water into the well to stimulate petroleum production. USGS scientists turned the injections on and off and followed the fluid pressure as it migrated through deep rocks. They came up with the exact injection pressure required to trigger quakes. When the pressure exceeded that level, earthquakes rumbled; when the pressure fell below the level, they quieted down.

The experiment showed that human-triggered earthquakes could be controlled by adjusting wastewater-injection pressure. Unfortunately, the lessons of Rangely and the Rocky Mountain Arsenal were apparently forgotten by the early 2000s, when fossil-fuel companies embarked on the shale-gas boom. "Scores of papers on injection-induced earthquakes were published in the geophysical literature in the following 40-plus years, and the problem was well understood and appreciated by seismologists," says Bill Ellsworth, a Stanford University geophysicist who launched his career at the USGS while the Rangely experiment was under way. He believes professional skepticism slowed the formation of a consensus. "There were a lot of doubts expressed by very good petroleum engineers that [earthquakes caused by injection wells] were even possible," he says. "Knowledge of the whole physical process was either lost or had not been effectively communicated to a broad community."

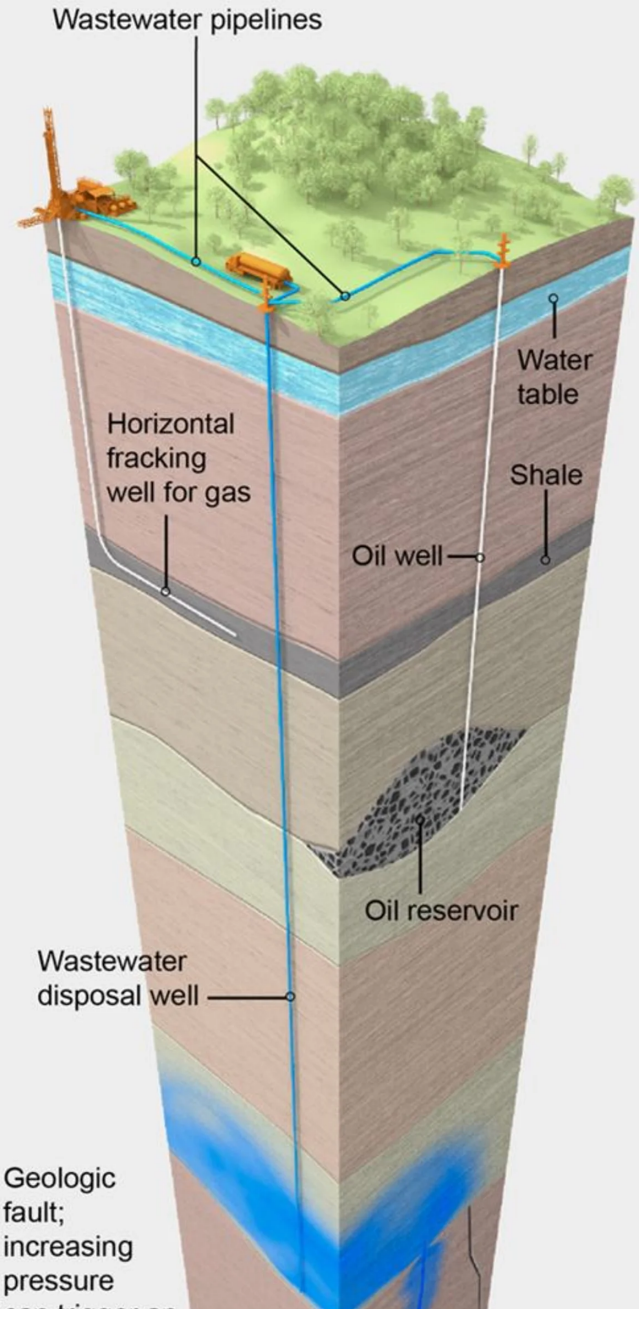
IT STARTED IN TEXAS

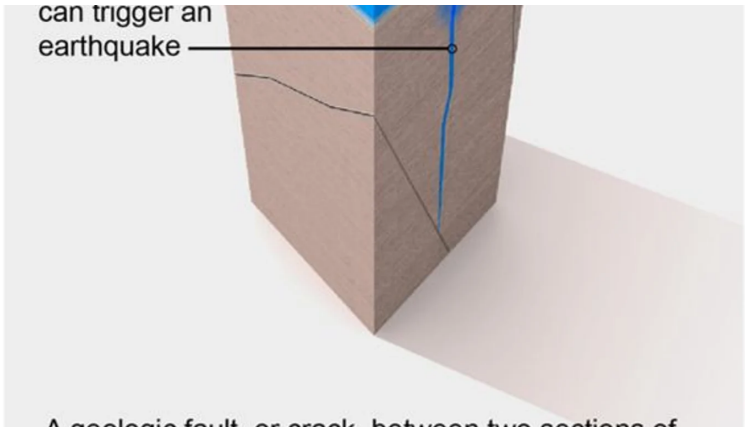
Soon after more aggressive drilling began in Texas and Oklahoma shales, reports of quakes started coming in. On October 30, 2008, Dallas–Fort Worth

residents called 911 to report loud booming noises accompanied by shaking walls and furniture. Many wondered if something had blown up.

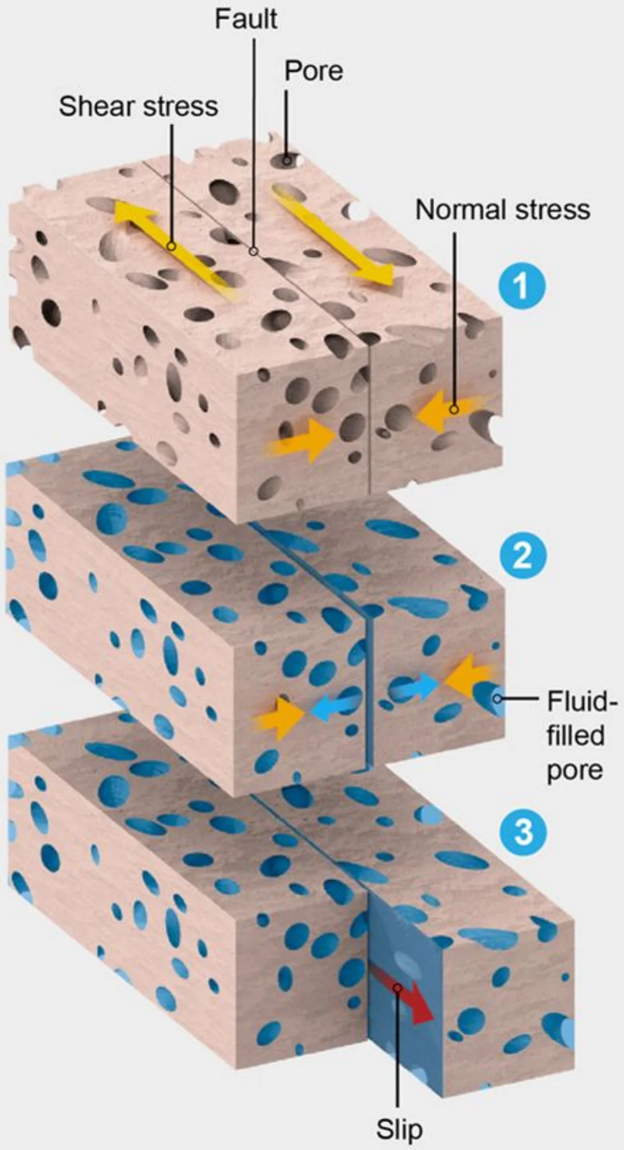
Wastewater Triggers an Earthquake

Large volumes of extremely salty brine, and chemicals, come back up gas and oil wells (*left and right, respectively*). Companies often inject this wastewater down a shaft (*blue*) into a deep layer of porous rock for permanent disposal, which can trigger an earthquake (*inset diagrams below*).





A geologic fault, or crack, between two sections of rock is held in place by “normal” stresses pushing against the crack from each side 1, negating sheer stresses that would slide the sections along the crack. When wastewater is injected it fills pores and the crack 2, which can counteract the normal stresses (*blue arrows*). That change can allow the sections to slip along the fault 3 — an earthquake.



Credit: Illustration by Bryan Christie

Seismologists Cliff Frohlich of the University of Texas at Austin and Brian Stump of S.M.U. investigated. They put out numerous seismometers and recorded more than 180 small earthquakes between October 30 and May 31, 2009. They then found that a major gas producer had recently drilled a wastewater well at Dallas–Fort Worth International Airport, less than half a mile from the center of the quake cluster. “On the basis of time and spatial correlations, we conclude the DFW sequence may be the result of fluid injection at the SWD [saltwater-disposal] well,” they wrote in a paper published in March 2010 in *The Leading Edge*.

The paper, Frohlich says, might have been ignored were it not for several other events. In June 2009 another set of quakes had rustled a small industrial city south of Fort Worth. A few months later stronger quakes shook the towns of Guy and Greenbrier in Arkansas. In March 2011 the typically steady ground of Ohio started shifting as 12 quakes rattled the Youngstown area.

From their offices in Menlo Park, Calif., USGS scientists noticed that something unusual was happening. “On a daily basis, we could see there were earthquakes occurring in places where they didn't belong,” says Ellsworth, who worked at the USGS until 2015. He began to look broadly at earthquake rates in the U.S. and discovered an unsettling pattern: Between 1967 and 2000 the average rate of earthquakes east of the Rocky Mountains was 21 per year. Between 2010 and 2012 the rate had jumped to 100. He plotted the data and presented them at a scientific conference. “It generated a lot of interest,” he says, from the general public as well as from scientists in industry and academia.

DRILLING SIDEWAYS

Behind the rise of earthquakes is the rise of wastewater injection wells. And behind those wells is a technological breakthrough known as horizontal drilling. The technique allows operators to drill wells vertically and then bend them 90 degrees like flexible straws. Instead of drilling right through a gas deposit that is 300 feet thick but miles across, these wells can turn when they are inside the deposit and run for thousands of feet, collecting significantly more gas and oil.

With that gas and oil, however, come vast quantities of very salty water. “The oil and gas business is really a water-handling business,” says Scott Tinker, Texas's state geologist and director of the University of Texas at Austin's Bureau of Economic Geology. The water comes from the same rocks as the oil and gas. All three are remnants of ancient seas that heat, pressure and time transformed. “The pore spaces, or tiny holes, in the rock remain filled with these ancient oceans, so when we drill wells today that water is produced to the surface,” Tinker says. Although the water is natural, it can be several orders of magnitude more saline than seawater and is often laced with naturally occurring radioactive material. It is toxic to plants and animals, so operators bury it deep underground to protect drinking-water supplies closer to the surface.

A legendary Texas natural gas baron named George Mitchell, who died in 2013, was the first to tap the Barnett shale using hydraulic fracturing. Oklahoma's Devon Energy combined horizontal drilling with hydraulic fracturing to extract even more gas. The technique soon caught on across Texas, Oklahoma and other petroleum-producing states.

As drilling proliferated, U.S. shale-gas production rose steeply, from 1.3 trillion cubic feet in 2007 to 5.3 trillion in 2010 and 13.4 trillion in 2014. The volume

of wastewater that was brought to the surface and had to be disposed of soared, too.

In Texas the amount of water pumped into wastewater wells grew from 33.8 million barrels per month in 2007 to 81.1 million in 2014. In Oklahoma it nearly doubled from 849 million barrels per month in 2009 to 1.54 billion in 2014. Soon regular injection wells were not large enough, and operators turned to so-called high-volume injection wells with names like "Deep Throat." Many absorbed more than 300,000 barrels of water per month.

OKLAHOMA LIGHTS UP

As the quakes mounted, scientists moved from loosely associating them with wastewater injection to deducing a more direct link. In 2011 University of Oklahoma seismologist Katie Keranen returned from a field study in Alaska with half a dozen seismometers in tow. As they stood in storage in her basement lab, a magnitude 4.8 earthquake jolted the town of Prague, about 60 miles east of Oklahoma City. No sooner had she and her students put out the instruments than a 5.6 quake rocked the same town. To date, that November earthquake is the largest event related to wastewater injection, according to the USGS. It injured two people, destroyed 14 homes, buckled parts of a highway and was felt in at least 17 states.

1

2

3

4

In 2011 a magnitude 5.6 quake shook homes in Prague, Okla., knocking down Sandra and Gary Landra's chimney, which struck Sandra (1). It also cracked their basement floor (2). More quakes in the state since then have prompted residents to protest against disposal wells, linked to the Prague temblor and others (3). Scientists are installing additional seismographs to increase their data, in some cases powered by solar panels (4). Credits: (1, 2 & 4) LINDA DAVIDSON Getty Images; (3) J PAT CARTER Getty Images

Keranen and her students recorded that temblor, and hundreds of aftershocks, and used the data to publish papers in *Geology* and *Science*. For the *Geology* paper, published in March 2013, Keranen and her colleagues created a geophysical model to estimate how quickly fluid pressure could build up underground and how far it could spread. It showed that the pressure was likely strong enough to have caused the first earthquake, which then set off a domino effect; stress changes from the first rupture caused nearby faults to slip. The *Science* paper, released in July 2014, tied four high-volume injection wells to a cluster of earthquakes in Jones, just west of Prague.

Keranen compares the movement of fluid and pressure through the earth's subsurface to water filling a vase that someone broke and glued back together. "If you have high enough pressure, the fluid could just force its way down the fractured pathways," she says. The pressure counteracts the friction that holds faults together and allows them to slip apart—a phenomenon known as an induced earthquake.

Unconvinced, the Oklahoma Geological Survey (OGS) issued a statement disputing Keranen's findings in the *Geology* paper. "Our point was just that it looked like a natural earthquake, and there was no reason to call it induced," says Randy Keller, who was director of the survey until he retired at the end of 2014. The statement, signed by Keller and Oklahoma's state seismologist at the time, Austin Holland, pointed to evidence of historical natural earthquakes in the area.

Keranen was surprised by the response but now thinks her reaction was naive. “I have more appreciation for the fact that they wouldn't necessarily believe one report,” she says. “They wanted to see the bulk of the scientists and multiple studies point in that direction.” Still, she felt frustrated that Oklahoma did not quickly slow down or stop injections in some wells, a step the state did not take on a wide scale until early 2015. She says she also received pushback from administrators at her university who were not convinced that a link between disposal wells and quakes could be demonstrated. In mid-2013 Keranen left the University of Oklahoma for Cornell University.

Sources: *Class II Saltwater Disposal for 2009–2014 at the Annual-, State-, and County- Scales by Geologic Zones of Completion, Oklahoma*, by Kyle e. Murray. Oklahoma Geological Survey, December 31, 2015 (*wastewater injection data*); USGS Earthquake Maps (*earthquake data*) Maps by Amanda Montañez

RUMBLES NEAR FORT WORTH

A few months after Keranen's paper came out, Texas started shaking again. This time quakes struck two rural towns northwest of Fort Worth—Azle and Reno, in one of the densest areas of oil and gas development.

By this time S.M.U. had hired several new geophysicists, who joined Frohlich and Stump's investigation. Heather DeShon, a seismologist, deployed seismic stations and began mapping faults underneath the towns. Hornbach, along

with Stanford's Ellsworth, began studying lake, river and aquifer levels to see if North Texas's drought could have altered stresses on faults. The team also collected data on nearby saltwater-disposal wells and built a 3-D model to simulate pressure from injection wells and estimate how it would move through underground rock. Their conclusion: wastewater injection from two nearby wells was the most likely cause of the earthquakes.

Even before the study was published in April 2015, state regulators began questioning its findings. After I sent an embargoed version of the S.M.U. paper to Craig Pearson, a seismologist who works for the Railroad Commission of Texas (RRC)—the state agency that regulates oil and gas—he responded with a statement saying the research raised "many questions with regard to its methodology, the information used and conclusions it reaches." But he declined to elaborate before meeting with the paper's authors.

The RRC (its name is a historical artifact) is overseen by three commissioners. One received campaign contributions from an oil-company political-action committee, and the two others received contributions from the CEO of EnerVest, one of the two operators implicated in the S.M.U. study. Nevertheless, "regulatory decisions are made based on science, data and best practices to ensure protection of public safety and our natural resources," wrote Gaye McElwain, an RRC spokesperson, in a statement to *Scientific American*.

The RRC did eventually summon both well operators to full-day hearings in Austin to demonstrate why their wells should not be shut down. "As a result of those highly technical hearings, based on scientific data and evidence presented, it was determined the operators were not contributing to seismic activity," McElwain wrote. By September 2015, when the commission issued

its ruling, the volumes of wastewater being injected in the vicinity of the earthquakes had been reduced, the earthquakes had died down and the well operators were officially allowed to continue business as usual.

OHIO SAYS STOP

Other states have reacted differently. After a series of tremors disturbed the residents of Youngstown, Ohio, in 2011, the state shut down nearby injection wells and installed additional seismic stations to detect earthquakes too tiny to be felt. It established new rules dictating that a quake as small as magnitude 2.0, about 10 times too weak to create noticeable shaking, would trigger well shutdowns and investigations. Ohio's earthquakes peaked at 11 in 2011 before decreasing to four in 2015, according to USGS data.

Kansas also responded relatively quickly. Rex Buchanan, interim director of the Kansas Geological Survey, was watching a Kansas City Royals game in September 2014 when his cell phone started buzzing with alerts from the USGS. Tremors were shaking south-central Kansas near the state's border with Oklahoma. This was not a surprise, because more than 100 earthquakes had visited Kansas during that year, up from an average of one every two years. But the tremors were growing stronger and soon reached magnitude 4.2. Kansas governor Sam Brownback convened an induced-seismicity task force to evaluate the quakes. The task force, chaired by Buchanan, recommended restricting injection volumes within five seismic zones across two counties.

How were Kansas officials able to reach a consensus? “I don't think we could come up with any other explanation,” Buchanan says. “You see a level of activity like we saw: a dramatic, dramatic increase, and in almost exactly the place where the really large-volume wells are going in—and where you see the

same correlation in Oklahoma. It's pretty hard to come to any other conclusion." He adds that he and his colleagues had the benefit of watching science and regulations develop in Ohio, Texas and Oklahoma. So far the measures Kansas took seem to have had an impact. "Certainly our activity has been down lately," he says, in terms of both earthquake rates and size. "But I have pressed people real hard not to take the approach that this is some sort of problem solved, because it's not."

The reduced activity is at least partly related to the currently low price of oil, which has prompted some operators to drill less and therefore to produce less wastewater. But prices will eventually rise again, Buchanan says, and he wants to be ready "so we don't have to go through this again."

HOW BIG CAN QUAKES GET?

Engineers who set building codes and officers at insurance companies need to know where the next induced earthquakes will strike and how big they will be. To find out, geologists at the USGS's Earthquake Hazards Program are analyzing the rates of the induced quakes that have been multiplying across the U.S. and how induced earthquakes shake the ground differently from natural ones.

USGS scientists have found that ground movements from induced quakes are stronger just above the epicenter but less so away from the immediate area, possibly because they tend to be shallower than natural ones. Because the uppermost layers of the earth's crust east of the Rocky Mountains are denser than those in California, however, they transmit energy efficiently, and induced quakes can still be felt at great distances.

Next, the group had to come up with a maximum magnitude for these temblors: How strong could they get? After comparing central U.S. earthquakes with tremors in geologically similar parts of the world—and noting that induced quakes, so far, tended to rupture either smaller faults or smaller sections of faults than West Coast quakes—they settled on an upper limit of magnitude 6, which can damage even well-built structures. “But we can't rule out quakes of magnitude 7 and above,” says Mark Petersen, chief of the National Seismic Hazard Mapping Project. Because scientists have evidence in the prehistoric record of quakes that large in the Texas-Oklahoma region, the USGS's new maps include a low-probability chance for that possibility.

Finally, the geologists had to work out the time period over which to make a reasonable earthquake forecast. They settled on a one-year forecast based on the previous year's earthquake rate and put that information in a series of maps. “It's kind of like the weather,” Petersen says. “If it rained today, it's more likely that it will rain tomorrow.”

The USGS issued the maps on March 28 of this year. The computer models used to generate the maps also estimate where, how often and how strongly ground shaking from an earthquake could occur, so that residents, engineers and city planners can see the likelihood that their community will experience a damaging earthquake over the next year.

CURBING THE THREAT

To many Oklahomans, it is clear that that risk has risen sharply. Data back up their experiences. The earthquake rate in the state has grown at an astounding pace. In 2013 the state recorded 109 quakes of magnitude 3 and greater. The following year the number jumped to 585, and in 2015 it reached 890.

The escalation prompted two unusual warnings jointly issued by the USGS and the OGS in October 2013 and May 2014. Seismologists stated that Oklahoma had a significantly increased chance of seeing a damaging magnitude 5.5 temblor. “It was the first time I think we'd ever issued an earthquake advisory east of the Rockies,” says Robert Williams, the USGS central and eastern U.S. coordinator for earthquake hazards.

Scientists such as Keranen and Mark Zoback, a geophysicist at Stanford, are producing even more detailed analyses of why quakes happen so frequently in some places but less—or not at all—in others. For example, North Dakota, the second-largest crude oil–producing state after Texas, has logged only one earthquake in the past five years. One possibility is that fluid pressure has not yet built up strongly enough to cause quakes. And only a fraction of faults may have the necessary orientation, relative to natural stresses in the earth's crust, that is conducive to a slip.

As the science has advanced, so have regulations. The OGS formally declared in April 2015 that disposal wells were triggering its quakes. “The OGS considers it very likely that the majority of recent earthquakes, particularly those in central and north-central Oklahoma, are triggered by the injection of produced water in disposal wells,” it wrote in a statement.

Since then, the state has asked that more than 600 disposal wells operating in quake-prone areas cut injection volume by 40 percent below 2014 levels. Although it is too early to know if the actions will have a lasting effect, Jeremy Boak, director of the OGS, says he is starting to see declines in earthquake rates in the areas where injections have been reduced. Overall, the state saw an uptick in stronger quakes at the beginning of 2016, however. Stanford's Ellsworth does not offer policy prescriptions but wonders if the volume

reductions in Oklahoma will be sufficient. “If you pump less, you're still pumping,” he says, “and it doesn't guarantee you won't encounter a fault and cause an earthquake.”

Many wonder why Oklahoma waited until 2015, after the state had experienced more than 750 earthquakes over seven years, to take significant action.

Matt Skinner, a spokesperson for the Oklahoma Corporation Commission, which regulates oil and gas in the state, says the agency had been shutting down individual wells and taking other steps to manage earthquake risk since 2013. The agency did not take wider action until last year, he says, because by that time researchers had published more scientific studies showing how far fluid pressure could travel from a wastewater well. “The issue changed from which well do we take action on to what group of wells do we need to take action on to reduce potential risk?” Skinner says.

Keller, the retired OGS director, says he was also aware of the state's economic dependence on oil and gas. “We were absolutely slower than those that were quick to pull the trigger,” he says. “We were sitting there trying to balance the economic impact and trying to not push the panic button and at the same time trying to be responsible. It was not an easy task to figure out what to do.” For well operators, a volume reduction means a loss of income and the possibility of having to truck wastewater over long distances to other facilities.

Texas has introduced new measures to monitor earthquakes. Last year the state allocated nearly $4.5 million for the installation of a seismic network and additional earthquake research. Over the past two years the Railroad Commission has also given itself new powers to shut down wells and ask operators to perform tests in areas of new seismic activity. Although the

agency has expressed concern about the quakes, it has not yet formally concluded that any have been triggered by energy production.

Other mitigation strategies that states and oil and gas companies are exploring include recycling the wastewater or injecting it into layers of rock that are farther removed or isolated from deep faults. They may also space injection wells farther apart.

To the oil and gas industry, a moratorium on injections—even in a single broad area—is unacceptable. “A ban on injection is a ban on oil and gas production,” says Steve Everley, a spokesperson for Energy InDepth, which is part of the Independent Petroleum Association of America. That is because there are not yet any cost-effective alternatives to injection, and many come with their own environmental costs, such as trucking water over longer distances, he says.

Even if Oklahoma shut down all its wells today, many experts say the quakes would continue. “We're trying to calculate how much energy is in the system right now and how long it may continue on—and at the current earthquake rate the numbers are very big,” says Daniel McNamara, a seismologist at the USGS Geologic Hazards Science Center in Golden, Colo.

Pressed for details, he paused. Then he added: “It's hundreds of years.”

RIGHTS & PERMISSIONS

MORE TO EXPLORE

Sharp Increase in Central Oklahoma Seismicity since 2008 Induced by Massive Wastewater Injection. Katie Keranen et al. in *ScienceExpress* online; July 3, 2014.

High-Rate Injection Is Associated with the Increase in U.S. Mid-continent Seismicity. Matthew Weingarten et al. in *Science*, Vol. 348, pages 1336–1340; June 19, 2015.

2016 One-Year Seismic Hazard Forecast for the Central and Eastern United States from Induced and Natural Earthquakes. Mark D. Petersen et al. U.S. Geological Survey Open-File Report 2016-1035; March 28, 2016.

FROM OUR ARCHIVES

The Drillers Are Coming. Mark Fischetti; July 2010.

SCIENTIFIC AMERICAN ONLINE
To see the USGS earthquake-prediction map, go to ScientificAmerican.com/jul2016/kuchment

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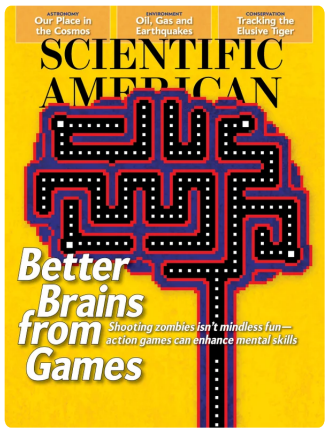

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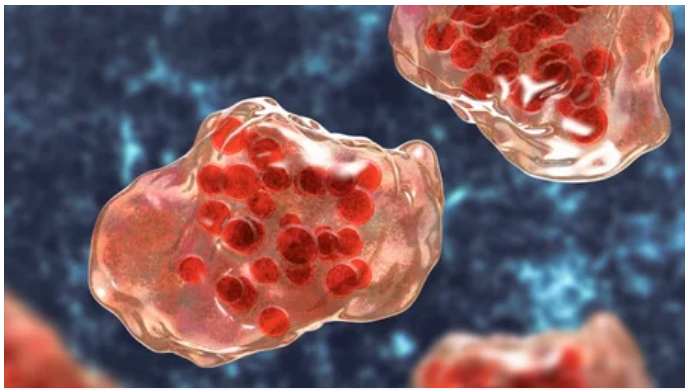

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NRDC REPORT

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Drilling in California: Who's at risk?

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Tanja Srebotnjak
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Natural Resources Defense Council

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Photo on front cover: oil wells in Los Angeles

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EXECUTIVE SUMMARY

As new drilling and stimulation techniques, including hydraulic fracturing ('fracking'), are heralded as the key to unlocking a new oil boom in California, there is mounting evidence that these technologies, and the expansion of oil and gas development that they enable, threaten public health. As California contemplates the safety of these technologies and necessary protections, it is important to identify the populations at risk. New analysis of oil and gas development in California shows that, already, approximately 5.4 million people (14 percent of the state's population) live within a mile of one, or more, of more than 84,000 existing oil and gas wells. More than a third of these people (1.8 million) also live in areas most burdened by environmental pollution as identified by California EPA's tool (CalEnviroscreen 2.0). These communities, highly vulnerable to additional pollution from oil and gas development, consist primarily of Latinos/Hispanics (69 percent), African Americans (10 percent), and Asian Americans (11 percent). In total, people of color make up nearly 92 percent of the 1.8 million people living within a mile of oil and gas development and in communities already heavily burdened by pollution.

Currently, the drill sites that use stimulation technologies like hydraulic fracturing are generally located near existing oil and gas extraction, primarily in Kern (2,361 wells), Los Angeles (124 wells), and Ventura (456) counties. However, a smaller number of sites have also been recorded in nine other counties, including Monterey, Fresno, and Santa Barbara. The push to use hydraulic fracturing and other well stimulation technologies to access oil from formations underlying some of the state's most fertile agricultural lands and densely populated urban areas raises public health concerns, including harmful air pollution, contaminated ground and surface waters, and large amounts of toxic waste. Increased oil and gas production using these new technologies can bring more contaminants—many of which have been linked to respiratory and neurological problems, birth defects, and cancer[1,2]—to backyards, communities, and cities. Future unconventional oil and gas development using hydraulic fracturing and other well stimulation techniques in these areas, and its expansion into new areas, may exacerbate environmental problems and health threats for communities that have already been disproportionately impacted. A comprehensive evaluation of the safety of expanding oil drilling must include and ensure protections for the most vulnerable, and already overburdened, communities.

Of the statewide population living within one mile of oil and gas development and in communities identified as most vulnerable by CalEPA's new alEnviroScreen 2.0, nearly 92 percent are people of color (69 percent Hispanic/Latino, 10 percent African American, 11 percent Asian, and 2 percent Other).

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Oil wells in Los Angeles

MAPPING OIL AND GAS ACTIVITY AND COMMUNITIES BURDENED BY ENVIRONMENTAL POLLUTION IN CALIFORNIA

The objective of our analysis is to examine where and how communities, especially those that are vulnerable to environmental pollution and degradation, are affected by existing and potential oil and gas development in California. In light of the impacts associated with the rapid scale-up of tight oil[3] and shale gas[4] development in Pennsylvania, Texas, Colorado, and North Dakota, the prospect of new and expanded oil exploration and production in California must be closely evaluated, including identifying who will be impacted by it and where.

We used the California Division of Oil, Gas and Geothermal Resources (DOGGR) "AllWells" and "Well Stimulation Treatment Notices Index" databases, the South Coast Air Quality Management District (SCAQMD) "Oil and Gas Wells Activity Notification" database, and the chemicals disclosure registry database FracFocus.org (all as of July, 2014) to map and describe oil and gas wells.[5,6]

The oil and gas wells that we selected from the "AllWells" database for our analysis are classified by DOGGR as either "New" or "Active". "New" wells are those that have been permitted to be drilled, while "Active" wells include producing wells and wells not plugged according to DOGGR standards. These wells may hence pose an ongoing threat as potential production sites or conduits for pollution.[7] We used the "New" and "Active" codes because they provide a measure of the number of wells that may—now or in the future—contribute to the total environmental burden on the communities. We then expanded this database to include the SB4 notification, SCAQMD, and FracFocus.org information while eliminating duplicate well entries. (For more details on well selection see Appendix I).

In a second step, we mapped the vulnerability of communities to environmental pollution and overlaid the location of oil and gas wells. We used the CalEnviroScreen 2.0—a tool developed by CalEPA to evaluate multiple pollution sources (including air, water, and soil pollution) in a community while accounting for its vulnerability to pollution's adverse health effects. The tool is now being used by several state agencies in their decision-making processes and to identify areas and communities that are in particular need of resources to address these pollution sources and cope with the negative health effects.[8] CalEnviroScreen 2.0 provides a means to identify communities that could be most vulnerable to pollution from new and existing oil and gas development. It aggregates a pollution burden index with Census characteristics that have been linked to pollution sensitivity and ranks census tracts from lowest to highest. We focus in particular on the subset of communities—the top 20% of census tracts—that CalEnviroScreen 2.0 identifies as the most highly burdened, and most vulnerable, communities in the state with respect to cumulative environmental pollution.[9]

Using spatial buffering techniques, we then calculated the number and demographics of people who live near oil and gas wells (within a quarter mile and within one mile).[10] (More detail on the calculation methods is included in Appendix I.)

EXTRACTION TECHNOLOGIES POISED TO EXPAND OIL DRILLING IN CALIFORNIA

Advanced well drilling and stimulation technologies such as horizontal drilling, hydraulic fracturing, and acidizing have brought a huge boom over the past decade in unconventional oil and gas development in at least 17 states.[11] The term 'unconventional' refers to reservoirs that have low permeability and porosity and require technologies such as hydraulic fracturing to produce oil or gas. Hydraulic fracturing ('fracking') involves pumping large volumes of water mixed with chemicals underground at high pressures to fracture the rock.[12] Acidizing is a process that increases the flow of oil and gas by injecting acids into the well to dissolve rocks and/or sediments and mud solids that are clogging the rock pores.[13] Hydraulic fracturing, as well as cyclic steam and water flooding, is also used for enhanced oil recovery (EOR) to improve formation permeability and oil flow.[14]

The Monterey Formation (see Map 1) contains various oil-bearing components known as members,[15] including the Puente or Modelo formations and the Nodular Shale in the Los Angeles Basin and the McClure, Reef Ridge, and Antelope shales in the San Joaquin Basin.[16] The Temblor Formation (including the Santos Shale), which underlies the central and southern San Joaquin Valley, has also been identified as prospective for oil. The Monterey Formation underlies much of the Central Valley's rich agricultural soils and important groundwater aquifers. In Los Angeles and Santa Barbara counties, it overlaps with one of the most populated regions in the country.

Despite uncertainty about how much oil is recoverable in the Monterey Formation tight oil play,[17] the industry continues to aggressively use and develop unconventional stimulation and enhanced recovery methods such as hydraulic fracturing to unlock oil deposits in California.[18,19] This could result in hundreds if not thousands of new wells— in addition to the more than 84,000 existing oil and gas wells (see Map 1)— in heavily drilled areas such as Kern County and new areas, even those near towns and cities.

Our database counts 84,434 active and new oil and gas wells. Of that, 7,177 are 'new' wells that have recently received a permit to be drilled, and, at least 3,003 wells that have been stimulated using hydraulic fracturing, acidizing, and other stimulation methods (including 596 SB4 notices). Since DOGGR only began adding this information recently, however, this estimate may be too low. Differences in reporting requirements also led to discrepancies between the South Coast Air Quality Management District (SCAQMD) well notices[20] and DOGGR's databases. These discrepancies, and the resulting underreporting in California, highlight the need for more effective regulation of an industry that hydraulically fractured approximately 82,000 wells in 17 other states between 2005 and 2013[21] while taking advantage of exemptions from portions of the nation's major environmental and public health protection laws.[22]

POLLUTION AND HEALTH THREATS ASSOCIATED WITH OIL AND GAS DEVELOPMENT

Experts are concerned that expanded oil drilling in California by developing the Monterey tight oil play could pose significant threats to health and the environment from hydraulic fracturing and other stimulation methods.[23,24,25] Although the extent to which these methods will be deployed in California is debated,[26,27] the literature linking oil and gas development, including hydraulic fracturing, to significant releases of air, water, and soil pollutants as well as physical, safety, and health hazards raises the potential for significant impacts.[28,29,30] Recent review studies of shale gas development identified pollutant emissions at all stages beginning with well pad construction and continuing through drilling, well completion, production, and ultimately well abandonment.[31,32] The majority of these pollutants, detailed below, are also present in unconventional oil development, which also uses hydraulic fracturing and acidizing.

AIR POLLUTION

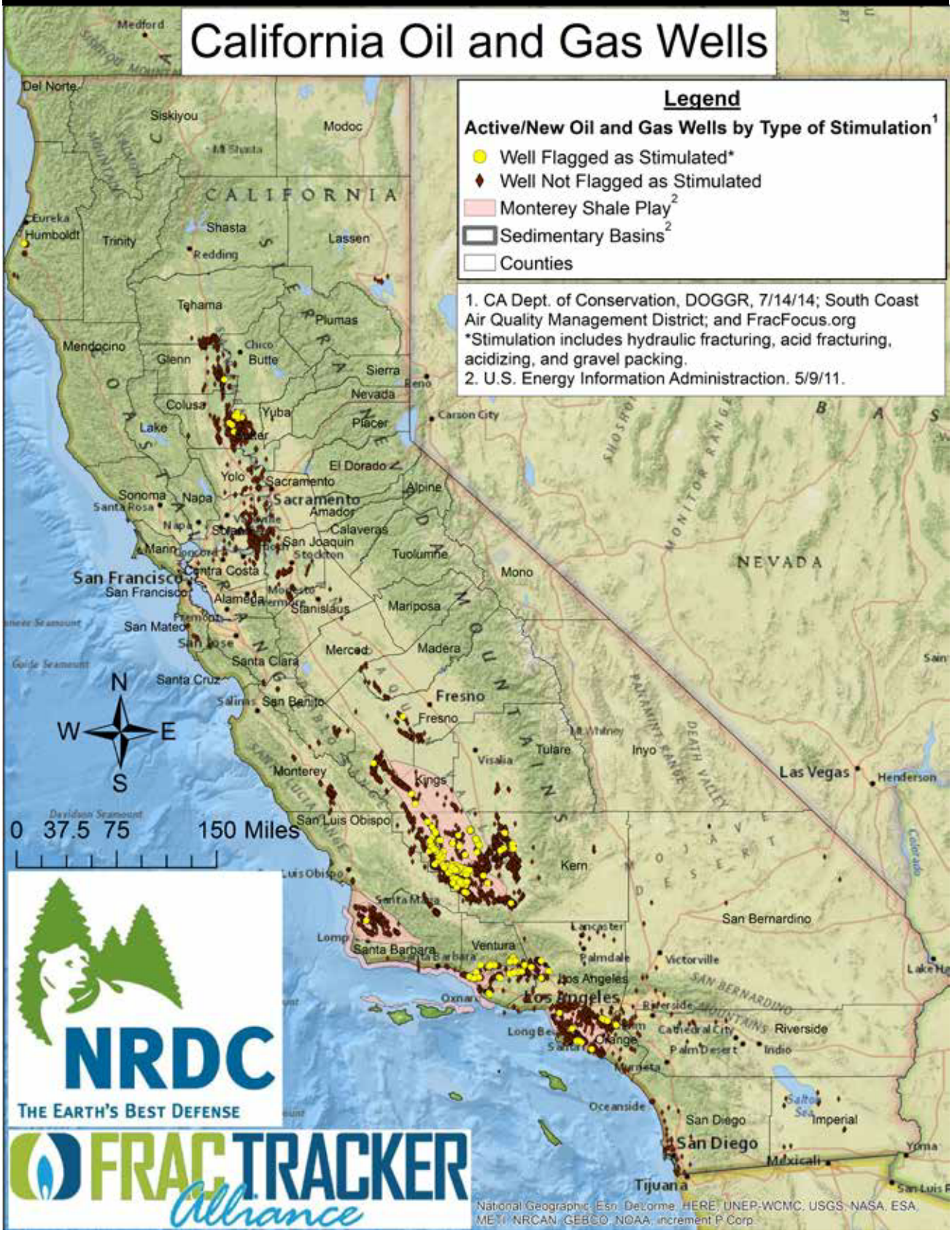
Multiple studies have found that air pollution from oil and gas development can reach levels associated with adverse health impacts for residents and communities in regions with intense oil and gas development. Air pollution from unconventional oil and gas development can be classified into emissions during preproduction, production, transmission and storage, use, and after well abandonment.[33] Preproduction emissions (i.e., well pad preparation, drilling, well stimulation, and completion) include methane, benzene, toluene, ethylbenzene, and xylene (BTEX),[34] volatile organic compounds (VOCs), nitrogen oxides (NO_x), fine particulate matter ($PM_{2.5}$), hydrogen sulfide, and silica dust.[35,36,37,38] VOCs and NO_x contribute to the formation of regional ozone, which causes smog and harms the respiratory system.[39,40,41] During production, methane and non-methane VOCs, including numerous toxic air contaminants (TACs), may continue to be released from the wellhead and other equipment such as condensate tanks, compressor stations, and open wastewater impoundment pits. Oil and gas transmission and storage release VOCs and methane.[42,43] Improper plugging of a well at the end of its life cycle can cause continued leakage of oil, methane, and other VOCs even after the well has ceased production.[44]

A broad range of health effects are associated with exposure to these air pollutants, including mild to severe respiratory and neurological problems, cardiovascular damage, endocrine disruption, birth defects, cancer, and premature mortality.[45,46]

CONTAMINATION OF DRINKING WATER AND SOILS

The large-scale exploration and production of conventional and tight oil deposits using hydraulic fracturing and related stimulation techniques risks water and soil contamination from spills and leaks; well blowouts; and faulty well casings, cement, and equipment. A recent analysis estimated that between 2012 and 2013, the number of reported spills in 15 major oil and gas producing states rose by 17 percent to more than 7,000.[47] Although many of these spills were small, their combined volume totaled more than 26 million gallons of oil, hydraulic fracturing fluid, wastewater, and other chemicals and compounds used or produced during oil and gas production. Hydraulic fracturing fluid and wastewater are often a toxic soup of chemicals. For example, a study of 353 fracking fluid constituents found that more than 75 percent of them have been shown to affect the

Map 1: Active and new oil and gas wells as of July 2014 and the Monterey shale play and sedimentary basins



skin, eyes, other sensory organs, and the respiratory and gastrointestinal systems. Approximately 40–50 percent can affect the central nervous system and the brain, the immune and cardiovascular systems, and the kidneys. Thirty-seven percent are known endocrine disruptors and 25 percent are linked to cancer and mutations.[48] Underground, the hydraulic fracturing fluid mixes with formation brines. This so-called "produced water" can be much saltier than seawater and can contain heavy metals and Naturally Occurring Radioactive Materials (NORM).[49,50,51] It is brought to the surface along with oil and gas over a well's lifespan. During "flowback" (several days following the fracturing process), between 10 and 80 percent of the hydraulic fracturing fluid returns to the surface.[52] The handling and disposal of this wastewater has been linked to air pollution when volatile contaminates evaporate and to water contamination incidents involving local groundwater and nearby waterways.

Methane, hydrocarbons, hydraulic fracturing fluid components, heavy metals, and formation fluids have been found in water wells near oil and gas sites.

Another potential source of water contamination is loss of mechanical integrity from improper well construction, maintenance, or plugging.[53] Failure of well casings and cement bonds could allow oil, gas, hydraulic fracturing fluids, and naturally occurring toxic and radioactive materials to migrate into shallower groundwater aquifers. While well integrity failure may not necessarily lead to groundwater contamination, monitoring and effective regulations are needed to detect and remediate well integrity problems and to properly plug wells. For example, a 2009 study examined records of more than 315,000 oil and gas production and injection wells drilled through 2004 in Alberta, Canada and found that 4.6 percent had gas migration problems due to improper construction. It remains unclear what percentage of these wells may have impacted groundwater.[54]An examination of more than 75,000 compliance reports for 41,381 conventional and unconventional oil and gas wells drilled in Pennsylvania between 2000 and 2012 found that the incidence of cement and/or casing issues was six-fold higher for unconventional wells compared with conventional wells and that incidence varied by geographical location.[55]

Several other studies have found methane, hydrocarbons (including BTEX), hydraulic fracturing fluids, formation brine, heavy metals, and NORM in water samples from drinking water wells and surface water bodies near oil and gas sites.[56,57,58,59,60] It is, however, difficult to determine the exact origin and pathways that led to the contamination. NORM also poses risks to workers at the well site, neighboring communities, and the environment. It can accumulate in pipes and other well equipment, build up in sediments downstream of wastewater treatment facilities, and contaminate the air and soil when wastewater is sprayed on roads.[61,62] Illegally dumped radioactive solid waste from oil and gas production has also caused contamination problems.[63]

NOISE AND LIGHT POLLUTION

Hydraulic fracturing and other well stimulation methods can lead to prolonged periods of noise and light pollution for nearby communities. Well pad preparation, drilling, and well stimulation generate significant noise levels for neighboring residences, schools, and work places. The noise—from trucks, generators, drilling operations, and pumps—can occur intermittently for days at a time over several years as wells are hydraulically fractured and reworked many times.[64] Produced gas that is not captured and sold may be flared, i.e., burned off, 24 hours a day, producing not only additional air pollution but a constant roar and bright light.[65] The health effects associated with noise and light pollution include sleep disturbance, fatigue, reduced school and work performance, hypertension, and cardiovascular problems.[66]

PUBLIC SAFETY

In areas with inadequate road infrastructure, traffic accidents are one of the largest sources of injuries and fatalities related to tight oil and shale gas development, because of the substantial amount of heavy truck traffic involved.[67,68] Other impacts include increased crime and social disruption, accidents at well sites and pipelines, fires, and explosions.[69]

SEISMIC RISKS

Researchers have known for a long time that underground injection can lubricate faults and change fault pressures potentially resulting in seismic events. The injection of oil and gas wastewater into deep underground wells (so-called UIC Class II wells) has repeatedly been linked to such events, known as induced seismicity.[70] Researchers at the U.S. Geological Survey found that the rate of earthquakes of magnitude 3.0 and higher in the central and eastern United States has increased from an average of 21 per year from 1967 through 2000 to more than 300 in the years 2010 through 2012. In 2011 alone, there were 188.[71] An analysis of the disposal of toxic wastewater in deep injection wells in California showed that 54 percent of 1,553 active and new injection wells are within 10 miles of a recently (within the past 200 years) active seismic fault line. Another 23 percent are within five miles and 6 percent are within one mile.[72] Most earthquakes caused by oil and gas activities have been relatively small. Some, like the 2011 magnitude 5.7 earthquake in Oklahoma that was triggered by wastewater injection, have been large enough to cause property damage and injuries.[73] Even small induced earthquakes, however, may compromise well integrity or other infrastructure, leading to water and soil contamination.

OIL AND GAS WELLS ARE CONCENTRATED IN COMMUNITIES STRUGGLING WITH AND VULNERABLE TO POLLUTION

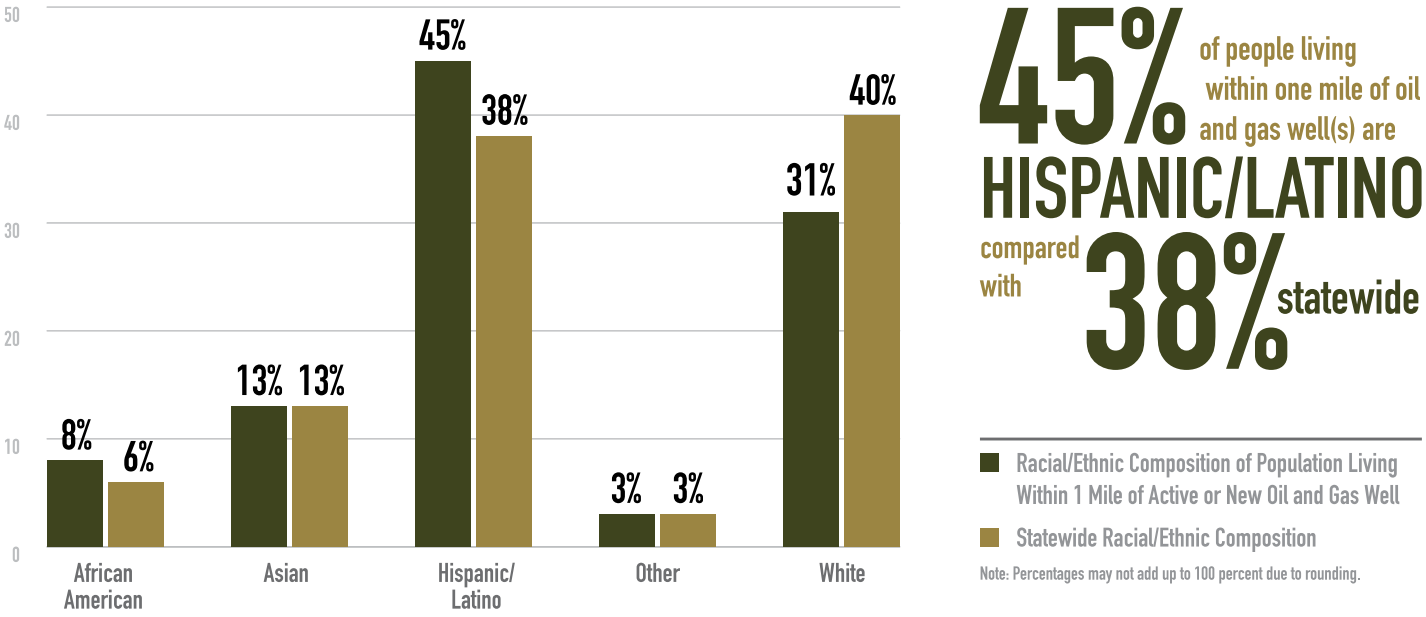
The number of oil and gas wells per census tract varies widely in California. The largest number of wells, more than 28,000, is found in a rural census tract west of Bakersfield in Kern County. Kern and Los Angeles counties top the charts with total well counts of 63,430 and 6,065, respectively. Map 2 shows the number and distribution of wells in relation to the 20 percent of census tracts identified by CalEnviroScreen 2.0 as most vulnerable. Since census tracts are roughly linked to population sizes, rural census tracts tend to be larger in area and therefore tend to have a greater number of wells. In Los Angeles, high population density means that the census tracts are much smaller and well counts of 1–100 are more typical and often found near other urban pollution sources.[74] Our maps show that residents in the southern part of the San Joaquin Valley and the greater Los Angeles area suffer from high pollution concentrations as well as a high concentration of oil and gas wells.

In California, approximately 5.4 million people (14 percent of the state's population) live within a mile of one or more oil and gas wells. This translates to roughly 1 in 5 African Americans, 1 in 6 Hispanics/Latinos, 1 in 7 Asians, and 1 in 9 Whites. More than a third of these people, 1.8 million (mainly in Los Angeles and Kern Counties), also live in areas identified by CalEnviroScreen 2.0 as most burdened by environmental pollution. A breakdown by race and ethnicity, as shown in Figure 1, reveals disparities in potential exposure for communities of color compared to the state's total population.[75]

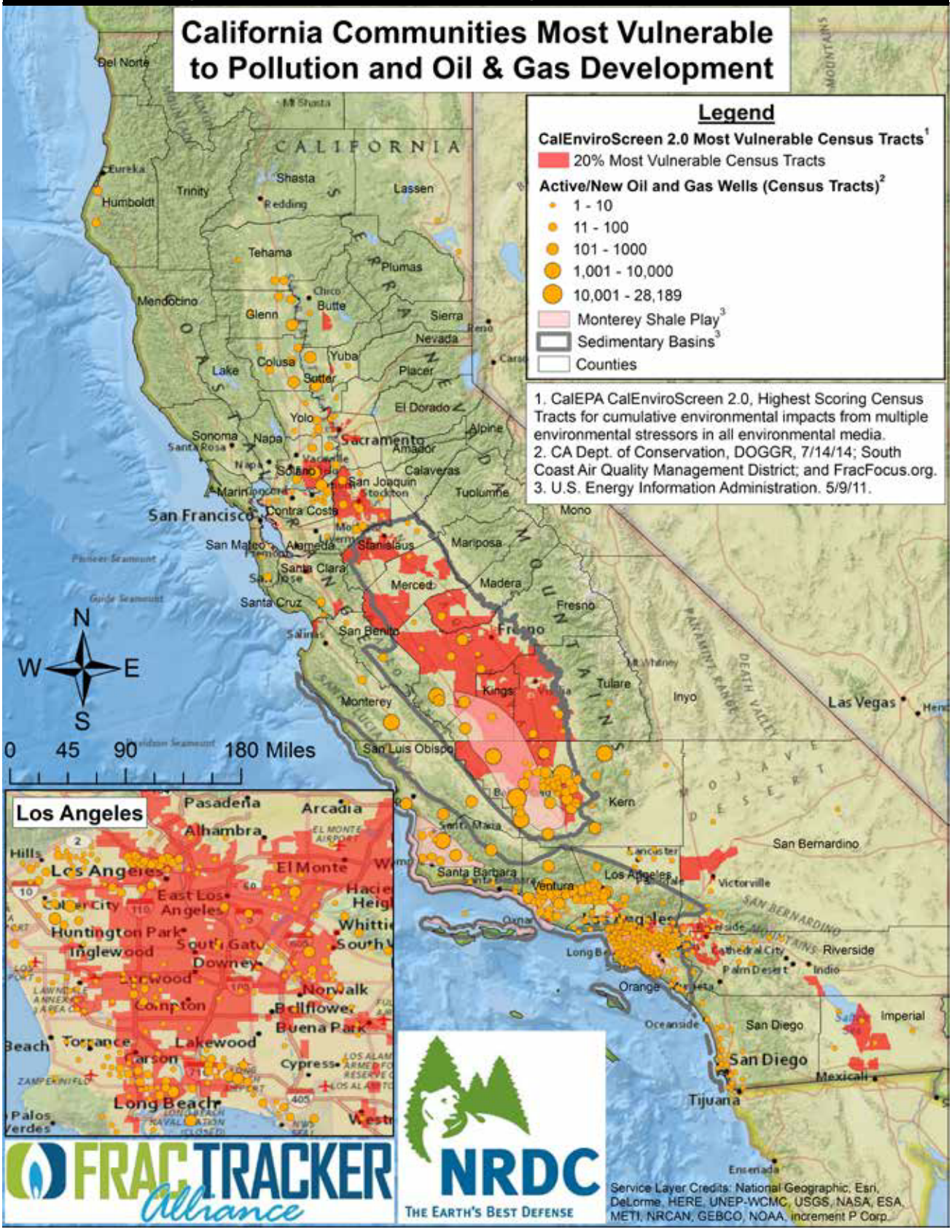
Of the statewide population living within one mile of oil and gas development and in communities identified as most vulnerable by CalEPA's new CalEnviroScreen 2.0, nearly 92 percent are people of color (69 percent Hispanic/Latino, 10 percent African American, 11 percent Asian, and 2 percent Other). Within the top 20 percent of census tracts ranked as most vulnerable—with a combined population of nearly 7.5 million—the number of oil and gas wells ranges from 0 to 6,575 per census tract, with a total of 11,329 wells. (See Appendix II for more detail.) Without the necessary monitoring data, scientific understanding, and health regulations, expanded oil development in these parts of the state could further exacerbate the toll on the most vulnerable communities.

Additionally, the geologic formations targeted for potential new exploration using hydraulic fracturing and other techniques include areas that are already heavily burdened by pollution, particularly in the Central Valley. So far, most of the new drilling and well stimulation techniques have been concentrated in areas of existing oil and gas drilling in Kern County. Los Angeles and Ventura counties each also have more than 100 stimulated wells. Fresno and Monterey counties, too, are seeing hundreds of new well permits and a handful of wells flagged as stimulated (Table 1 in Appendix II). Although it remains to be seen whether, and how, this exploration will be conducted given the geology of these basins in California, which is challenging for large-scale hydraulic fracturing, even small increases in pollution in already heavily burdened areas could result in increased health threats.

Figure 1: Demographics of Population Living Near Wells and Statewide in California



Map 2: Active and new oil and gas well counts as of July 2014 by census tract and the 20 percent most vulnerable census tracts according to the CalEnviroScreen 2.0 released in August 2014



Although the 3,003 wells identified as having been stimulated using hydraulic fracturing and other techniques (including 596 well stimulation notices under SB4) are likely an undercount, more than 80 percent of them are located in just three census tracts. Two of those tracts are in Kern County and one in Ventura County.[76] The two Kern County tracts (west and northwest of Bakersfield) also have the most new well permits and account for 591 of the 596 SB4 well stimulation notifications included in our database (430 and 161 notices, respectively). Of the 7,177 newly permitted wells—6,141, or 86 percent—are located in Kern County. More than half (3,209) are in the census tract with the most wells followed by 1,194 and 843 new wells in the next two tracts. The three census tracts surround Bakersfield to the west, northwest and northeast. This area also ranks in the top third of census tracts for environmental pollution.

According to CalEnviroScreen 2.0, the communities already experiencing new drilling, hydraulic fracturing, and acidizing are also exposed to high levels of ozone, particulate matter, diesel particulate pollution, water and soil contamination, and hazardous waste sites. If current drilling trends continue—and new well drilling, hydraulic fracturing and other stimulation techniques are concentrated in areas with existing oil and gas activity—more than 1.8 million Californians, already heavily burdened by pollution, may be saddled with even more health threats.

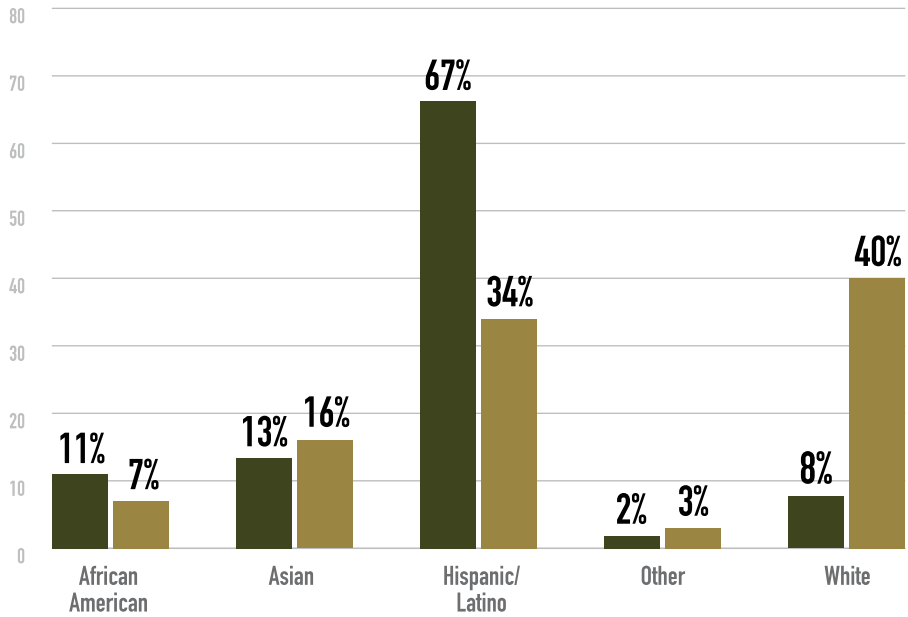
HOTSPOTS IN SOUTHERN CALIFORNIA: GREATER LOS ANGELES AND THE SOUTHERN SAN JOAQUIN VALLEY

GREATER LOS ANGELES

Los Angeles is home to the Inglewood Oil Field, the largest urban oil field in the United States.[77] This field is in the Baldwin Hills' community, which includes 300,000 residents.[78] Well pads often contain 30 or more wells within a few feet of buildings, roads, and parks. Map 3 illustrates that in Los Angeles, oil and gas wells are frequently in immediate proximity to, or even part of, neighborhoods and communities that are burdened by multiple environmental stressors with limited ability to address and cope with the associated health risks.

In Los Angeles County, 580,000 people live within a quarter mile of 5,715 active and 350 newly permitted oil and gas wells. At a one mile distance the number grows to 3.5 million (i.e., one third of the County's population), nearly half are Hispanic/Latino. Ninety-seven of Los Angeles County's 855 census tracts with the highest environmental pollution burden have at least one well for a total number of 1,723 wells (28 percent of the total number of wells in Los Angeles County). Furthermore, people of color are more likely to live near oil and gas wells in Los Angeles County: 44 percent of African Americans, 37 percent of Hispanics/Latinos and 38 percent of Asians compared with 31 percent of Whites.

Figure 2: Racial/Ethnic Composition According to the CalEnviroScreen 2.0 and 1/4 Mile Distance to Oil and Gas Wells in Los Angeles County



67%

of people living within a quarter mile of oil and gas well(s) and in areas facing the worst environmental health threats are

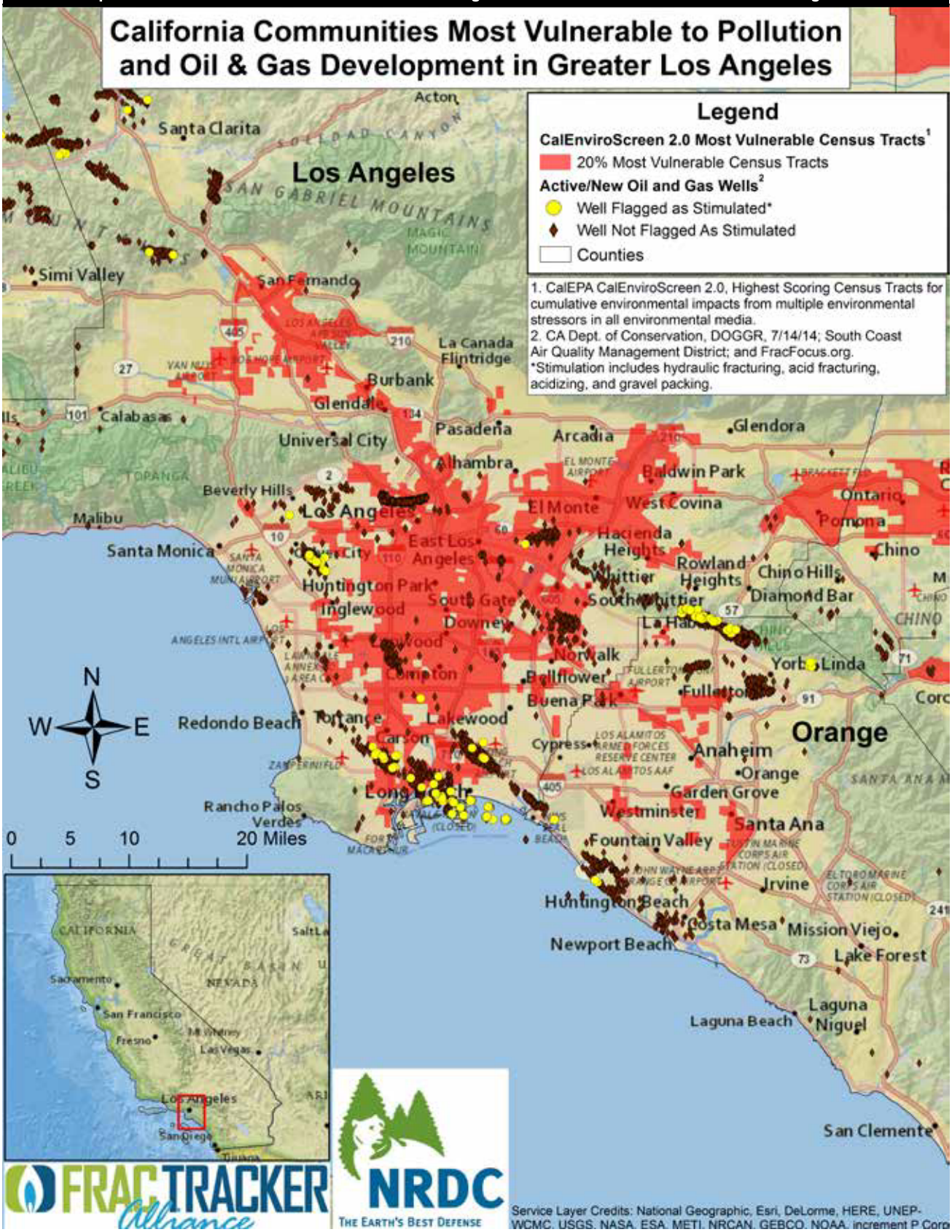
HISPANIC/LATINO.

Most Vulnerable Communities With Oil and Gas Wells Within 1/4 Mile

Less Vulnerable Communities Without Oil and Gas Wells Within 1/4 Mile

Note: Percentages may not add up to 100 percent due to rounding.

Map 3: Greater Los Angeles area showing the density of active and new oil and gas wells as of July 2014 and the 20 percent most vulnerable census tracts according to the CalEnviroScreen 2.0 released in August 2014



Of the more than 262,000 Los Angeles County residents that live within a quarter mile of oil and gas wells *and* in areas facing the worst health threats from pollution in the state; 67 percent are Hispanics/Latinos, 11 percent African Americans, 13 percent Asians, and 2 percent Other. In contrast, the communities less impacted by environmental pollution and not living in close proximity to oil and gas wells have a significantly higher White population (Figure 2).

Although many of Los Angeles' oil fields have been tapped for several decades, new stimulation and recovery techniques could bring currently idle wells back into production.[79] Much of the greater Los Angeles region is underlain by the Monterey Formation, which could soon be explored using unconventional drilling and stimulation techniques.

SAN JOAQUIN VALLEY AND KERN COUNTY

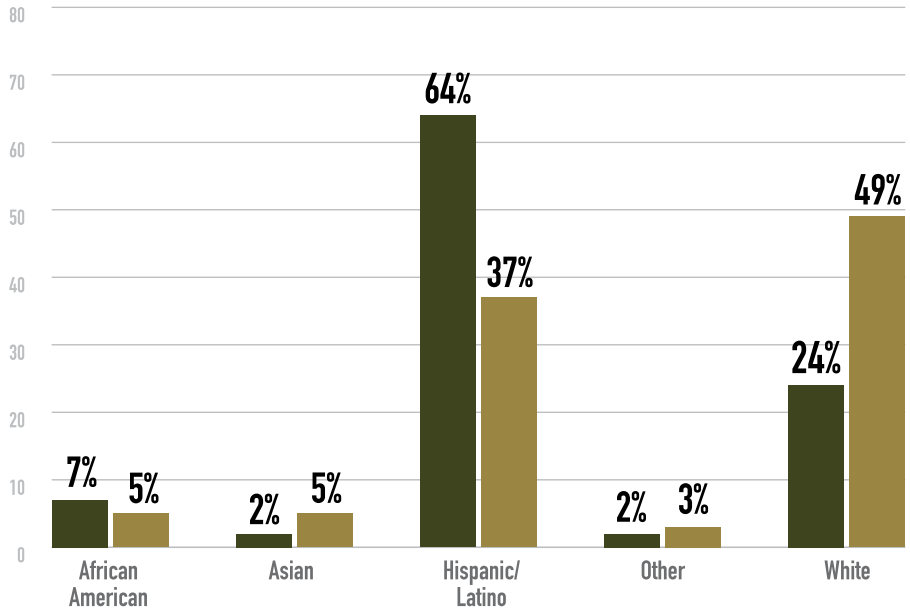
The San Joaquin Valley stretches from San Joaquin County in the north to Kern County in the south. Although mostly rural, this region contains several larger metropolitan areas, including Fresno, Bakersfield, Stockton, and Modesto.[80] The region is a major producer of agricultural crops, livestock, and other products, but also suffers from a high rate of food insecurity and poverty.[81] The San Joaquin Valley's air quality consistently ranks as among the worst in the nation with high levels of ozone and fine particulate matter ($PM_{2.5}$). More than 36 percent of the census tracts in the San Joaquin Valley rank in the top 20 percent for combined pollution threats, including air pollution and toxic releases.

While CalEnviroScreen 2.0 flags many census tracts throughout the San Joaquin Valley as highly impacted and vulnerable, we focus on Kern County because of its high concentration of oil and gas development and because new development using hydraulic fracturing and acidizing of the Monterey Formation is already underway there. Kern County produces approximately 75 percent of California's oil and about 58 percent of its natural gas.[82] Map 4 shows the dense distribution of the 63,430 active and new oil and gas wells in the County—6,141 of which are newly permitted and at least 2,361 have been stimulated—with up to 28,188 wells per census tract.

Kern County has 63,430 active and new oil and gas wells and at least 2,361 of them have been stimulated using hydraulic fracturing or other methods.

CalEnviroScreen 2.0 ranks 55 Kern County census tracts, with a population of 330,000, as among the most vulnerable to pollution and this includes many tracts with a high well density. Slightly more than 290,000 people (35 percent of the population) live within one mile of one of the 63,430 oil and gas wells. In Kern County, Hispanic/Latino and African American communities carry a disproportionate environmental pollution burden, which may be exacerbated by the effects of oil and gas production. Of the approximately 122,000 people living close to oil and gas wells *and* suffering

Figure 3: Demographics of Kern County According to the CalEnviroScreen 2.0 and 1 Mile Distance to Oil and Gas Wells in Kern County



64%

of people living within one mile of oil and gas well(s) and in areas facing the worst environmental health threats are

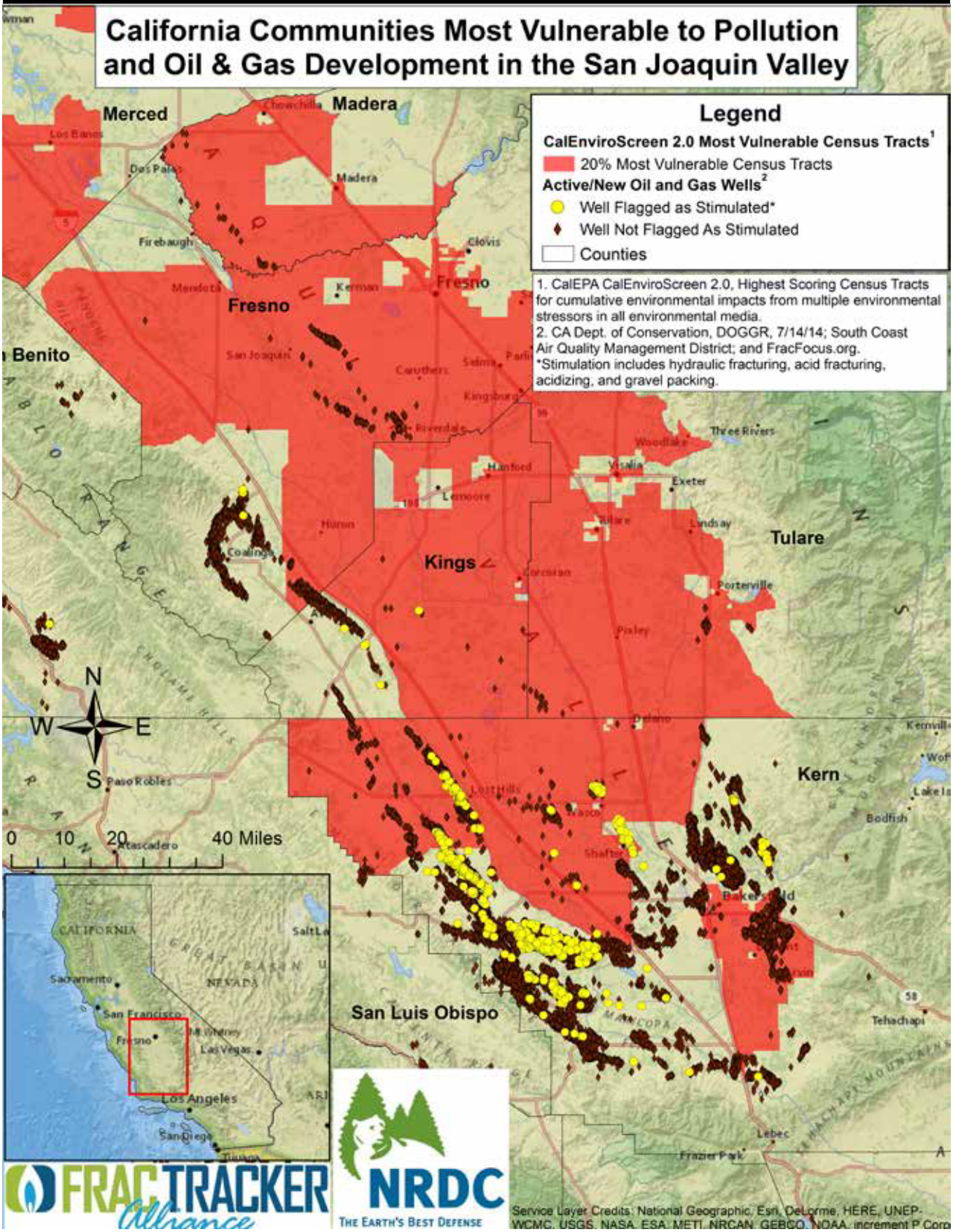
HISPANIC/LATINO.

Most Vulnerable Communities With Oil and Gas Wells Within 1 Mile

Less Vulnerable Communities Without Oil and Gas Wells Within 1 Mile

Note: Percentages may not add up to 100 percent due to rounding.

Map 4: Southern San Joaquin Valley showing the density of active and new oil and gas wells as of July 2014 and the 20 percent census tracts most vulnerable census tracts according to the CalEnviroScreen 2.0 released in August 2014



the most health threats from pollution as measured by CalEnviroScreen 2.0, nearly 92,000 (76 percent) are people of color.[83] In contrast, the communities less impacted by environmental pollution and not near oil and gas wells are majority white (49 percent) (see Figure 3).

Kern County is also the epicenter of well stimulation notices filed under the SB4 interim regulations. As of July 2014, 596 notices for well stimulation using hydraulic fracturing, acidizing, and other techniques have been filed, 591 of them for wells in Kern County. The majority of these wells were hydraulically fractured, while a smaller proportion used acid matrix stimulation. The western part of the county overlies the Monterey tight oil play and is considered prospective for development. There is also current production from the Monterey Formation.[84] Kern County's rural communities, which are already heavily impacted by pollution and predominantly Latino/Hispanic and low-income, are at the frontlines of new drilling and technologies with the accompanying health risks from heavy truck traffic, air pollutant emissions, accidents, and wastewater disposal.

CONCLUSIONS

Expanding oil production in California, in areas already heavily drilled or in new areas, can threaten the health of communities. For many already living with oil and gas wells and at ground zero for new drilling activity, these threats are piled on top of a heavy burden of environmental contamination. Evaluations of the safety of new drilling techniques must account for the threats to these communities and California policymakers must ensure that new oil exploration and development does not come at their expense.

RECOMMENDATIONS

To prevent further environmental damage and public health threats, major improvements are required before hydraulic fracturing, acidizing, and other stimulation techniques are allowed in California:

A comprehensive evaluation of pollution and health threats from oil and gas development, including well stimulation using hydraulic fracturing and other methods, must include the following:

- a full inventory and assessment of the types, sources, and quantities of contaminants associated with oil and gas development and production, including hydraulic fracturing and acidizing;
- an assessment of their health threats; and
- an evaluation and quantification of additional pollution, health threats, and environmental degradation from increased oil and gas extraction in existing oil fields and expansion into new areas within the Monterey tight oil play.

The current tracking, reporting, and notification system for oil and gas well development, activity, and stimulation methods is inaccurate and fragmented and is not transparent. DOGGR must work to overhaul its databases and improve data integration and reporting. Comprehensive measures are needed to ensure that oil and gas development does not contribute to environmental degradation, pollution, or threatens the health of residents in neighboring communities. Until this is complete, communities already overburdened with environmental pollution will remain in harm's way.

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75 U.S. Bureau of the Census, "American Community Survey 2012, 1-year estimates," factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml (accessed September 8, 2014).

76 A full analysis of the location of hydraulically fractured wells is not possible until DOGGR completes this field in its database and fracking activity is being fully recorded.

77 Inglewood Oil Field, www.inglewoodoilfield.com/history-future-of-inglewood/ (accessed September 8, 2014).

78 Ibid. [77].

79 R.C. Russell, "Final Technical Report: The Use of Acid Stimulation for Restoring to Production Shut-in Oil Fields," US Department of Energy, 2005, www.netl.doe.gov/kmd/cds/disk37/C%20-%20Independent%20Producers%20Program/NT15432%20Final.pdf (accessed September 8, 2014).

80 U.S. Census Bureau, "Metropolitan and Micropolitan Statistical Areas," www.census.gov/population/metro/ (accessed September 8, 2014).

81 UCLA Center for Health Policy Research , "*Nearly Four Million Californians Are Food Insecure*," Health Policy Brief, June 2012.

82 Greater Bakersfield Chamber of Commerce, "Oil and Gas Industry," www.bakersfieldchamber.org/section.asp/csasp/DepartmentID.537/cs/SectionID.1171/csasp.html (accessed September 8, 2014).

83 This includes 64 percent Hispanic/Latino, 7 percent African American, 2 percent Asian, and 2 percent Other.

84 The Bakersfield Californian, "Monterey Shale brightens Kern's oil prospects," www.bakersfieldcalifornian.com/business/oil/x65918320/Monterey-Shale-brightens-Kerns-oil-prospects (accessed September 8, 2014).

APPENDIX I: METHODS

Our analysis uses well location data from California's Division of Oil, Gas, and Geothermal Resources (DOGGR), the South Coast Air Quality Management District (SCAQMD), and FracFocus.org to locate existing and potentially new oil and gas development.[1] We overlay this information with the total environmental burden and vulnerability score from the California EPA's (CalEPA) cumulative environment impact tool (CalEnviroScreen 2.0).[2]

OIL AND GAS WELL DATA

We located active (AOG) wells and new (NOG) wells through the DOGGR's AllWells database (version released July 14, 2014) using the *GISSymbol* field. Active wells, according to DOGGR's classification, include producing wells and unplugged wells that may not be producing (e.g., idle and buried wells) but that can still be brought back into production or become a conduit for pollution.[3] New wells have recently been permitted to be drilled.[4] We used the AOG and NOG codes because they provide a more complete measure of the total number of wells that may be sites of active development or serve as a conduit for pollution and contribute to the total environmental burden. We note that the "AllWells" database also includes the *WellStatus* field. There are discrepancies between the *GISSymbol* field and the *WellStatus* field and neither is fully accurate at this point. The discrepancies should be investigated and corrected by DOGGR. Communication with DOGGR staff, and other experts, suggested that although the *GISSymbol* field is not perfect, DOGGR staff regularly use it for spatial analysis of well data. We, therefore, concluded that the use of this field is justified to account for wells that are currently producing or may be brought back into production in the future.

We then added information from DOGGR's new Well Stimulation Notices database, which was developed in response to Senate Bill 4 (SB4), California's law for oil and gas well stimulation enacted in 2013 (SB4 notices as of July 2014).[5] The SB4 interim regulations[6]—developed by DOGGR and effective since January 1, 2014—require well operators to file notices at least 30 days prior to commencing well stimulation using controversial technologies such as hydraulic fracturing and acidizing. We also added information from the South Coast Air Quality Management District's Oil and Gas Wells Activity Notification database, which was developed under Rule 1148.2, as well as the Chemicals Disclosure Registry website FracFocus.org. We then removed duplicates, multiple entries for well reworks, offshore wells, and wells without correct latitude and longitude coordinates. Our final total came to 84,434 wells (77,257 active and 7,177 newly permitted wells).

To determine the number of wells that have been stimulated, we used the DOGGR AllWells database, the SB4 Well Stimulation Treatment Notification Index, the SCAQMD Oil and Gas Well Activity Notification database, and FracFocus.org. We counted 3,003 wells that have used or plan to use hydraulic fracturing, acid fracturing, acidizing, and/or gravel packing. These 3,003 wells include 596 wells, for which SB4 stimulation notices are available.

In 2012 DOGGR added the field *HydraulicallyFractured* to its "AllWells" database as a basic yes/no indicator and is still adding this information to the database. Therefore, our count of stimulated wells—while it is the best currently available—is still likely an undercount. According to the DOGGR, the new field will be used to identify future wells using hydraulic fracturing techniques and former wells that have used hydraulic fracturing techniques.[7]

ENVIRONMENTAL POLLUTION AND VULNERABILITY DATA

The CalEnviroScreen 2.0 data layer (released in August 2014) was downloaded from the California Office of Environmental Health Hazard Assessment's (OEHHA) CalEnviroScreen website.[8] We use the census tracts falling into the top 20 percent of most vulnerable communities according to the CalEnviroScreen 2.0 aggregate score. The CalEnviroScreen tool was developed to evaluate multiple pollution sources (including air, water, and soil) in a community while accounting for a community's vulnerability to pollution's adverse health effects.[9]

CALCULATING THE POPULATION VULNERABLE TO ENVIRONMENTAL POLLUTION AND AFFECTED BY OIL AND GAS DEVELOPMENT

The number and percentage of people living within 0.25 and 1 mile of active and new oil and gas wells was estimated using 2012 population data from the U.S. Census Bureau[10] and well location information from our well database. The 0.25 and 1 mile distances were chosen to represent oil- and gas-related health threats at scales relevant to urban and rural settings, respectively, and to reflect both local and regional pollution.[11] To do so, circles of 0.25 and 1 mile, as appropriate to the area, were drawn around each well to create a buffered well layer. The boundaries of these circles were merged and the resulting shape was intersected with the census tract population layer. We then calculated the portions of each census tract that overlapped with the buffered well layer. Assuming that the census tract population (total population and population by race and ethnicity) is uniformly distributed across the census tract, we then determined the fraction (total population and by race and ethnicity) that lived within the buffered well layer. All maps were produced in ArcGIS version 10.1.

Appendix I Endnotes

1 CA Division of Oil, Gas and Geothermal Resources (DOGGR) (2014). GIS Mapping. "AllWells" database. Available at www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx (accessed July 14, 2014) and "Well Stimulation Treatment Notices Index," www.conservation.ca.gov/dog/Pages/IWST_disclaimer.aspx (accessed July 2014). South Coast Air Quality Management District Rule 1148.2, "Oil and Gas Wells Activity Notification," xappprod.aqmd.gov/r1148pubaccessportal/Home/Index (accessed July, 2014). FracFocus Chemical Disclosure Registry. fracfocus.org/ (accessed July, 2014).

2 CalEPA, OEHHA, "CalEnviroScreen Version 2.0," oehha.ca.gov/ej/ces2.html (accessed August 18, 2014).

3 DOGGR, "GIS Mapping," www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx (accessed July 29, 2014).

4 Ibid. [3].

5 DOGGR, "Well Stimulation Notices Index," www.conservation.ca.gov/dog/Pages/IWST_disclaimer.aspx (accessed July 2014). The database contains well stimulation notices filed since December 2013.

6 California Legislature, "Legislative Council Information," leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB4 (accessed May 14, 2014).

7 DOGGR, GIS Mapping, "Readme file," www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx (accessed May 16, 2014).

8 Ibid. [2].

9 Ibid. [2].

10 U.S. Bureau of the Census, "American Community Survey. Census Tract Population Estimates," factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml (accessed May 12, 2014).

11 There is as of yet no commonly accepted distance over which air or water pollution effects from oil and gas development are assessed for local populations. McKenzie et al. (2012) used a ½ mile for their health risk assessment in a mostly rural area in Colorado and a 10 mile radius to calculate the inverse-distance-weighted metric in their 2014 paper. Hill applied a 2.5 km (1.55 miles) radius in Pennsylvania and Osborn et al. (2011) used a 1 km (0.62 miles) distance in their study of methane contamination of drinking water.

APPENDIX II: TABLES

The tables in this Appendix provide details on the number and location of oil and gas wells in California. The data was extracted from public databases maintained by California's Division of Oil, Gas, and Geothermal Resources (DOGGR), the South Coast Air Quality Management District (SCAQMD), and FracFocus.org. Data from the AllWells database is current as of July 14, 2014 and the information on SB4 Well Stimulation Notices Index, the SCAQMD Oil and Gas Activity Notification database, and FracFocus.org are current as of July 2014.

The following well types are included in our analysis:

- Active Oil and Gas Wells (AOG): According to DOGGR's classification, these wells include producing wells and wells that have not been plugged and may not be producing, such as idle and buried wells, but can still represent a potential for reactivation or conduit for pollution.
- New Oil and Gas Wells (NOG): These wells have recently been permitted to be drilled.
- Stimulated wells: These wells have been stimulated using hydraulic fracturing, acid fracturing, acidizing, and/or gravel packing as compiled from the DOGGR AllWells database, and SB4 Well Stimulation Treatment Notices Index, the SCAQMD Oil and Gas Activity Notification database, and FracFocus.org.
- SB4 Wells: These wells are listed as approved in DOGGR's SB4 interim well stimulation notices database. These wells are a subset of the stimulated wells.

Table 1: Counties with at least one active or new oil and gas well

County	Total Number of Active and New Oil and Gas Wells	Active Wells	New Wells	Stimulated Wells	Stimulated Wells with SB4 Notifications
Kern	63,430	57,289	6,141	2,361	591
Los Angeles	6,065	5,715	350	124	-
Fresno	3,671	3,470	201	3	2
Ventura	3,078	2,988	90	456	3
Santa Barbara	2,141	2,058	83	3	-
Orange	1,585	1,530	55	30	-
Monterey	1,263	1,153	110	1	-
Sutter	423	417	6	14	-
San Luis Obispo	402	323	79	-	-
Colusa	372	350	22	3	-
Kings	366	358	8	6	-
Glenn	325	323	2	1	-
Solano	248	247	1	-	-
Sacramento	214	206	8	-	-
Tehama	151	149	2	-	-
San Joaquin	147	143	4	-	-
Tulare	102	99	3	-	-
Yolo	75	73	2	-	-
San Bernardino	67	67	-	-	-
Humboldt	57	57	-	-	-
San Benito	46	44	2	-	-
Contra Costa	43	42	1	-	-
San Diego	31	31	-	1	-

Table 1: Counties with at least one active or new oil and gas well (cont'd.)

County	Total Number of Active and New Oil and Gas Wells	Active Wells	New Wells	Stimulated Wells	Stimulated Wells with SB4 Notifications
Madera	29	25	4	-	-
San Mateo	25	25	-	-	-
Riverside	18	18	-	-	-
Santa Clara	16	13	3	-	-
Imperial	13	13	-	-	-
Butte	10	10	-	-	-
Alameda	7	7	-	-	-
Lassen	7	7	-	-	-
Stanislaus	3	3	-	-	-
Merced	2	2	-	-	-
Santa Cruz	1	1	-	-	-
Yuba	1	1	-	-	-
TOTAL	**84,434**	**77,257**	**7,177**	**3,003**	**596**

Data sources: DOGGR "AllWells" database (as of 7/14/2014). DOGGR SB4 Well Stimulation Notices database (as of July 2014). The total number of active and new oil and gas wells is the sum of active wells and new wells. Stimulated wells include wells with SB4 notifications.

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6019003900	Fresno	96-100%	5804	72%	541	9%	389	7%	117	117	0	0	0
6019007801	Fresno	81-85%	2722	98%	524	19%	513	19%	109	109	0	0	0
6019007700	Fresno	91-95%	5599	74%	3001	54%	2218	40%	79	77	2	0	0
6019008200	Fresno	81-85%	6978	93%	582	8%	541	8%	35	34	1	0	0
6019007600	Fresno	86-90%	4806	76%	431	9%	329	7%	9	8	1	0	0
6019008402	Fresno	81-85%	1152	69%	24	2%	16	1%	1	1	0	0	0
6019008302	Fresno	91-95%	6562	97%	41	1%	40	1%	1	1	0	0	0
6025012400	Imperial	81-85%	1266	27%	3	0%	1	0%	3	3	0	0	0
6025010102	Imperial	81-85%	5007	85%	225	4%	192	4%	3	3	0	0	0
6029004500	Kern	86-90%	3937	95%	1086	28%	1027	26%	6575	5381	1194	587	161
6029006202	Kern	91-95%	6401	94%	1686	26%	1583	25%	804	751	53	0	0
6029001000	Kern	86-90%	9186	72%	8448	92%	6091	66%	369	356	13	0	0
6029000507	Kern	81-85%	3598	31%	3598	100%	1112	31%	224	222	2	0	0
6029006201	Kern	96-100%	2877	73%	937	33%	685	24%	147	146	1	0	0
6029003700	Kern	86-90%	3953	67%	1340	34%	891	23%	146	121	25	2	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6029004604	Kern	91-95%	15845	92%	1315	8%	1212	8%	145	97	48	0	0
6029004200	Kern	86-90%	1320	70%	268	20%	187	14%	96	94	2	1	0
6029002400	Kern	96-100%	7478	82%	4119	55%	3361	45%	60	59	1	0	0
6029004000	Kern	81-85%	7704	87%	4215	55%	3646	47%	44	35	9	18	0
6029006301	Kern	86-90%	4004	92%	3750	94%	3454	86%	40	39	1	0	0
6029001801	Kern	81-85%	5579	56%	5579	100%	3130	56%	17	17	0	0	0
6029003112	Kern	86-90%	5116	68%	5007	98%	3379	66%	6	6	0	0	0
6029002600	Kern	96-100%	3539	85%	3539	100%	3015	85%	6	6	0	0	0
6029006303	Kern	86-90%	6784	96%	6784	100%	6513	96%	3	3	0	0	0
6029000200	Kern	86-90%	7644	27%	4367	57%	1175	15%	3	3	0	0	0
6029006304	Kern	81-85%	3895	94%	3834	98%	3589	92%	2	2	0	0	0
6029004301	Kern	86-90%	7416	89%	1208	16%	1070	14%	2	2	0	2	0
6029000400	Kern	96-100%	4319	28%	2300	53%	635	15%	2	2	0	0	0
6029003114	Kern	81-85%	7654	63%	6387	83%	3992	52%	1	1	0	0	0
6029003113	Kern	96-100%	4784	78%	4759	99%	3693	77%	1	1	0	0	0
6031001601	Kings	91-95%	4516	86%	204	5%	175	4%	18	18	0	1	0
6037208000	Los Angeles	96-100%	6893	93%	6893	100%	6376	93%	167	167	0	0	0
6037980014	Los Angeles	96-100%	239	23%	217	91%	51	21%	145	138	7	1	0
6037197700	Los Angeles	86-90%	5103	90%	5103	100%	4613	90%	110	110	0	0	0
6037502700	Los Angeles	96-100%	6956	92%	6876	99%	6339	91%	108	83	25	0	0
6037530003	Los Angeles	91-95%	2983	78%	2983	100%	2318	78%	106	102	4	0	0
6037211122	Los Angeles	86-90%	3075	90%	3075	100%	2764	90%	87	87	0	0	0
6037294701	Los Angeles	91-95%	3019	96%	3019	100%	2892	96%	86	65	21	1	0
6037208302	Los Angeles	96-100%	4360	96%	4360	100%	4177	96%	82	82	0	0	0
6037502902	Los Angeles	91-95%	4043	92%	4043	100%	3711	92%	79	72	7	0	0
6037573401	Los Angeles	81-85%	1439	73%	1439	100%	1045	73%	65	63	2	1	0
6037208401	Los Angeles	96-100%	3770	97%	3770	100%	3638	96%	61	61	0	0	0
6037540902	Los Angeles	91-95%	4506	99%	4506	100%	4461	99%	46	46	0	0	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6037502802	Los Angeles	96-100%	1380	87%	1380	100%	1194	86%	44	44	0	0	0
6037572201	Los Angeles	91-95%	6197	82%	6197	100%	5106	82%	43	43	0	0	0
6037208802	Los Angeles	81-85%	2906	86%	2906	100%	2505	86%	35	35	0	0	0
6037294120	Los Angeles	86-90%	2370	99%	2370	100%	2337	99%	33	33	0	0	0
6037208301	Los Angeles	86-90%	2201	98%	2201	100%	2161	98%	26	26	0	0	0
6037543604	Los Angeles	81-85%	5620	91%	5620	100%	5109	91%	25	23	2	2	0
6037530005	Los Angeles	91-95%	4346	89%	4346	100%	3872	89%	25	25	0	0	0
6037221401	Los Angeles	91-95%	3359	91%	3359	100%	3063	91%	21	20	1	0	0
6037541001	Los Angeles	96-100%	1164	97%	1164	100%	1133	97%	21	21	0	0	0
6037208502	Los Angeles	91-95%	3571	95%	3571	100%	3385	95%	20	20	0	0	0
6037532303	Los Angeles	96-100%	4464	97%	4320	97%	4203	94%	19	19	0	0	0
6037532302	Los Angeles	96-100%	4707	98%	4096	87%	3993	85%	18	18	0	0	0
6037224010	Los Angeles	91-95%	2433	92%	2433	100%	2246	92%	17	17	0	0	0
6037207103	Los Angeles	96-100%	2077	98%	2077	100%	2033	98%	16	16	0	0	0
6037211320	Los Angeles	86-90%	3184	92%	3184	100%	2917	92%	14	14	0	0	0
6037224420	Los Angeles	91-95%	2369	95%	2369	100%	2243	95%	14	14	0	0	0
6037701100	Los Angeles	86-90%	746	60%	746	100%	444	60%	13	13	0	0	0
6037294620	Los Angeles	91-95%	4219	99%	4219	100%	4156	99%	13	13	0	0	0
6037206010	Los Angeles	96-100%	3127	96%	3127	100%	3002	96%	13	13	0	0	0
6037197600	Los Angeles	91-95%	2376	80%	2376	100%	1891	80%	11	11	0	0	0
6037291130	Los Angeles	96-100%	3582	95%	3582	100%	3410	95%	11	11	0	0	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6037208610	Los Angeles	86-90%	4195	96%	4195	100%	4036	96%	10	10	0	0	0
6037218800	Los Angeles	81-85%	2658	97%	2658	100%	2586	97%	8	8	0	0	0
6037980015	Los Angeles	81-85%	554	80%	503	91%	404	73%	7	7	0	0	0
6037550100	Los Angeles	91-95%	7518	89%	7518	100%	6653	88%	5	5	0	0	0
6037543305	Los Angeles	96-100%	2666	73%	2402	90%	1756	66%	5	5	0	0	0
6037540901	Los Angeles	96-100%	4994	98%	4994	100%	4904	98%	5	5	0	0	0
6037208720	Los Angeles	81-85%	4179	95%	4179	100%	3970	95%	4	4	0	0	0
6037503000	Los Angeles	86-90%	6057	95%	6057	100%	5724	95%	4	4	0	0	0
6037502801	Los Angeles	86-90%	6186	82%	6186	100%	5097	82%	4	4	0	0	0
6037208801	Los Angeles	91-95%	2995	93%	2995	100%	2791	93%	4	4	0	0	0
6037602802	Los Angeles	81-85%	4304	99%	4304	100%	4239	99%	3	3	0	0	0
6037553504	Los Angeles	81-85%	5368	96%	5368	100%	5159	96%	3	3	0	0	0
6037433802	Los Angeles	86-90%	2780	96%	2780	100%	2655	96%	3	3	0	0	0
6037294610	Los Angeles	91-95%	4065	96%	4065	100%	3898	96%	3	3	0	0	0
6037603900	Los Angeles	91-95%	7527	83%	7527	100%	6217	83%	3	3	0	0	0
6037291120	Los Angeles	96-100%	2210	98%	2210	100%	2168	98%	3	3	0	0	0
6037201402	Los Angeles	96-100%	4311	96%	4311	100%	4151	96%	3	3	0	0	0
6037550201	Los Angeles	81-85%	2941	90%	2941	100%	2659	90%	2	2	0	0	0
6037541100	Los Angeles	91-95%	3321	99%	3321	100%	3294	99%	2	2	0	0	0
6037602801	Los Angeles	91-95%	3819	99%	3819	100%	3777	99%	2	2	0	0	0
6037203500	Los Angeles	96-100%	3064	98%	3064	100%	2990	98%	2	2	0	0	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6037532304	Los Angeles	96-100%	3987	94%	3597	90%	3385	85%	2	2	0	0	0
6037185202	Los Angeles	81-85%	3712	76%	3712	100%	2825	76%	1	1	0	0	0
6037502004	Los Angeles	81-85%	4359	92%	4359	100%	4028	92%	1	1	0	0	0
6037603400	Los Angeles	81-85%	4367	87%	4367	100%	3817	87%	1	1	0	0	0
6037554600	Los Angeles	81-85%	4374	83%	4374	100%	3613	83%	1	1	0	0	0
6037573004	Los Angeles	81-85%	5153	92%	5153	100%	4725	92%	1	1	0	0	0
6037551300	Los Angeles	81-85%	5422	82%	5422	100%	4446	82%	1	1	0	0	0
6037541200	Los Angeles	81-85%	5662	99%	5662	100%	5622	99%	1	1	0	0	0
6037550700	Los Angeles	81-85%	6921	79%	6921	100%	5481	79%	1	1	0	0	0
6037550800	Los Angeles	81-85%	7170	76%	7170	100%	5471	76%	1	1	0	0	0
6037543602	Los Angeles	81-85%	7762	79%	7762	100%	6148	79%	1	1	0	0	0
6037124103	Los Angeles	86-90%	2030	82%	2030	100%	1659	82%	1	1	0	0	0
6037503104	Los Angeles	86-90%	2719	92%	2719	100%	2504	92%	1	1	0	0	0
6037530203	Los Angeles	86-90%	3238	93%	3238	100%	3005	93%	1	1	0	0	0
6037543201	Los Angeles	86-90%	3607	99%	3607	100%	3571	99%	1	1	0	0	0
6037530004	Los Angeles	86-90%	3695	85%	3695	100%	3152	85%	1	1	0	0	0
6037294830	Los Angeles	86-90%	3707	97%	3707	100%	3592	97%	1	1	0	0	0
6037543903	Los Angeles	86-90%	3804	92%	3795	100%	3492	92%	1	1	0	0	0
6037482800	Los Angeles	86-90%	4074	92%	3224	79%	2953	72%	1	1	0	0	0
6037602509	Los Angeles	86-90%	4118	96%	4057	99%	3891	94%	1	1	0	0	0
6037504101	Los Angeles	86-90%	5126	80%	5126	100%	4111	80%	1	1	0	0	0
6037541700	Los Angeles	86-90%	6366	99%	6366	100%	6277	99%	1	1	0	0	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6037604100	Los Angeles	86-90%	7058	84%	7058	100%	5893	84%	1	1	0	0	0
6037550300	Los Angeles	86-90%	7727	84%	7696	100%	6465	84%	1	1	0	0	0
6037403200	Los Angeles	91-95%	391	31%	391	100%	121	31%	1	1	0	0	0
6037207400	Los Angeles	91-95%	1363	79%	1363	100%	1082	79%	1	1	0	0	0
6037220100	Los Angeles	91-95%	2334	96%	2334	100%	2229	95%	1	1	0	0	0
6037241002	Los Angeles	91-95%	3606	99%	3606	100%	3584	99%	1	1	0	0	0
6037242000	Los Angeles	91-95%	3938	99%	3938	100%	3910	99%	1	1	0	0	0
6037500403	Los Angeles	91-95%	4023	95%	4023	100%	3818	95%	1	1	0	0	0
6037543400	Los Angeles	91-95%	4090	94%	2648	65%	2491	61%	1	1	0	0	0
6037534301	Los Angeles	91-95%	4636	97%	4636	100%	4511	97%	1	1	0	0	0
6037402403	Los Angeles	91-95%	5381	79%	4933	92%	3892	72%	1	1	0	0	0
6037203600	Los Angeles	91-95%	5394	99%	5394	100%	5329	99%	1	1	0	0	0
6037500600	Los Angeles	91-95%	5688	97%	5688	100%	5506	97%	1	1	0	0	0
6037502200	Los Angeles	91-95%	6585	90%	6585	100%	5894	89%	1	1	0	0	0
6037203300	Los Angeles	96-100%	2607	91%	2607	100%	2375	91%	1	1	0	0	0
6037534405	Los Angeles	96-100%	4292	98%	4292	100%	4215	98%	1	1	0	0	0
6037543000	Los Angeles	96-100%	4345	100%	4345	100%	4323	100%	1	1	0	0	0
6037553702	Los Angeles	96-100%	4902	98%	4902	100%	4814	98%	1	1	0	0	0
6037573201	Los Angeles	96-100%	4930	95%	4930	100%	4703	95%	1	1	0	0	0
6037482402	Los Angeles	96-100%	6971	95%	6280	90%	5991	86%	1	1	0	0	0
6037402402	Los Angeles	96-100%	7076	85%	2633	37%	2246	32%	1	1	0	0	0
6039000400	Madera	81-85%	1288	68%	204	16%	139	11%	29	25	4	0	0

Table 2: Census tracts that fall into the top 20% of Census tracts most vulnerable to health impacts from multiple environmental stressors as measured by CalEnviroScreen 2.0 and which have one or more oil & gas wells within their boundaries (cont'd.)

Census tract	County (alphabetically)	CalEnviroScreen 2.0 Total Score (highest percentile = worst)	Total Population	Percent Non-White	Population within 1 mile of oil and gas well	Population within 1 mile of oil and gas well (% of total)	Non-White Population within 1 mile of oil and gas well	Non-White Population within 1 mile of oil and gas well (% of total pop.)	Total Wells	Active oil and gas wells	New oil and gas wells	Stimulated Wells	Wells with SB4 notifications
6047000201	Merced	91-95%	3626	64%	246	7%	158	4%	1	1	0	0	0
6059086407	Orange	81-85%	6488	70%	5398	83%	3762	58%	5	5	0	0	0
6059011721	Orange	81-85%	5023	81%	5023	100%	4064	81%	1	1	0	0	0
6059011722	Orange	86-90%	2363	50%	2363	100%	1179	50%	1	1	0	0	0
6059099601	Orange	86-90%	7016	82%	6116	87%	5003	71%	1	1	0	0	0
6059011720	Orange	91-95%	7329	96%	6620	90%	6322	86%	1	1	0	0	0
6059110500	Orange	91-95%	8631	87%	6914	80%	5980	69%	1	1	0	0	0
6065041500	Riverside	96-100%	2053	93%	1230	60%	1141	56%	4	4	0	0	0
6065041909	Riverside	81-85%	4990	58%	1433	29%	828	17%	1	1	0	0	0
6065040808	Riverside	81-85%	7008	72%	6064	87%	4384	63%	1	1	0	0	0
6071012400	San Bernardino	96-100%	3617	91%	1391	38%	1267	35%	1	1	0	0	0
6071004004	San Bernardino	96-100%	5076	79%	1571	31%	1247	25%	1	1	0	0	0
6071001600	San Bernardino	96-100%	6133	94%	1664	27%	1567	26%	1	1	0	0	0
6073013205	San Diego	86-90%	2381	92%	2381	100%	2188	92%	1	1	0	0	0
6077003900	San Joaquin	96-100%	1749	74%	225	13%	167	10%	56	56	0	0	0
6077003803	San Joaquin	96-100%	5281	74%	2036	39%	1500	28%	23	23	0	0	0
6077004001	San Joaquin	91-95%	2508	61%	610	24%	370	15%	16	14	2	0	0
6077004902	San Joaquin	81-85%	6106	36%	351	6%	125	2%	2	2	0	0	0
6095253500	Solano	81-85%	8423	30%	2621	31%	786	9%	202	201	1	0	0
6107003400	Tulare	96-100%	7016	66%	1160	17%	764	11%	84	81	3	0	0
6107004300	Tulare	96-100%	7682	94%	501	7%	469	6%	13	13	0	0	0
6107004500	Tulare	81-85%	6628	76%	255	4%	194	3%	4	4	0	0	0
6111004704	Ventura	81-85%	1469	86%	972	66%	839	57%	50	49	1	3	0
6111004902	Ventura	96-100%	5091	99%	3887	76%	3829	75%	37	30	7	1	0
6113010102	Yolo	86-90%	7702	56%	1062	14%	592	8%	1	1	0	0	0

Data sources: DOGGR "AllWells" database (as of 7/14/2014). DOGGR SB4 Well Stimulation Notices database (as of July 2014). The total number of active and new oil and gas wells is the sum of active wells and new wells. Stimulated wells include wells with SB4 notifications.

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U.S.

California Earthquakes Caused $200 Million in Damage, Report Says

The estimate doesn't include damage to infrastructure, such as roads or to a nearby naval base

A magnitude 7.1 earthquake shook Southern California earlier this month, cracking buildings, breaking roads and causing power outages on Friday night.

PHOTO: GENE BLEVINS/ZUMA PRESS

By Ethan Millman
July 24, 2019 6:15 pm ET

A pair of earthquakes that shook California earlier this month caused about $200 million in property damage, according to a new report.

Residents of the small towns of Argus and Trona, located in San Bernardino County between the Sierra Nevadas and Death Valley National Park, suffered the most significant damage, according to catastrophe modeling firm Karen Clark and Co. Homes and buildings in those towns are generally older than those in the nearby larger city of Ridgecrest and weren't built to sustain shaking as well.

Several Trona residents had their homes red-tagged following the earthquakes, meaning their homes were deemed unlivable by the county. Others suffered less structural damage to their homes but lost personal belongings.

The larger quake, which struck the rural region east of the Sierra Nevada mountains on July 5, measured magnitude 7.1.

WSJ NEWSLETTER

Notes on the News

The news of the week in context, with Tyler Blint-Welsh.

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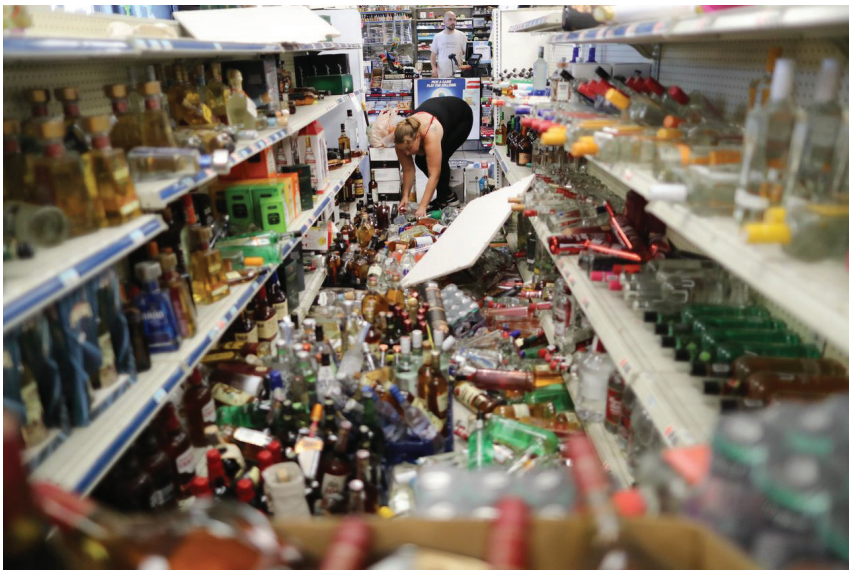
The estimate doesn't include damage to infrastructure, such as roads, or to a nearby naval base, which had closed following the quakes. Operations have since begun to normalize, according to the posts on the base's official Facebook page.



A convenience store employee in Ridgecrest, Calif., cleans an aisle with bottles scattered on the floor after a magnitude 7.1 struck nearby on July 6.

PHOTO: MARIO TAMA/GETTY IMAGES

Less than $40 million of the damage in the area will be covered by insurance, Karen Clark and Co. estimated, as only about 20% of residents in the area have earthquake insurance. Statewide, 10% of Californians with residential insurance also have earthquake coverage, according to the California Earthquake Authority.

Earthquakes are often more economically damaging than other disasters such as fires and tornadoes because of how few people are covered, said Karen Clark, the catastrophe modeling company's chief executive.

"Insurance companies do offer earthquake insurance, but in a homeowner's mind, it's too expensive," Ms. Clark said. "Ridgecrest might cause a little blip for people to buy more insurance...but as time goes on, people stop buying it."

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Have you purchased or considered purchasing earthquake insurance since the earthquakes? Why or why not? Join the conversation below.

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Earthquake triggering and large-scale geologic storage of carbon dioxide

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Edited by Pamela A. Matson, Stanford University, Stanford, CA, and approved May 4, 2012 (received for review March 27, 2012)

Despite its enormous cost, large-scale carbon capture and storage (CCS) is considered a viable strategy for significantly reducing CO_2 emissions associated with coal-based electrical power generation and other industrial sources of CO_2 [Intergovernmental Panel on Climate Change (2005) IPCC Special Report on Carbon Dioxide Capture and Storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change, eds Metz B, et al. (Cambridge Univ Press, Cambridge, UK); Szulczewski ML, et al. (2012) *Proc Natl Acad Sci USA* 109:5185–5189]. We argue here that there is a high probability that earthquakes will be triggered by injection of large volumes of CO_2 into the brittle rocks commonly found in continental interiors. Because even small- to moderate-sized earthquakes threaten the seal integrity of CO_2 repositories, in this context, large-scale CCS is a risky, and likely unsuccessful, strategy for significantly reducing greenhouse gas emissions.

carbon sequestration | climate change | triggered earthquakes

The combustion of coal for electrical power generation in the United States generates approximately 2.1 billion metric tons of CO_2 per year, ~36% of all US emissions. In 2011, China generated more than three times that much CO_2 by burning coal for electricity, which accounted for ~80% of its total emissions. (According to the Energy Information Agency of the US Department of Energy, total CO_2 emissions in China were 8.38 billion metric tonnes in 2011, with 6.95 billion tons from coal burning, nearly all of which is used electrical power generation.) From a global perspective, if large-scale carbon capture and storage (CCS) is to significantly contribute to reducing the accumulation of greenhouse gases, it must operate at a massive scale, on the order of 3.5 billion tons (1) of CO_2 per year, a volume roughly equivalent (2) to the ~27 billion barrels of oil currently produced annually around the world. (Under reservoir conditions, one billion tons of CO_2 occupies a volume of ~1.3 billion cubic meters, equivalent to 8.18 billion barrels. Thus, 3.5 billion tons of carbon dioxide would correspond to a volume of approximately 28.6 billion barrels. There are currently ~850,000 wells producing oil around the world.) Moreover, a leak rate from underground CO_2 storage reservoirs of less than 1% per thousand years is required for CCS to achieve the same climate benefits as renewable energy sources (3).

Before embarking on projects to inject enormous volumes of CO_2 at numerous sites around the world, it is important to note that over time periods of just a few decades, modern seismic networks have shown that earthquakes occur nearly everywhere in continental interiors. Fig. 1, *Upper* shows instrumentally recorded earthquakes in the central and eastern United States and southeastern Canada. Fig. 1, *Lower* shows instrumentally recorded intraplate earthquakes in south and east Asia (4). The seismicity catalogs are complete to magnitude (M) 3. The occurrence of these earthquakes means that nearly everywhere in continental interiors a subset of the preexisting faults in the crust is potentially active in the current stress field (5, 6). This is sometimes referred to as the *critically stressed* nature of the brittle crust (7). It should also be noted that despite the overall low rate of earthquake occurrence in continental interiors, some of the most devastating earthquakes in history occurred in these regions. In eastern China, the M 7.8, 1976 Tangshan earthquake, approximately 200 km east of Beijing, killed several hundred thousand people. In the central United States, three M 7+ earthquakes in 1811 and 1812 occurred in the New Madrid seismic zone in southeast Missouri.

Because of the critically stressed nature of the crust, fluid injection in deep wells can trigger earthquakes when the injection increases pore pressure in the vicinity of preexisting potentially active faults. The increased pore pressure reduces the frictional resistance to fault slip, allowing elastic energy already stored in the surrounding rocks to be released in earthquakes that would occur someday as the result of natural geologic processes (8). This effect was first documented in the 1960s in Denver, Colorado when injection into a 3-km-deep well at the nearby Rocky Mountain Arsenal triggered earthquakes (9). Soon thereafter it was shown experimentally (10) at the Rangely oil field in western Colorado that earthquakes could be turned on and off by varying the rate at which water was injected and thus modulating reservoir pressure. In 2011 alone, a number of small to moderate earthquakes in the United States seem to have been triggered by injection of wastewater (11). These include earthquakes near Guy, Arkansas that occurred in February and March, where the largest earthquake was M 4.7. In the Trinidad/Raton area near the border of Colorado and New Mexico, injection of produced water associated with coalbed methane production seems to have triggered a number of earthquakes, the largest being a M 5.3 event that occurred in August. Earthquakes seem to have been triggered by wastewater injection near Youngstown, Ohio on Christmas Eve and New Year's Eve, the largest of which was M 4.0. Although the risks associated with wastewater injection are minimal and can be reduced even further with proper planning (11), the situation would be far more problematic if similar-sized earthquakes were triggered in formations intended to sequester CO_2 for hundreds to thousands of years.

Deep borehole stress measurements confirm the critically stressed nature of the crust in continental interiors (12), in some cases at sites directly relevant to the feasibility of large-scale CCS. For example, deep borehole stress measurements at the Mountaineer coal-burning power plant on the Ohio River in West Virginia indicate a severe limitation on the rate at which CO_2 could be injected without the resulting pressure build-up initiating slip on preexisting faults (13). Because of the low permeability of the formations at depth, pore pressure increases would be expected to trigger slip on preexisting faults if CO_2 injection rates exceed approximately 1% of the 7 million tons of CO_2 emitted by the Mountaineer plant each year. Similarly, stress measurements at Teapot Dome, Wyoming, the US government-owned oil field where pilot CO_2

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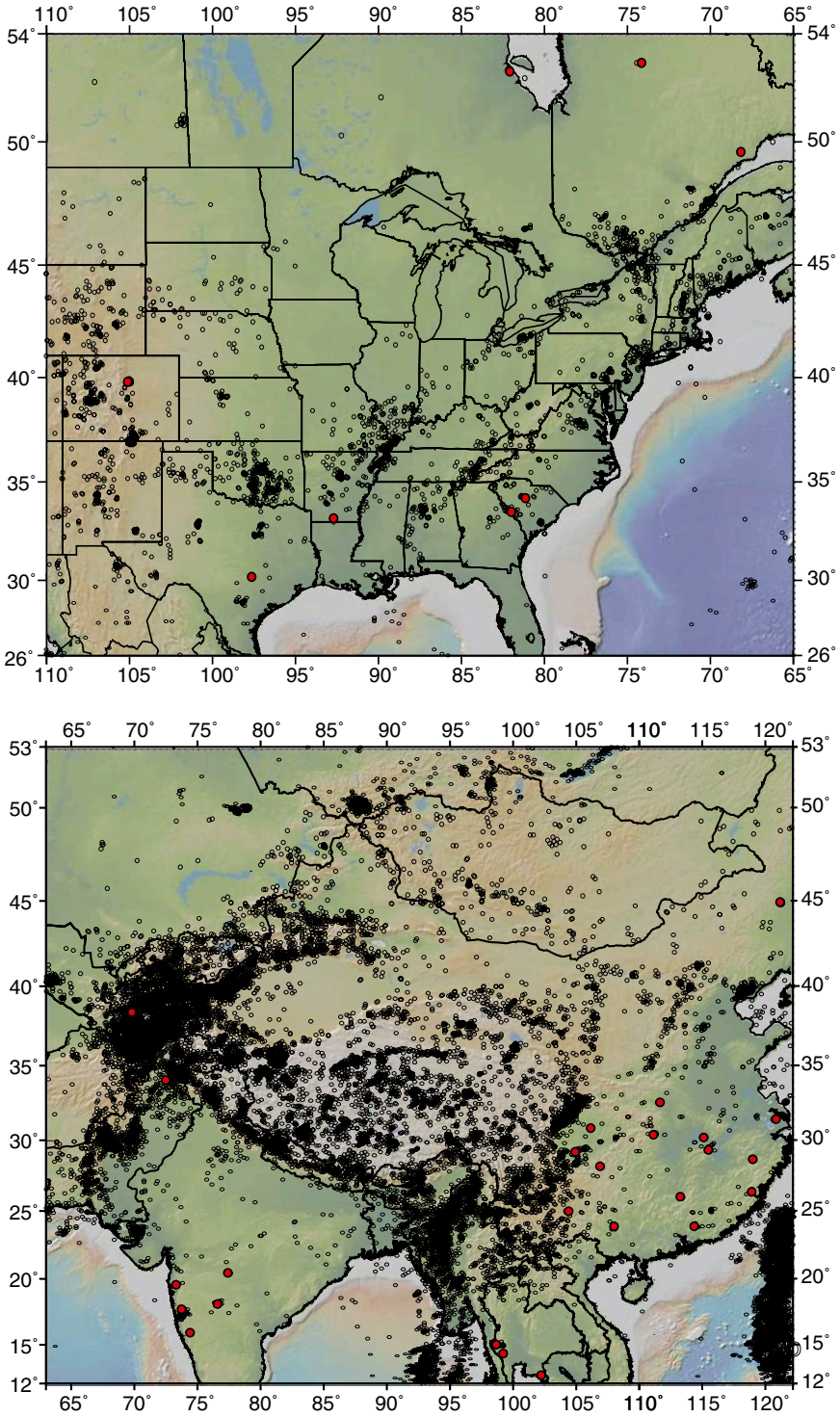

Fig. 1. *Upper*: Instrumentally recorded seismicity and damaging historical earthquakes in the central and eastern United States and southeastern Canada. Red dots indicate sites of reservoir-induced seismicity. *Lower*: Seismicity of south and east Asia and sites of reservoir-induced seismicity. Both data sets are available from the US Geological Survey (4).

injection projects have been considered, show that very small pressure buildups are capable of triggering slip on some preexisting faults (14).

Dam construction and water reservoir impoundment produce much smaller pore pressure changes at depth than are likely to occur with CO_2 sequestration, but many have triggered earthquakes at various sites around the world (15) (red dots in Fig. 1). Except for the much smaller pore pressure increases at depth, reservoir-triggered earthquakes are a good analog for the potential for seismicity to be triggered by CO_2 injection. Both activities cause pore pressure increases that act over large areas and are persistent for long periods. Three reservoir impoundments in eastern Canada (located in the ancient, stable core of the North American continent) triggered earthquakes as large as M 4.1 and M 5 at the two sites (Fig. 1), despite the fact that the pore pressure increases at depth were extremely small.

Triggered Earthquakes and Seal Integrity

Our principal concern is not that injection associated with CCS projects is likely to trigger large earthquakes; the problem is that even small to moderate earthquakes threaten the seal integrity of a CO_2 repository. In parts of the world with good construction practices, it is unusual for earthquakes smaller than approximately M 6 to cause significant human harm or property damage. Fig. 2 uses well-established seismological relationships to show how the magnitude of an earthquake is related to the size of the fault that slipped and the amount of fault slip that occurred (16). As shown, faults capable of producing M ~6 earthquakes are at least tens of kilometers in extent. (The fault size indicated along the abscissa is a lower bound of fault size as it refers to the size of the fault segment that slips in a given earthquake. The fault on which an earthquake occurs is larger than the part of the fault that slips in an individual event.) In most cases, such faults should be easily identified during geophysical site characterization studies and thus should be avoided at any site chosen for a CO_2 repository. (Faults in crystalline basement rocks might be difficult to recognize in geophysical data. We assume, however, that any site chosen as a potential CO_2 repository would be carefully selected, avoiding the possibility of pressure changes in the CO_2 repository from affecting faults in crystalline basement.) The problem is that site characterization studies can easily miss the much smaller faults associated with small to moderate earthquakes.

Although the ground shaking from small- to moderate-sized earthquakes is inconsequential, their impact on a CO_2 repository would not be. Most of the geologic formations to be used for long-term storage of CO_2 are likely to be at depths of approximately 2 km—deep enough for there to be adequate sealing formations to isolate the CO_2 from the biosphere but not so deep as to encounter formations with very low permeability. Given large volumes of CO_2 injected into selected formations for many decades, if a small to moderate earth-

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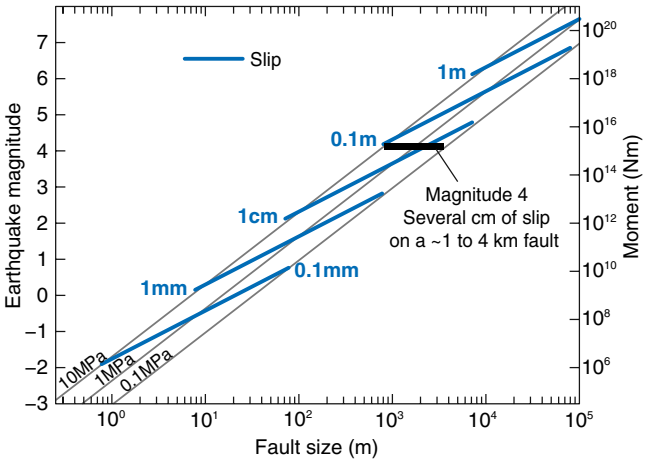

Fig. 2. Relationships among various scaling parameters for earthquakes. The larger the earthquake, the larger the fault and amount of slip, depending on the stress drop in a particular earthquake. Observational data indicate that earthquake stress drops range between 0.1 and 10 MPa.

quake were to be triggered in a geologic formation at approximately 2 km depth, it could jeopardize the seal integrity of the storage formation. For example, if a M ~4 earthquake were to be triggered by CO_2 sequestration (17)—an event that would be widely felt in a populated area but for which shaking would be unlikely to cause harm or damage—it would be associated with several centimeters of slip on a fault several kilometers in size. Because laboratory studies show that just a few millimeters of shear displacement are capable of enhancing fracture and joint permeability (18), several centimeters of slip would be capable of creating a permeable hydraulic pathway that could compromise the seal integrity of the CO_2 reservoir and potentially reach the near surface.

Safe Sequestration

It is important to emphasize that CCS can be valuable and useful for reducing greenhouse gas emissions in specific situations. A good example is the injection of CO_2 into the Utsira formation (19) at the Sleipner gas field in the North Sea, where a significant amount of CO_2 is coproduced with natural gas. After separating the CO_2 from the produced gas, approximately 1 million tons of CO_2 per year has been injected over the past 15 y without triggering seismicity. Assuming isolation from the near surface, injection into highly porous and permeable reservoirs that are laterally extensive would produce small increases in pressure in response to CO_2 injection. Moreover, weak, poorly cemented sandstones are expected to deform slowly in response to applied geologic forces. In such reservoirs, the stresses *relax* over time, and such formations are not prone to faulting (20). In this regard, the Utsira formation is ideal for CO_2 sequestration. It is isolated from vertical migration by impermeable shale formations, and it is highly porous, permeable, laterally extensive, and weakly cemented.

To contribute significantly to greenhouse gas emission reductions (2), roughly 3,500 sites similar to the Utsira formation would have to be found at convenient locations around the world, assuming comparable injection rates of approximately 1 million tons of CO_2 per year. In fact, it would take approximately 85 such sites coming on line each year to reach a goal of storing approximately 1 billion tons of CO_2 by midcentury. Clearly this is an extraordinarily difficult, if not impossible, task if only highly porous and permeable and weakly cemented formations are to be used.

Of course, rather than using potentially problematic geologic formations close to coal-burning power plants for sequestration (as illustrated by the Mountaineer case study cited above), relatively ideal formations for CO_2 storage could be sought on a regional basis to accommodate emissions from a number of plants. One example of this is the potential use of the Mt. Simon sandstone in the Illinois basin. The Mt. Simon is porous, permeable, and regionally extensive. However, models of injection of 100 million tons of CO_2 per year for 40 y predicts (21) increases in pore pressure of several megapascals over a region of ~40,000 km^2. The approximate area of significantly increased pore pressure resulting from injection is shown as the blue-shaded area in Fig. 3, essentially adjacent to the Wabash fault zone, where a series of moderate natural earthquakes occurred in the spring of 2008, the largest being M 5.2. Paleoseismic data indicate the occurrence of much larger nearby earthquakes (some greater than M ~7) in the recent geologic past (22). Importantly, the 100 million ton annual CO_2 injection rate used in the

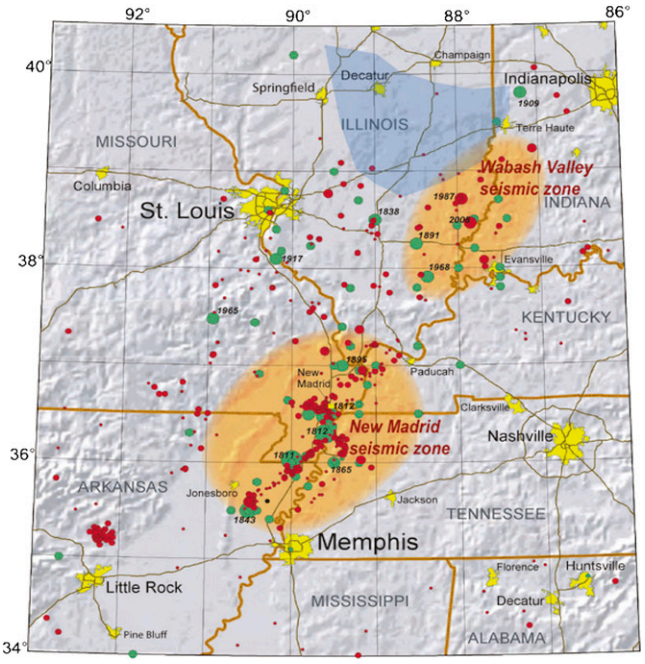

Fig. 3. Instrumentally recorded seismicity in the New Madrid and Wabash Valley seismic zones (modified from ref. 23). Red circles indicate earthquakes that occurred from 1974 to 2002 with magnitudes larger than 2.5 located using modern instruments. Green circles denote earthquakes that occurred before 1974. Larger earthquakes are represented by larger circles. The area shown in blue corresponds to the area where a pressure increase of several megapascals would result from injecting 100 million tons per year of CO_2 into the Mt. Simon sandstone in the Illinois Basin for 40 y (19).

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modeling only represents approximately one seventh of the CO_2 generated by the coal-burning power plants in the Ohio River Valley alone.

Because of the need to carefully monitor CO_2 repositories with observation wells, geophysical and geochemical monitoring systems, etc., it is likely that most sites will have to be located on land or very near shore. Otherwise, highly porous reservoirs located offshore, like those adjacent to salt domes along the US Gulf Coast, would be relatively ideal sites because salt formations are known to be excellent seals for hydrocarbons.

Depleted oil and gas reservoirs are potentially suitable for CO_2 storage for a variety of reasons—an infrastructure of wells and pipelines exist, and there is a great deal of geologic and subsurface property data available to characterize the subsurface from decades of study. In addition, from an earthquake-triggering perspective, depleted reservoirs are attractive because at the time injection of CO_2 might start, the pore pressure would be below the value that existed before petroleum production. Thus, there could be significant injection of CO_2 before pressures increase to preproduction values, thereby reducing the potential for triggering earthquakes.

There are a number of potential issues to consider before using depleted oil and gas reservoirs for CO_2 storage, the most important of which are capacity and geographic distribution. The reasons that there is such interest in using saline aquifers for CO_2 storage is that they are potentially well distributed with respect to likely sources of CO_2, and they could presumably accommodate the enormous volumes of CO_2 that need to be stored. If one were only to consider the United States, storing the 2.1 billion tons of CO_2 currently generated annually by coal-burning power plants in depleted oil and gas reservoirs would require injection of CO_2 at a rate of approximately 17 billion barrels per year; a rate equivalent to eight times current US annual oil production and more than four times US peak annual oil production that occurred in the early 1970s. In addition, it is important to make sure that production-related activities, such as water flooding during secondary recovery, did not compromise the seal capacity of the reservoirs. There also needs to be careful study of the wells in the depleted oil or gas field to make sure that poorly cemented well casings, especially in older wells, will not be pathways for release of stored CO_2 (23). Finally, there are likely to be complicated legal questions concerning ownership and liability that will need to be worked out on a case-by-case basis.

Although enhanced oil recovery (EOR) using CO_2 (in which CO_2 is injected to dissolve in oil and reduce its viscosity) would be a beneficial use of CO_2, it is important not to confuse this with CCS. In CCS the goal is to inject large quantities of CO_2 into available pore space and store it there for hundreds to thousands of years. When CO_2 is used for EOR, the CO_2 dissolved in the oil is separated and captured from produced oil and then reinjected. Thus, smaller volumes of CO_2 are used, and the long-term storage capacity of the reservoir is not an issue.

Many CCS research projects are currently underway around the world. Much of this work involves characterization and testing of potential storage formations and includes a number of small-scale pilot injection projects. Because the storage capacity/pressure build-up issue is critical to assess the potential for triggered seismicity, small-scale pilot injection projects do not reflect how pressures are likely to change (increase) once full-scale injection is implemented. Moreover, even though limitations on pressure build-up are among the many factors that are evaluated when potential formations are considered as sequestration sites, this is usually done in the context of not allowing pressures to exceed the pressure at which hydraulic fractures would be initiated in the storage formation or caprock. In the context of a critically stressed crust, slip on preexisting, unidentified faults could trigger small- to moderate-sized earthquakes at pressures far below that at which hydraulic fractures would form.

As mentioned above, sequences of small to moderate earthquakes were apparently induced by injection of waste water near Guy, Arkansas, Trinidad, Colorado, and Youngstown, Ohio in 2011 and on the Dallas-Ft. Worth airport, Texas. Although these earthquakes were widely felt, they caused no injury, and only the Trinidad earthquake resulted in any significant damage. However, had similar earthquakes been triggered at sites where CO_2 was being injected, the impacts would have raised pressing and important questions: Had the seal been breached? Was it still safe to leave previously injected CO_2 in place?

In summary, multiple lines of evidence indicate that preexisting faults found in brittle rocks almost everywhere in the earth's crust are subject to failure, often in response to very small increases in pore pressure. In light of the risk posed to a CO_2 repository by even small- to moderate-sized earthquakes, formations suitable for large-scale injection of CO_2 must be carefully chosen. In addition to being well sealed by impermeable overlaying strata, they should also be weakly cemented (so as not to fail through brittle faulting) and porous, permeable, and laterally extensive to accommodate large volumes of CO_2 with minimal pressure increases. Thus, the issue is not whether CO_2 can be safely stored at a given site; the issue is whether the capacity exists for sufficient volumes of CO_2 to be stored geologically for it to have the desired beneficial effect on climate change. In this context, it must be recognized that large-scale CCS will be an extremely expensive and risky strategy for achieving significant reductions in greenhouse gas emissions.

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The Gassing Of Satartia

A CO2 pipeline in Mississippi ruptured last year, sickening dozens of people. What does it forecast for the massive proposed buildout of pipelines across the U.S.?

By Dan Zegart
August 26, 2021

It was just after 7 p.m. when residents of Satartia, Mississippi, started smelling rotten eggs. Then a greenish cloud rolled across Route 433 and settled into the valley surrounding the little town. Within minutes, people were inside the cloud, gasping for air, nauseated and dazed.

Some two dozen individuals were overcome within a few minutes, collapsing in their homes; at a fishing camp on the nearby Yazoo River; in their vehicles. Cars just shut off, since they need oxygen to burn fuel. Drivers scrambled out of their paralyzed vehicles, but were so disoriented that they just wandered around in the dark.

The first call to Yazoo County Emergency Management Agency came at 7:13 p.m. on February 22, 2020.

“CALLER ADVISED A FOUL SMELL AND GREEN FOG ACROSS THE HIGHWAY,” read the message that dispatchers sent to cell phones and radios of all county emergency personnel two minutes later.

First responders mobilized almost immediately, even though they still weren't sure exactly what the emergency was. Maybe it was a leak from one of

several nearby natural gas pipelines, or chlorine from the water tank.

The first thought, however, was not the carbon dioxide pipeline that runs through the hills above town, less than half a mile away. Denbury Inc, then known as Denbury Resources, operates a network of CO2 pipelines in the Gulf Coast area that inject the gas into oil fields to force out more petroleum. While ambient CO2 is odorless, colorless and heavier than air, the industrial CO2 in Denbury's pipeline has been compressed into a liquid, which is pumped through pipelines under high pressure. A rupture in this kind of pipeline sends CO2 gushing out in a dense, powdery white cloud that sinks to the ground and is cold enough to make steel so brittle it can be smashed with a sledgehammer.

Even Durward Pettis, a contract welder for Denbury and chief of the local Tri-Community Volunteer Fire Department, didn't figure out that the mystery fog was CO2 for a full 15 minutes. He'd directed first responders to set up three roadblocks to prevent traffic from entering the area. But it wasn't until 7:30 p.m. that word went out that they'd need self-contained breathing apparatus, or SCBA, to enter Satartia and evacuate the town's 42 residents, many of them elderly, and about 250 others who lived just outside town. By then, rescuers and residents were already in motion, fleeing the gas or evacuating others.

Even once Pettis figured it out, none of the sheriffs' deputies and volunteer firefighters had any emergency training in CO2 leaks. Neither did staff at two area hospitals, which had detrimental consequences for gas victims, according to interviews with many of the 49 who were hospitalized.

"It was bad enough that I thought my mama wouldn't make it, and she still has trouble breathing," said Army veteran Hugh Martin, who fled Satartia in a pickup truck with his 78-year-old mother as he struggled to remain conscious. "She never had asthma or COPD, now she's on inhalers full time."

Even months later, the town's residents reported mental fogginess, lung dysfunction, chronic fatigue and stomach disorders. They said they have

trouble sleeping, afraid it could happen again.

This story is the result of a 19-month HuffPost/Climate Investigations Center investigation into the Satartia pipeline rupture, and the safety of CO2 pipelines. It is based on interviews with more than 60 witnesses, victims, first responders, lawyers, medical and toxicological experts, pipeline and petroleum experts, and public health officials; and a review of medical records, police and fire reports, 911 recordings, emergency dispatch logs, internal documents from the Mississippi Emergency Management Agency and the state Department of Environmental Quality, as well as federal pipeline incident reports.

Meanwhile, the federal government is taking the first steps to vastly increase the size of the nation's carbon dioxide pipeline network as a way of fighting climate change. Our investigation reveals that such pipelines pose threats that few are aware of and even fewer know how to handle.

"We got lucky," said Yazoo County Emergency Management Agency director Jack Willingham, who oversaw the rescue effort. "If the wind blew the other way, if it'd been later when people were sleeping, we would have had deaths."

A Deadly Gas

Carbon dioxide has long been used to euthanize laboratory rodents and other small animals, a practice animal welfare organizations now consider inhumane due to the suffering the gas inflicts on the animals. Each year, CO2 accidents kill about 100 workers worldwide — often in basements of restaurants that use CO2-charged systems for their bar mixers — or in industrial accidents.

Carbon dioxide is an asphyxiant that displaces ambient oxygen, making it more difficult to breathe. Smaller exposures cause coughing, dizziness and a panicky feeling called "air hunger." As CO2 concentrations get higher and exposure times

longer, the gas causes a range of effects from unconsciousness to coma to death. Even at lower levels, CO2 can act as an intoxicant, impairing cognitive performance and inducing a confused, drunken-like state.

Denbury's entire business is built around piping carbon dioxide to oilfields and a few industrial users in two operational centers in the Gulf Coast and the Rockies. It owns or has an interest in 14 oil fields in Mississippi, Texas and Louisiana, which are connected by five CO2 pipelines spanning 925 miles. Among its properties is Tinsley Field, adjacent to Satartia, which became Mississippi's first commercially successful oil field in 1939.

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Left: The Tinsley oil field in Tinsley, Mississippi, on July 23, 2021. Right: A CO2 gas pipeline remains active in Satartia, Mississippi, that same day.

Rory Doyle for HuffPost

In 2007, Denbury built its 31-mile Delta pipeline to connect Tinsley to the Jackson Dome, an extinct volcano under Jackson, Mississippi, whose 4.6 trillion cubic feet of naturally occurring CO2 gas supplies all of the company's fields. Denbury extended the Delta line 77 miles to Louisiana's Delhi field in 2009.

Denbury uses the CO2 for enhanced oil recovery, or EOR, which uses the gas to flush more oil out of wells. About 20% to 40% of the oil in a field can be recovered through conventional drilling and injecting water into the reservoir. Injecting CO2 after that can increase the yield up to 60%.

CO2 use in oil fields has resulted in accidents in several states and abroad. Tinsley itself suffered a sizeable CO2 "blowout" — where injected CO2 explodes out of the ground along with water, mud and drilling fluids — in 2011 that took 37 days to bring under control, sickened one worker, and killed deer, birds, fish and other animals.

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Denbury had already had two other blowouts in Mississippi, one requiring the evacuation of local homes in Amite County in 2007. Another underground CO2

blowout at Delhi field in 2013 lasted for more than six weeks and contaminated the air with unsafe levels of both CO2 and methane.

Denbury and other companies that do EOR are well versed in the dangers of CO2. At Denbury's Heidelberg Field in eastern Mississippi, signs warn of a CO2 hazard and say SCBA must be worn, and there are muster stations where workers gather if there is a release. The company also has safety pamphlets on its website — one for the public called "Pipeline Safety Is Everybody's Responsibility" and another for first responders titled, "AWARE: Tactics for Responding to a CO2 Pipeline Leak." None of the emergency workers interviewed for this story had seen either.

While the risks of CO2 exposure were well established, the Satartia gassing was the first known instance of an outdoor mass exposure to piped CO2 gas anywhere in the world, according to Marcelo Korc, chief of the World Health Organization's Climate Change and Environmental Determinants of Health Unit, whose staff researched injuries from CO2 pipeline leaks in response to an inquiry from HuffPost.

The sun sets on the village of Satartia alongside the Yazoo River in July.
Rory Doyle for HuffPost

Korc's staff also found that CO2 from the Jackson Dome is contaminated with hydrogen sulfide, a deadly gas that likely worsened residents' symptoms and also accounts for the gas cloud's odor and greenish color, since pure CO2 is odorless and colorless.

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Denbury declined to answer specific questions for this story, sending only a statement:

> *On February 22, 2020, at approximately 7:00 p.m., Denbury Enterprises' Delta pipeline experienced a sudden rupture and release of CO2 gas near Satartia, Mississippi. Before, during, and after the event, Denbury's main interest has been the health and safety of the residents in the vicinity of the release and the surrounding environment. Denbury and its personnel were quickly in the community, working directly with nearby leadership and any individual residents affected by the event to ensure that any needs arising from the event were met. We have continued to work closely with the community and have made significant contributions to local emergency response organizations to support the important role they play in keeping the community safe. Denbury has cooperated fully with all federal, state, and local agencies who responded to the incident. The federal agency charged with regulating the pipeline continues its review and investigation of the incident, and Denbury continues to cooperate fully with their efforts.*

Beyond the suffering of those who lived through it, the fact that the Biden administration is poised to commit unprecedented billions to carbon capture and sequestration (CCS) technology — putting CCS at the center of the country's strategy for reducing greenhouse gas emissions — further magnifies the importance of Satartia's CO2 accident.

The historic hike in federal support for CCS infrastructure includes taking the first steps toward the construction of a continent-spanning network of pipelines in order to move America's many millions of tons of CO2 to storage areas where,

theoretically, the gas can be injected deep underground and sequestered indefinitely.

Some experts estimate this network will need to be as large as or even larger than the 2.6 million miles of existing petroleum pipelines. Meanwhile, there are only 5,000 miles of existing CO2 lines, meaning there is little experience with a wide range of operational — and safety — issues likely to arise from such a massive new system.

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Nevertheless, Biden's climate team; his Department of Energy and three of its former secretaries; most utilities; the coal industry and the governments of several coal states; ExxonMobil, the rest of Big Oil and other major industrial corporations; several climate NGOs; the AFL-CIO; and a bipartisan group that spans both houses of Congress all support CCS and the pipeline expansion in some form.

"We want to build more pipes," DOE Secretary Jennifer Granholm told a reporter in June. "There's a lot of jobs that are associated with decarbonizing ... and I think pipes are one of those opportunities."

But the rush to build and operate an integrated CCS and pipeline system has so far taken place with little examination of the safety issue, as the people of

Satartia learned.

Korc of the WHO worried that the basic science done long ago on many toxic chemicals, including petroleum products, has never been done for CO2.

“The exposure studies simply don’t exist,” he said.

Satartia was, in effect, an unwitting case study for a monumental project.

Gas victim DeEmmeris Burns in July 2021, near the site where he was rescued in Satartia.
Rory Doyle for HuffPost

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“They Can’t Come Evacuate Y’all”

DeEmmeris Burns was returning to his mother’s house in Satartia from a fishing trip with his brother Andrew Burns and cousin Victor Lewis when they heard an explosion and then a deafening roar, like a jet engine. The stench of rotten eggs filled the car.

DeEmmeris Burns immediately thought: pipeline explosion. He knew there was one nearby, but other than its approximate location, knew nothing else about it.

They were driving on Perry Creek Road, a gravel and dirt country lane that hugs its namesake waterway and passes close to but below the location of the pipe rupture. They were almost at his mother’s house.

He called his mother’s cellphone at 7:18 p.m. and told her there had been a gas explosion.

“You got to get out. We’re close, we’re coming to get you,” Burns shouted over the roar of escaping gas.

On the other end of the call, 65-year-old Thelma Brown was trying to figure out why her son sounded so strange. He was hollering, breathing heavily, not making sense. She knew the pipeline he was talking about; it runs about half a mile from her house. But she hadn’t smelled anything. She heard her son frantically repeating, “Cut the air! Cut everything off! Cut the air!” And then, silence.

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She tried calling him back. No answer. She rang the other two men's cell phones, but got nothing.

Inside the car, the three men rolled up the windows to keep out whatever it was they were driving through. Then the engine died.

"Hunh," Burns said. "Car shut off."

Minutes later, Thelma's sister, Linda Garrett, who lived just down the road, smelled the gas and called too. Thelma repeated what her sons had told her before their call dropped.

Garrett hung up with Thelma and called 911, but the dispatcher didn't seem to know about a gas leak.

"Do I need to be getting out of here?" Garrett asked. The 911 operator said she'd call her back and let her know.

"She can't breathe. She's

"

0:00 / 3:43

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Garrett noticed her own breathing was becoming labored. Then her daughter Lynett Garrett and 14-year-old granddaughter, Makaylan Burns, who had been out picking up a pizza for dinner, staggered in the door.

Makaylan seemed to be in full-blown respiratory distress, and Lynett was unable to talk. She pounded on the dining room table and panted.

“What is it? What’s wrong? What is it?” Garrett shouted.

Makaylan dropped to the floor, unconscious.

Garrett tried 911 again. This time the operator acknowledged that there was a gas leak.

“They have shut the highway down because of it. They’re not letting anyone in, they can’t come evacuate y’all,” she said.

Garrett was afraid if they left the house, all three of them would pass out. She insisted on an ambulance. The dispatcher said one would meet them outside of town.